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(54) **SYSTEMS AND METHODS FOR MEASURING REDUCED PRESSURE EMPLOYING AN ISOLATED FLUID PATH**

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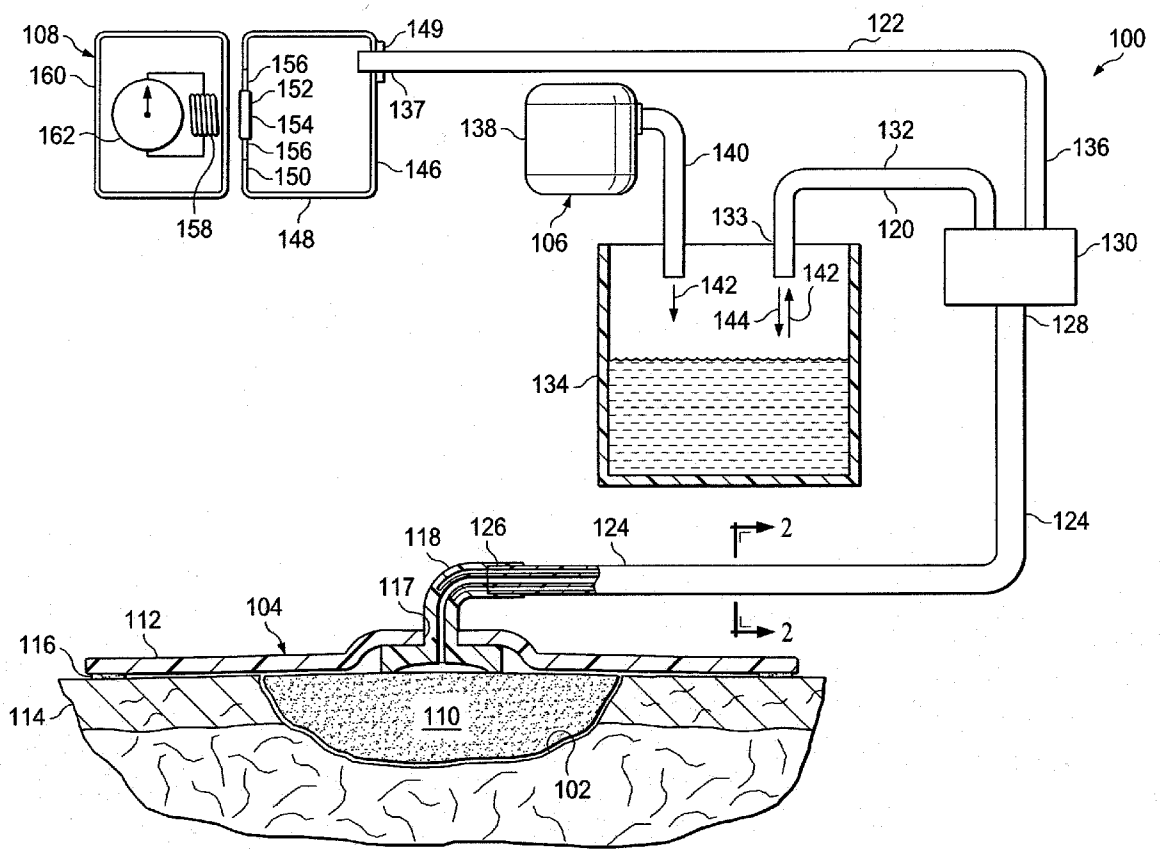
(57) **ABSTRACT**

Systems, devices, and methods are presented that provide for the assessment of reduced pressure at a tissue site. The systems, devices, and methods involve an assessment chamber that is fluidly isolated from a pressure detector. Other systems, methods, and devices are presented.



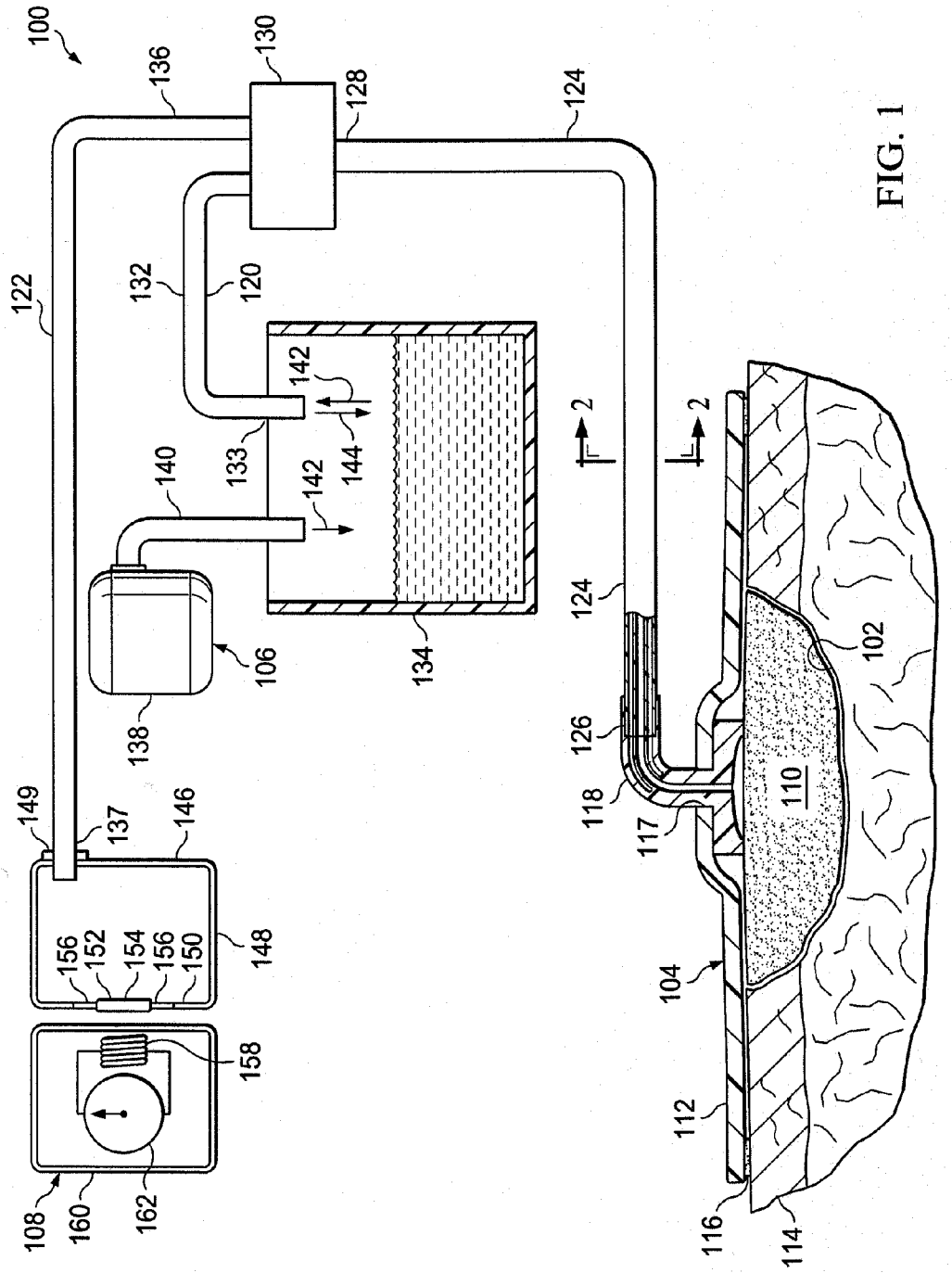

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FIG. 1

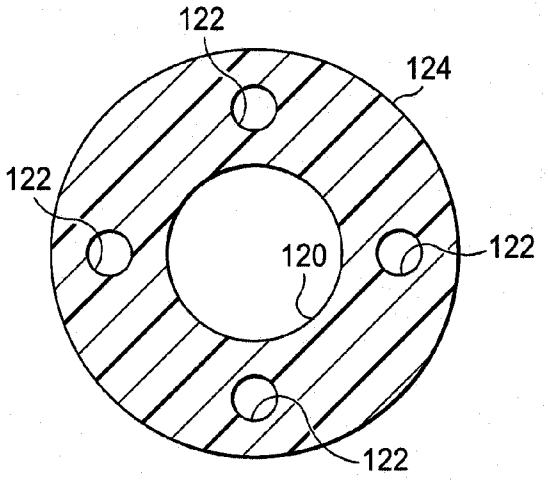
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FIG. 2

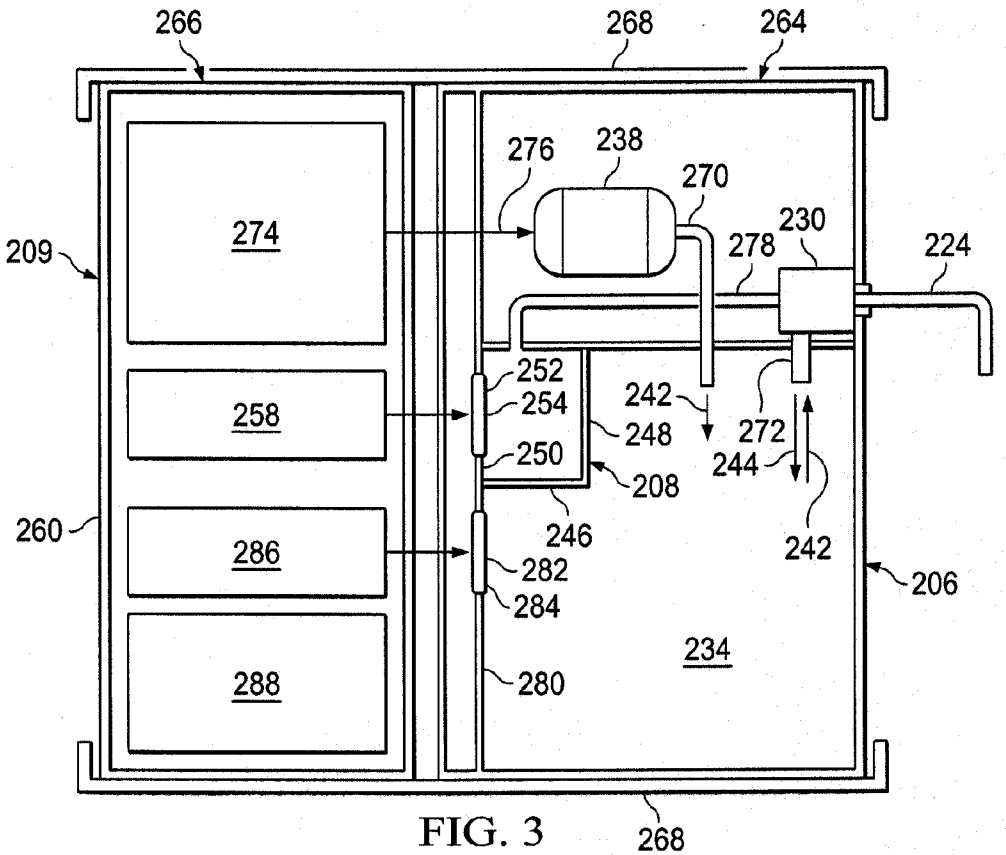
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FIG. 3

FIG. 4A

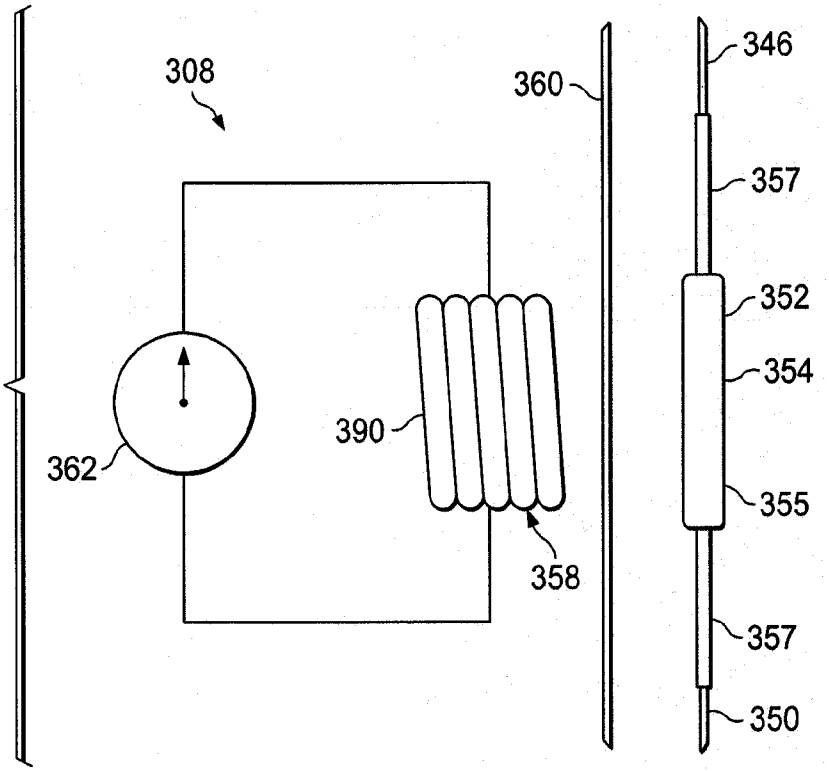
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FIG. 4B

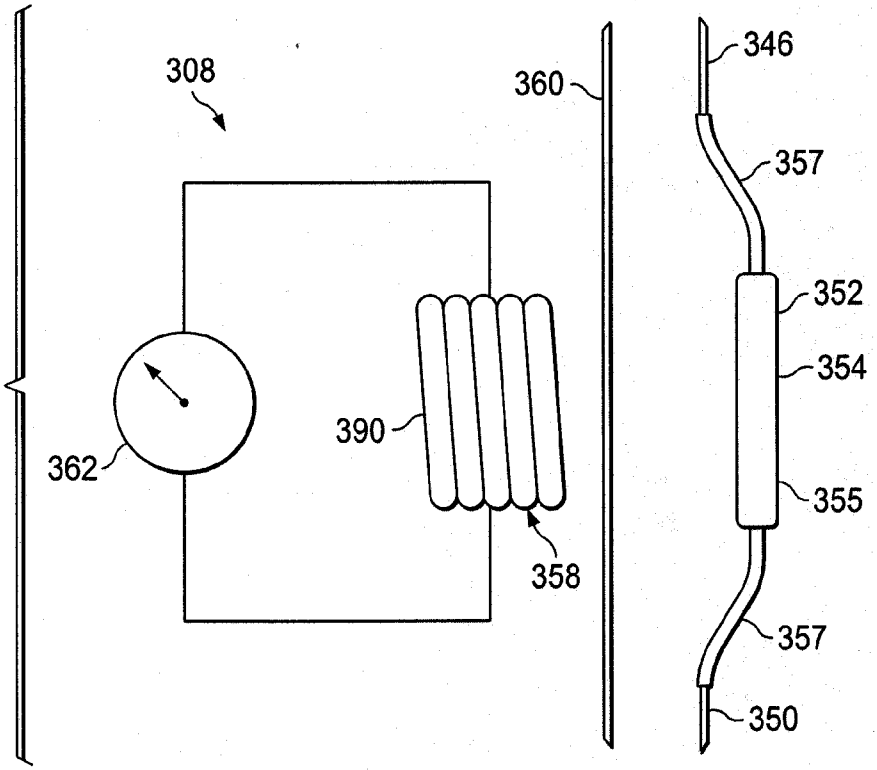
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FIG. 5A

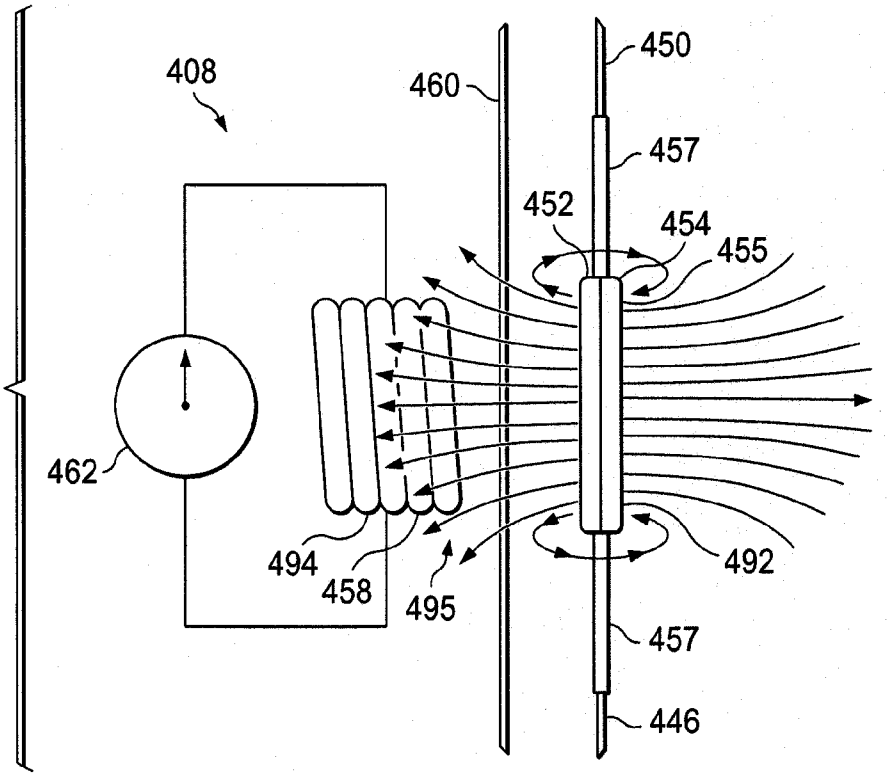
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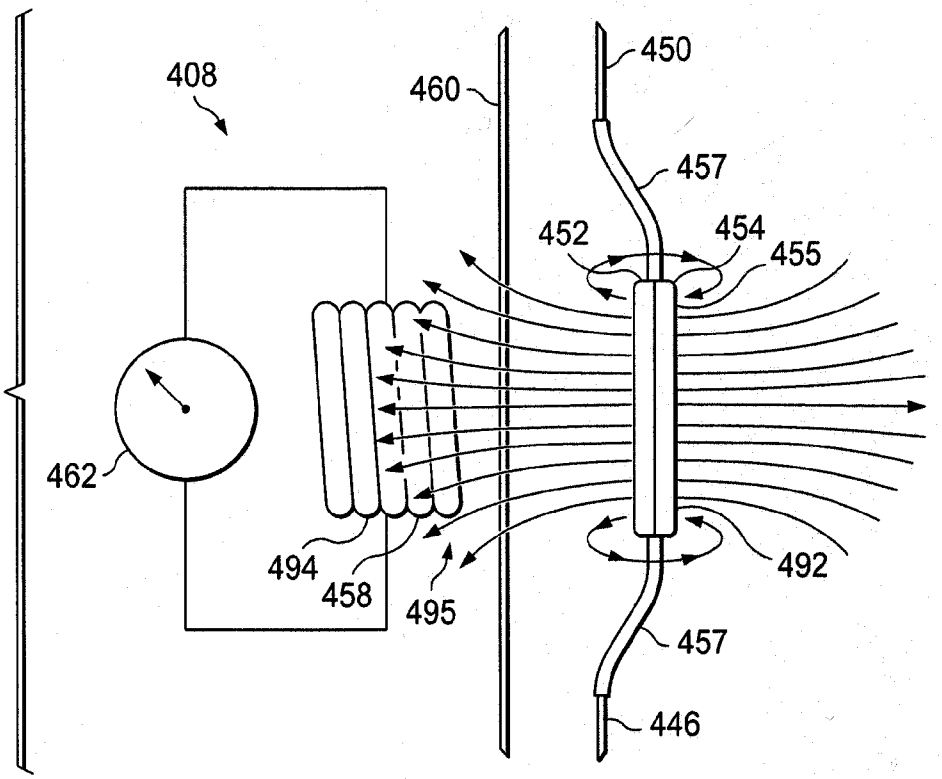
FIG. 5B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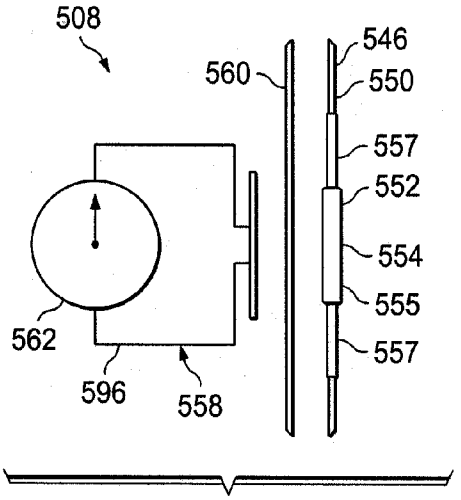

FIG. 6A

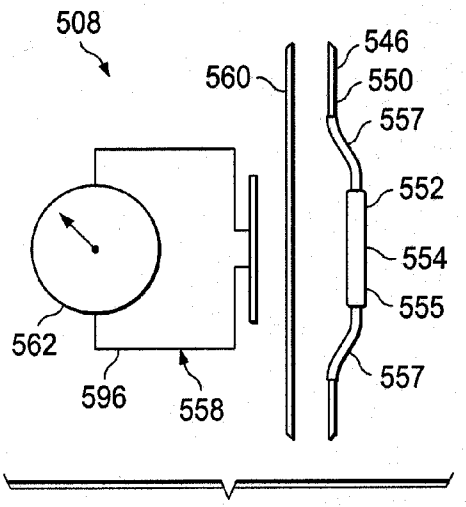

FIG. 6B

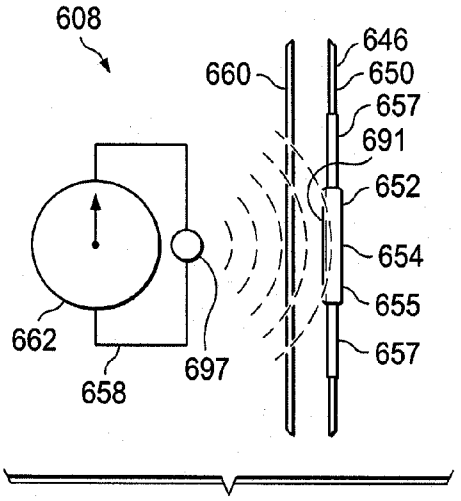

FIG. 7A

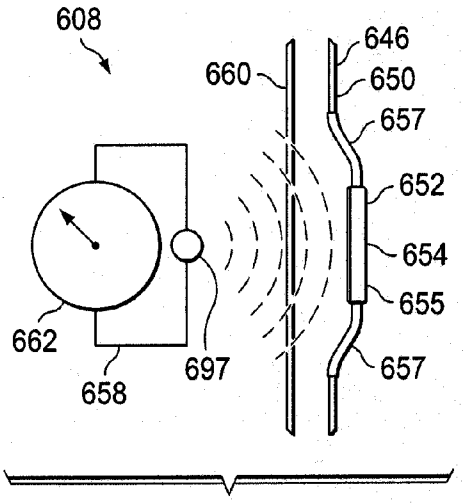

FIG. 7B

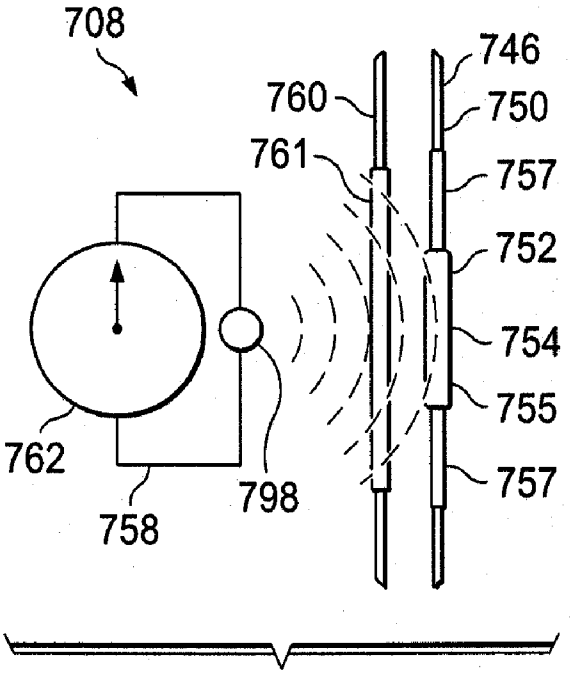
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FIG. 8A

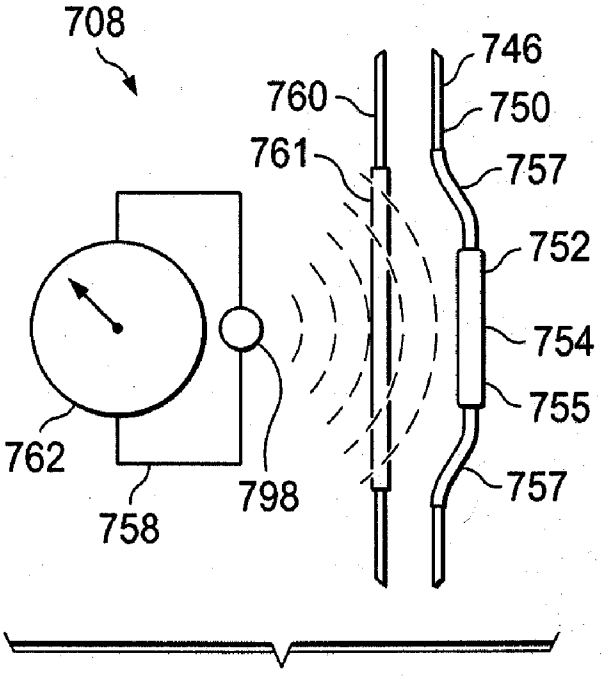
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FIG. 8B

SYSTEMS AND METHODS FOR MEASURING REDUCED PRESSURE EMPLOYING AN ISOLATED FLUID PATH

RELATED APPLICATIONS

[0001] The present invention claims the benefit, under 35 USC §119(e), of the filing of U.S. Provisional Patent Application Ser. No. 61/345,830, entitled "Systems and Methods for Measuring Reduced Pressure Employing An Isolated Fluid Path," filed 18 May 2010, which is incorporated herein by reference for all purposes; U.S. Provisional Patent Application Ser. No. 61/345,821, entitled "Reduced-Pressure Treatment Systems and Methods Employing A Fluidly Isolated Pump Control Unit," filed 18 May 2010, which is incorporated herein by reference for all purposes; and U.S. Provisional Patent Application Ser. No. 61/414,738, entitled "Reduced-Pressure Canisters and Methods for Recycling," filed 17 Nov. 2010, which is incorporated herein by reference for all purposes.

BACKGROUND

[0002] The present disclosure relates generally to reduced-pressure medical treatment systems and, more particularly, but not by way of limitation, to systems and methods for measuring reduced pressure that employ an isolated fluid path.

[0003] Clinical studies and practice have shown that providing a reduced pressure in proximity to a tissue site augments and accelerates the growth of new tissue at the tissue site. The applications of this phenomenon are numerous, but application of reduced pressure has been particularly successful in treating wounds. This treatment (frequently referred to in the medical community as "negative pressure wound therapy," "reduced pressure therapy," or "vacuum therapy") provides a number of benefits, which may include faster healing and increased formulation of granulation tissue. Typically, reduced pressure is applied to tissue through a porous pad or other manifold device. The porous pad contains cells or pores that are capable of distributing reduced pressure to the tissue and channeling fluids that are drawn from the tissue. At times, it may be desirable to determine the reduced pressure involved at the tissue site. For example, it may be desirable to ascertain that the reduced pressure is in a therapeutic range.

SUMMARY

[0004] According an illustrative, non-limiting embodiment, a system for treating a tissue site on a patient with reduced pressure includes a treatment manifold for deploying proximate to the tissue site, a sealing member for forming a fluid seal over the treatment manifold and a portion of the patient's epidermis, a reduced-pressure source for providing reduced pressure, and a reduced-pressure delivery conduit for fluidly coupling to the treatment manifold and to the reduced-pressure source. The reduced-pressure delivery conduit is for delivering treatment-reduced-pressure to the treatment manifold. The system further includes a reduced-pressure assessment conduit for fluidly coupling to the tissue site and an assessment chamber. The assessment chamber is for fluidly coupling to the reduced-pressure assessment conduit and for receiving an assessment-reduced-pressure from the tissue site. The assessment chamber includes a sealed enclosure having a first moveable portion on a wall. The first moveable portion is operable to move under the influence of reduced pressure. The system also includes a first pressure detector proximate to the first moveable portion of the assessment chamber. The first pressure detector is fluidly isolated from the assessment chamber and is operable to sense displacement of the first moveable portion.

[0005] According to another illustrative, non-limiting embodiment, a method for treating a tissue site on a patient with reduced pressure includes disposing a treatment manifold proximate to the tissue site, disposing a sealing member over the treatment manifold and a portion of the patient's epidermis to form a fluid seal, providing a reduced-pressure source, fluidly coupling a reduced-pressure delivery conduit to the treatment manifold and to the reduced-pressure source, providing an assessment chamber, and fluidly coupling a reduced-pressure assessment conduit to the assessment chamber and to the tissue site for delivering an assessment-reduced-pressure to the assessment chamber. The assessment chamber has a first moveable portion on a wall. The method further includes disposing a first pressure detector proximate to the first moveable portion of the assessment chamber. The first pressure detector is fluidly isolated from the assessment chamber. The method also includes using the first pressure detector to sense displacement of the first moveable portion.

[0006] According to another illustrative, non-limiting embodiment, a method for manufacturing a system for measuring reduced pressure at a tissue site on a patient includes forming an assessment chamber having a sealed enclosure with a first moveable portion, and forming a reduced-pressure assessment conduit having a distal end and a proximal end. The reduced-pressure assessment conduit is for fluidly coupling at the distal end to the tissue site and at the proximal end to the assessment chamber. The method also includes forming a first pressure detector disposed proximate to the first moveable portion of the assessment chamber and fluidly isolated from the assessment chamber. The first pressure detector is operable to sense displacement of the first moveable portion.

[0007] Other objects and advantages of the illustrative embodiments will become apparent with reference to the drawings and detailed description that follow.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. **1** is a schematic diagram with a portion shown in cross section of an illustrative, non-limiting embodiment of a reduced-pressure treatment system employing a subsystem for measuring reduced pressure that includes a first pressure detector isolated from an assessment chamber;

[0009] FIG. **2** is a cross section of an illustrative, non-limiting embodiment of a combination conduit taken along line **2-2** in FIG. **1**;

[0010] FIG. **3** is a schematic diagram of an illustrative, non-limiting embodiment of a reduced-pressure therapy unit;

[0011] FIG. **4**A is a schematic diagram of an illustrative, non-limiting embodiment of a pressure detector utilizing an electromagnetic coil and placed proximate to a first diaphragm having ferrite;

[0012] FIG. **4**B is the pressure detector of FIG. **4**A shown with the first diaphragm displaced;

[0013] FIG. **5**A is a schematic diagram of another illustrative, non-limiting embodiment of a pressure detector utilizing a Hall Effect sensor and placed proximate to a first diaphragm, which has a permanent magnet;

[0014] FIG. **5**B is the pressure detector of FIG. **5**A shown with the first diaphragm displaced;

[0015] FIG. **6**A is a schematic diagram of an illustrative, non-limiting embodiment of a pressure detector having a capacitive sensor proximate to a first diaphragm, which has ferrite;

[0016] FIG. **6**B is the pressure indicator of FIG. **6**A shown with the first diaphragm displaced;

[0017] FIG. **7**A is a schematic diagram of an illustrative, non-limiting embodiment of a pressure detector that includes an ultrasonic sensor and placed proximate to a first diaphragm;

[0018] FIG. **7**B is the pressure detector of FIG. **7**A shown with the first diaphragm displaced;

[0019] FIG. **8**A is a schematic diagram of an illustrative, non-limiting embodiment of a pressure detector including an infrared sensor and placed proximate to a first diaphragm, which has a reflector; and

[0020] FIG. **8**B is the pressure detector of FIG. **8**A shown with the first diaphragm displaced.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0021] In the following detailed description of the illustrative embodiments, reference is made to the accompanying drawings that form a part hereof. These embodiments are described in sufficient detail to enable those skilled in the art to practice the invention, and it is understood that other embodiments may be utilized and that logical structural, mechanical, electrical, and chemical changes may be made without departing from the spirit or scope of the invention. To avoid detail not necessary to enable those skilled in the art to practice the embodiments described herein, the description may omit certain information known to those skilled in the art. The following detailed description is not to be taken in a limiting sense, and the scope of the illustrative embodiments are defined only by the appended claims.

[0022] Referring to the drawings and primarily to FIGS. **1** and **2**, a system **100** for treating a tissue site **102** on a patient with reduced pressure is presented. The system **100** includes a dressing **104**, a reduced-pressure subsystem **106**, and a reduced-pressure assessment subsystem **108**. The reduced-pressure assessment subsystem **108** allows the reduced pressure at the tissue site **102** to be assessed with respect to pressure level while avoiding exposure of high-value components to contaminated fluids, which may be either liquids or gasses. As used herein, "or" does not require mutual exclusivity. The tissue site **102** may be the bodily tissue of any human, animal, or other organism, including bone tissue, adipose tissue, muscle tissue, dermal tissue, vascular tissue, connective tissue, cartilage, tendons, ligaments, or any other tissue. Fluid contaminants may include, without limitation, proteins, volatile organic compounds (VOC), fatty acids, amine such as putrescine and beutenoic acid, and other contaminates. The reduced-pressure assessment subsystem **108** will work with any orientation with respect to the gravity field because the pressure acts in all directions.

[0023] The dressing **104** includes a treatment manifold **110**, which is placed proximate to the tissue site **102**. A manifold is a substance or structure that is provided to assist in applying reduced pressure to, delivering fluids to, or removing fluids from a tissue site **102**. The treatment manifold **110** typically includes a plurality of flow channels or pathways that distribute fluids provided to and removed from the tissue site **102** in an area near the treatment manifold **110**. In one illustrative embodiment, the flow channels or pathways are interconnected to improve distribution of fluids provided or removed from the tissue site **102**. The treatment manifold **110** may be a biocompatible material that is capable of being placed in contact with the tissue site **102** and distributing reduced pressure to the tissue site **102**. Examples of treatment manifolds **110** may include, for example, without limitation, devices that have structural elements arranged to form flow channels, such as, for example, cellular foam, open-cell foam, porous tissue collections, liquids, gels, and foams that include, or cure to include, flow channels. The treatment manifold **110** may be porous and may be made from foam, gauze, felted mat, or any other material suited to a particular biological application.

[0024] In one illustrative, non-limiting embodiment, the treatment manifold **110** is a porous foam and includes a plurality of interconnected cells or pores that act as flow channels. The porous foam may be a polyurethane, open-cell, reticulated foam, such as GranuFoam® material manufactured by Kinetic Concepts, Incorporated of San Antonio, Tex. In some situations, the treatment manifold **110** may also be used to distribute fluids such as medications, antibacterials, growth factors, and various solutions to the tissue site **102**. Other layers may be included in or on the treatment manifold **110**, such as absorptive materials, wicking materials, hydrophobic materials, and hydrophilic materials.

[0025] The dressing **104** further includes a sealing member **112** that covers the treatment manifold **110** and a portion of the patient's epidermis **114**. An attachment device **116** may be used to help form a fluid seal between the sealing member **112** and the patient's epidermis **114**. A reduced-pressure interface **118** may extend through the sealing member **112** to provide fluid access to the treatment manifold **110**. The fluid seal is adequate to maintain reduced pressure at a desired site given the particular reduced-pressure source or subsystem involved.

[0026] The sealing member **112** may be any material that provides a fluid seal. The sealing member **112** may be, for example, without limitation, an impermeable or semi-permeable, elastomeric material. Examples of elastomers may include, but are not limited to, natural rubbers, polyisoprene, styrene butadiene rubber, chloroprene rubber, polybutadiene, nitrile rubber, butyl rubber, ethylene propylene rubber, ethylene propylene diene monomer, chlorosulfonated polyethylene, polysulfide rubber, polyurethane, EVA film, co-polyester, and silicones. Additional, specific examples of sealing members **112** include a silicone drape, 3M Tegaderm® drape, acrylic drape such as one available from Avery Dennison Corporation of Pasadena, Calif.

[0027] The attachment device **116** may be used to hold the sealing member **112** against the patient's epidermis **114** or another layer, such as a gasket or additional sealing member. The attachment device **116** may take numerous forms. For example, without limitation, the attachment device **116** may be a medically acceptable, pressure-sensitive adhesive that extends about a periphery of the sealing member **112** or a hydrocolloid material.

[0028] The reduced pressure developed by the reduced-pressure subsystem **106** is delivered through a reduced-pressure delivery conduit **120** to the reduced-pressure interface **118**. In one illustrative embodiment, the reduced-pressure interface **118** is a T.R.A.C.® Pad or Sensa T.R.A.C.® Pad available from KCI of San Antonio, Tex. The reduced-pressure interface **118** allows the reduced pressure to be delivered to the treatment manifold **110**. The reduced-pressure inter-

face **118** is also typically fluidly coupled to a reduced-pressure assessment conduit **122**, which may be a plurality of reduced-pressure assessment conduits.

[0029] The reduced-pressure assessment conduit **122** allows the reduced pressure at the tissue site **102** to be communicated for measurement purposes. As shown clearly in FIG. **2**, the reduced-pressure delivery conduit **120** and the reduced-pressure assessment conduit **122** may be combined into a combination conduit **124** over some or all of their length. In the embodiment shown in FIGS. **1** and **2**, the distal end **126** of the combination conduit **124** is fluidly coupled to the reduced-pressure interface **118** and receives reduced pressure from the tissue site **102**. A proximal end **128** of the combination conduit **124** may be fluidly coupled to a connector **130**. A portion **132** of the reduced-pressure delivery conduit **120** is fluidly coupled between the connector **130** and a fluid reservoir **134**. A proximal end **133** of the reduced-pressure delivery conduit **120** is fluidly coupled to the fluid reservoir **134**. A portion **136** of the reduced-pressure assessment conduit **122** is fluidly coupled between the connector **130** and the reduced-pressure assessment subsystem **108**. A proximal end **137** of the reduced-pressure assessment conduit **122** is fluidly coupled to the assessment chamber **146** and may include a hydrophobic filter **149**.

[0030] The reduced-pressure subsystem **106** delivers reduced pressure to the dressing **104**. The reduced-pressure subsystem **106** includes a reduced-pressure source **138** that provides reduced pressure. The reduced-pressure source **138** is fluidly coupled to the fluid reservoir **134** by a second reduced-pressure delivery conduit **140** to deliver reduced pressure **142**, or treatment-reduced-pressure **142**, thereto. The reduced-pressure source **138** may be any device for supplying a reduced pressure, such as a vacuum pump, wall suction, or other source. While the amount and nature of reduced pressure applied to a tissue site will typically vary according to the application, the reduced pressure will typically be between −5 mm Hg (−667 Pa) and −500 mm Hg (−66.7 kPa) and more typically between −75 mm Hg (−9.9 kPa) and −300 mm Hg (−39.9 kPa).

[0031] Reduced pressure is a pressure less than the ambient pressure at a tissue site that is being subjected to treatment. In most cases, this reduced pressure will be less than the atmospheric pressure at which the patient is located. Alternatively, the reduced pressure may be less than a hydrostatic pressure at the tissue site. Unless otherwise indicated, quantitative values of pressure stated herein are gauge pressures. The reduced pressure delivered may be constant or varied (patterned or random) and may be delivered continuously or intermittently. Although the terms "vacuum" and "negative pressure" may be used to describe the pressure applied to the tissue site, the actual pressure applied to the tissue site may be more than the pressure normally associated with a complete vacuum. Consistent with the use herein, an increase in reduced pressure or vacuum pressure typically refers to a relative reduction in absolute pressure.

[0032] The reduced-pressure subsystem **106** includes the reduced-pressure source **138** that delivers reduced pressure **142** to the fluid reservoir **134**. The treatment-reduced-pressure **142** is delivered to the portion **132** of the reduced-pressure delivery conduit **120**. The treatment-reduced-pressure **142** is then delivered via the reduced-pressure interface **118** to the treatment manifold **110**.

[0033] The reduced-pressure interface **118** may receive fluids **144** from the tissue site **102** that are delivered by the reduced-pressure delivery conduit **120** to the fluid reservoir **134**. The portion **136** of the reduced-pressure assessment conduit **122** delivers an assessment-reduced-pressure to the reduced-pressure assessment subsystem **108**. The assessment-reduced-pressure is reduced pressure that is communicated from the reduced-pressure interface **118** or the tissue site **102** for the purpose of measuring. The reduced-pressure assessment subsystem **108** includes an assessment chamber **146** that receives the assessment-reduced-pressure from the reduced pressure assessment conduit **122**. The hydrophobic filter **149** may be placed at the inlet where the reduced-pressure assessment conduit **122** enters the assessment chamber **146**. The hydrophobic filter **149** is to help prevent fluids from entering the assessment chamber **146**.

[0034] The assessment chamber **146** includes a sealed enclosure **148**. The sealed enclosure **148** includes a wall **150** having a first movable portion **152**, such as first diaphragm **154**. The first movable portion may experience a mixed phase, e.g. gas and liquids, without compromising accuracy. Typically, the first diaphragm **154** is a sheet of semi-flexible material anchored at the sheet's periphery **156** to the wall **150**. The first diaphragm **154** is operable to move at least slightly from a neutral position to a displaced position within the assessment chamber **146** under the influence of reduced pressure. The sealed enclosure **148** may include a vent in some embodiments to allow gas from the tissue site to be vented to atmosphere.

[0035] A first pressure detector **158** is located proximate to the first movable portion **152** and is operable to sense movement of the first movable portion **152**. The first pressure detector **158** is fluidly isolated from the assessment chamber **146**. Fluidly isolating the first pressure detector **158** from the assessment chamber **146** means that contaminates in any gas or liquid reaching the assessment chamber **146** will not reach or contaminate the first pressure detector **158**. The first pressure detector **158** may be contained within an isolation chamber **160** or housing. As will be described in more detail below in connection with FIGS. **4A-8B**, the first pressure detector **158** may use a Hall Effect sensor, a capacitance sensor, ultrasonic sensor, infrared sensor, or other device to detect the movement of the first movable portion **152**.

[0036] The reduced-pressure assessment subsystem **108** is operable to receive the assessment-reduced-pressure, which upon reaching a sufficient level will move the first movable portion **152** inward from a neutral position to a displaced position. The first pressure detector **158** senses the location of the first movable portion **152** and is able to provide an indication of a relative change in reduced pressure. The change in reduced pressure may be calibrated based on an initial measurement to reflect the reduced pressure experienced at the tissue site **102**. The first pressure indicator **158** may present an indication of the relative change on indicator **162** or provide a signal for further processing or use.

[0037] In operation according to one illustrative embodiment, the treatment manifold **110** is placed proximate to the tissue site **102**. The sealing member **112** is deployed using the attachment device **116**. Thus, a fluid seal is formed between the sealing member **112** and a portion of the patient's epidermis **114**. If not already installed, the reduced-pressure interface **118** may be applied through an aperture **117** in the sealing member **112**.

[0038] If not already coupled, the reduced-pressure delivery conduit **120** and reduced-pressure assessment conduit **122** may be fluidly coupled to the reduced-pressure interface

118. Alternatively, as shown, a combination conduit 124 that includes the reduced-pressure delivery conduit 120 and the reduced-pressure assessment conduit 122 may be fluidly coupled to the reduced-pressure interface 118. The reduced-pressure delivery conduit 120 is fluidly coupled to the fluid reservoir 134. The reduced-pressure source 138 is fluidly coupled to the fluid reservoir 134 to provide reduced pressure to the fluid reservoir 134. Once activated, the reduced-pressure source 138 will deliver reduced pressure to the fluid reservoir 134 and to the tissue-site 102 via the reduced-pressure delivery conduit 120. Fluids will be typically moved into the reduced-pressure delivery conduit 120 and will flow to the fluid reservoir 134.

[0039] The reduced-pressure interface 118 allows the reduced pressure at one or more sampling sites to be communicated to one or more of the reduced-pressure assessment conduits 122. The reduced-pressure assessment conduit 122 delivers the assessment-reduced-pressure to the assessment chamber 146. As previously noted, the reduced pressure, upon reaching a sufficient level, moves the first movable portion 152 of the sealed enclosure 148 inward from a neutral position to a displaced position. The displacement of the first movable portion 152 is detected or sensed by the first pressure detector 158 and an indication of the reduced pressure may be made by the indicator 162 or a signal provided for further processing including display. The first pressure detector 158 may be coupled to provide a control signal to the reduced pressure source 138 to provide feedback control in order to maintain a desired pressure or desired pressure range. The reduced-pressure assessment subsystem 108 may also include a user interface, e.g., a keypad and display, allowing the reduced pressure desired or the range desired to be entered or other control inputs to be received.

[0040] The system 100, and particularly the reduced-pressure assessment subsystem 108, allows the reduced pressure to be assessed with respect to pressure without contamination by gasses or liquids. The reduced-pressure assessment subsystem 108 may be made so that the assessment chamber 146 is made from relatively inexpensive components so as to conveniently allow the assessment chamber 146 to be disposed of after use while allowing the first pressure detector 158 to be used again without risking contamination. In this way, the reduced-pressure assessment subsystem 108 minimizes opportunities for the exposure of contaminated fluids to come into contact with the more high-valued items, or relatively expensive components.

[0041] Referring now primarily to FIG. 3, another illustrative, non-limiting embodiment of a reduced-pressure subsystem 206 and a reduced-pressure assessment subsystem 208 are presented. FIG. 3 is presented as a figurative cross section. In this illustrative embodiment, the reduced-pressure subsystem 206 and reduced-pressure assessment subsystem 208 are combined into a reduced-pressure therapy unit 209. The reduced-pressure therapy unit 209 may have a first portion 264, which may be designed for disposal and which isolates fluids in the first portion 264, and may have a second portion 266, which may be fluidly isolated from the first portion 264 and which may contain higher-valued items and components that may be reused. The first portion 264 and second portion 266 may be held proximate to one another either by an integral housing or by a bracket 268 or other device. In this illustrative embodiment, the reduced-pressure source 238 is a pump head that delivers reduced pressure 242 into a conduit 270 that delivers the reduced pressure into a fluid reservoir 234. The reduced pressure 242 is delivered into another conduit 272 that delivers the reduced pressure 242 to a connector 230. The connector 230 delivers the reduced pressure into a reduced-pressure delivery conduit (not explicitly shown) that is a part of a combination conduit 224. The combination conduit 224 delivers the reduced pressure to the tissue site. The second portion 266 of the reduced-pressure therapy unit 209 contains a pump control unit 274 that may provide pump energy to the pump head of the reduced pressure source 238 using a linking interface 276.

[0042] Assessment-reduced-pressure is delivered from the tissue site to the connector 230 using a reduced-pressure assessment conduit (not explicitly shown), which may be a part of the combination conduit 224. The assessment-reduced-pressure is delivered by a conduit 278 from the connector 230 to an assessment chamber 246 in a manner analogous to that shown in FIG. 1. The assessment chamber 246 includes a sealed enclosure 248 that includes a wall 250. The wall 250 includes a first movable portion 252, such as a first diaphragm 254. A first pressure detector 258 may be included in the first portion 264 and may be aligned substantially with the first movable portion 252. The first pressure detector 258 is fluidly isolated from the assessment chamber 246. Under reduced pressure, the first movable portion 252 moves inward from a neutral position to a displaced position. The first pressure detector 258 is operable to sense displacement of the first movable portion 252 under the influence of reduced pressure and to indicate a change in reduced pressure on an indicator or with a signal. Thus, the first pressure detector 258 is operable to assess the pressure level at the tissue site.

[0043] The fluid reservoir 234 may include a wall 280 having a second movable portion 282, such as a second diaphragm 284. Under the influence of reduced pressure, the second movable portion 282 may move into the fluid reservoir 234 from a neutral position to a displaced position. A second pressure detector 286 may be included in the first portion 264 and may be substantially aligned with the second movable portion 282. The second pressure detector 286 is fluidly isolated from the fluid reservoir 234. The second pressure detector 286 is operable to sense displacement of the second movable portion 282 and to help determine the pressure or change in pressure within the fluid reservoir 234. Reduced-pressure data from the first pressure detector 258, which is indicative of the pressure at the tissue site, and data from the second pressure detector 286, which is indicative of the pressure in the fluid reservoir 234, may be used to assess performance of a reduced-pressure treatment system.

[0044] The pump control unit 274, the first pressure detector 258, the second detector 286 may be included in an isolation chamber 260 to help avoid dust and other small contaminates. The isolation chamber 260 may include one or more vents and may further include a power unit 288, such as a battery, that may provide electrical energy to the various components, e.g., the pump control unit 274, first pressure detector 258, and second pressure detector 286. In addition, the first portion 264 may include a user interface to receive inputs, such as a desired pressure. The first portion 264 may include an indicator (not shown) for visually indicating the pressure at the tissue or in the fluid reservoir 234. One should note that with the reduced-pressure therapy unit 209, the high-value components that may be desired for re-use are located within the first portion 264 and are fluidly isolated from the contaminated or potentially contaminated portions located in the second portion 266.

[0045] In the illustrative, non-limiting embodiments presented herein, numerous combinations of components may be used to sense the displacement of the movable portions **152**, **252**, **282**. A number of illustrative, non-limiting embodiments for sensing the displacement will now be presented. Referring now primarily to FIGS. **4**A and **4**B, a portion of a reduced-pressure assessment subsystem **308** is presented. A portion of an assessment chamber **346** is shown with a wall **350** having a first movable portion **352**, such as a first diaphragm **354**. The first diaphragm **354** may include a target **355** and flexible or semi-flexible peripheral portion **357**. In this illustrative, non-limiting embodiment, at least a portion of the first diaphragm **354**, e.g. at least the target **355**, is covered or made with a ferrite material.

[0046] Located proximate to the first movable portion **352**, but fluidly isolated or separate from the interior of the assessment chamber **346**, is a first pressure detector **358**. The first pressure detector **358** may be located within an isolation chamber **360**, which is partially shown. In this instance, the first pressure detector **358** includes an electromagnetic coil **390**. Displacement of the first movable portion **352** with ferrite into the assessment chamber **346** as suggested in FIG. **4**B changes the inductance experienced by the electromagnetic coil **390**. A change in the inductance may be measured and used to determine the displacement of the first movable portion **352**. For example, as flux drops, one knows that the reduced pressure has increased, and the displacement of the first movable portion **352** may be calibrated to indicate the pressure inside the assessment chamber **346** relative to atmospheric pressure. The pressure change or pressure may be shown on an indicator **362** or a signal may be sent for further processing including displaying at another location.

[0047] Referring now primarily to FIGS. **5**A and **5**B, another illustrative, non-limiting embodiment of a portion of a reduced-pressure assessment subsystem **408** is presented. A portion of an assessment chamber **446** is shown having a wall **450**. The wall **450** includes a first movable portion **452**, which may be a first diaphragm **454**. The first diaphragm **454** includes a target **455** and a flexible or semi-flexible periphery **457**. The target **455** includes a permanent magnet **492**.

[0048] Located outside of the assessment chamber **446** and fluidly isolated from the assessment chamber **446** is a first pressure detector **458**. The first pressure detector **458** may be within an isolation chamber **460**, part of which is shown. The first pressure detector **458** may be a Hall Effect sensor **494** for sensing a magnetic field **495** or a change in the magnetic field **495**. The change in the magnetic field **495** is caused by movement of the permanent magnet **492** on the first movable portion **452**. The change in the magnetic field **495** may be used to produce a signal or indicate on indicator **462** the reduced pressure within the assessment chamber **446** or a change in reduced pressure.

[0049] Referring now primarily to FIGS. **6**A and **6**B, another illustrative, non-limiting embodiment of a portion of a reduced-pressure assessment subsystem **508** is presented. A portion of an assessment chamber **546** is shown and includes wall **550**. The wall **550** includes a first movable portion **552**, such as a first diaphragm **554**. The first diaphragm **554** includes a target **555** and a flexible or semi-flexible periphery **557**. The target **555** on the first movable portion **552** includes ferrite or other material that may be sensed by a capacitive sensor **596**.

[0050] A first pressure detector **558** may be located proximate to the first movable portion **552** and is fluidly isolated from the assessment chamber **546**. The first pressure detector **558** may be within an isolation chamber **560**, or housing. In this illustrative embodiment, the first pressure detector **558** is the capacitive sensor **596**, and thus, displacement of the first movable portion **552** causes a change in capacitance that is sensed by the capacitance sensor **596**. The change may be used to detect displacement of the first movable portion **552** such as is shown in FIG. **6**B. The displacement may be indicative of the pressure change or the pressure experienced within the assessment chamber **546** and may produce a signal or be shown on an indicator **562**. In general, the capacitance between the first movable portion **552** and the capacitive sensor **596** is proportional to the square of the distance between them.

[0051] Referring now primarily to FIGS. **7**A and **7**B, a portion of an illustrative, non-limiting embodiment of a reduced-pressure assessment subsystem **608** is presented. The reduced-pressure assessment subsystem **608** includes assessment chamber **646**, a portion of which is shown, having a wall **650**. The wall **650** includes a first movable portion **652**. The first movable portion **652** may be a first diaphragm **654**. The first diaphragm **654** may include a target **655** having a flexible or semi-flexible portion **657** coupling the target **655** and the wall **650**. The flexible or semi-flexible portion **657** allows movement of the target **655**. Under reduced pressure, the first movable portion **652** moves inward into the assessment chamber **646** from a neutral position to a displaced position as shown in FIG. **7**B.

[0052] A first pressure detector **658** is fluidly separated from the assessment chamber **646** and is substantially aligned with the first movable portion **652**. The first pressure detector **658** may be inside of an isolation chamber **660**. In this embodiment, the first pressure detector **658** is an ultrasonic sensor **697** that sends out ultrasonic sound waves that are bounced off of a reflector **691** on the first movable portion **652**. The ultrasonic sensor **697** senses displacement of the first movable portion **652** and develops a signal indicative of the displacement. The signal may be used to show a pressure measurement on an indicator **662** or for further processing.

[0053] Referring now primarily to FIGS. **8**A and **8**B, another illustrative, non-limiting embodiment of a portion of a reduced-pressure assessment subsystem **708** is presented. The reduced-pressure assessment subsystem **708** includes an assessment chamber **746**, which is partially shown. The assessment chamber **746** includes a wall **750** having a first movable portion **752**. The first movable portion **752** may be a first diaphragm **754**. The first diaphragm **754** may include a target **755** and a flexible or semi-flexible portion **757**. The first movable portion **752** moves under the influence of reduced pressure and may move into the assessment chamber **746** from a neutral position to a displaced position.

[0054] A first pressure detector **758** may be located proximate to the first movable portion **752** and is fluidly isolated from the inside of the assessment chamber **746**. The first pressure detector **758** may be contained within an isolation chamber **760**. In this illustrative, non-limiting embodiment, the isolation chamber **760** includes a window **761**. The window **761** allows at least infrared signals to travel through. The first pressure detector **758** includes the infrared sensor **798** that is operable to propagate an infrared wave through the window **761** to impact the first movable portion **752** and to determine the relative location of the first movable portion **752**. The first movable portion **752** reflects the infrared wave. The first movable portion **752** moves into the assessment

chamber **746** under the influence of reduced pressure as shown in FIG. **8**B. The infrared sensor **798** detects the displacement and is able to provide a signal or indicate, such as on indicator **762**, the amount of displacement or the corresponding pressure.

[0055] Although the present invention and some of its advantages have been disclosed in the context of certain illustrative, non-limiting embodiments, it should be understood that various changes, substitutions, permutations, and alterations can be made without departing from the scope of the invention as defined by the appended claims. As one illustrative, non-limiting example, it should be noted that any of the portions of the reduced-pressure assessment subsystems presented in FIGS. **4**A to **8**B, may also be used with a second movable portion, such as second movable portion **282** in FIG. **3**.

[0056] It will be understood that the benefits and advantages described above may relate to one embodiment or may relate to several embodiments. It will further be understood that reference to "an" item refers to one or more of those items.

[0057] The steps of the methods described herein may be carried out in any suitable order, or simultaneously where appropriate.

[0058] Where appropriate, aspects of any of the embodiments described above may be combined with aspects of any of the other embodiments described to form further examples having comparable or different properties and addressing the same or different problems.

[0059] It will be understood that the above description of preferred embodiments is given by way of example only and that various modifications may be made by those skilled in the art. The above specification, examples and data provide a complete description of the structure and use of exemplary embodiments of the invention. Although various embodiments of the invention have been described above with a certain degree of particularity, or with reference to one or more individual embodiments, those skilled in the art could make numerous alterations to the disclosed embodiments without departing from the scope of the claims.

We claim:

1. A system for treating a tissue site on a patient with reduced pressure, the system comprising:
- a treatment manifold for deploying proximate to the tissue site;
- a sealing member for forming a fluid seal over the treatment manifold and a portion of the patient's epidermis;
- a reduced-pressure source for providing reduced pressure;
- a reduced-pressure delivery conduit for fluidly coupling to the treatment manifold and to the reduced-pressure source, the reduced-pressure delivery conduit for delivering treatment-reduced-pressure to the treatment manifold;
- a reduced-pressure assessment conduit for fluidly coupling to the tissue site;
- an assessment chamber for fluidly coupling to the reduced-pressure assessment conduit for receiving an assessment-reduced-pressure from the tissue site, wherein the assessment chamber comprises a sealed enclosure having a first moveable portion on a wall and wherein the first moveable portion is operable to move under the influence of reduced pressure; and
- a first pressure detector proximate to the first moveable portion of the assessment chamber and fluidly isolated from the assessment chamber, the first pressure detector operable to sense displacement of the first moveable portion.

2. The system of claim **1**, further comprising an indicator and wherein the first pressure detector is operable to indicate on the indicator a change in relative reduced pressure based on sensing displacement of the first moveable portion.

3. The system of claim **1**, wherein the first moveable portion comprises a first diaphragm member with ferrite and the first pressure detector comprises an electromagnet coil for sensing changes in flux density.

4. The system of claim **1**, wherein the first moveable portion comprises a first diaphragm member with a permanent magnet coupled to the first diaphragm and the first pressure detector comprises an a Hall Effect sensor for sensing changes in location of the first diaphragm.

5. The system of claim **1**, wherein the first moveable portion comprises a first diaphragm member with a ferrite coupled to the first diaphragm and the first pressure detector comprises a capacitive sensor for sensing changes in location of the first diaphragm.

6. The system of claim **1**, wherein the first moveable portion comprises a first diaphragm member and the first pressure detector comprises an ultrasonic sensor for sensing changes in location of the first diaphragm.

7. The system of claim **1**, wherein the first moveable portion comprises a first diaphragm member having a reflector, wherein the first detector further comprises a window on an exterior wall proximate the first diaphragm, and the first pressure detector comprises an infrared sensor for sensing changes in location of the first diaphragm.

8. The system of claim **1**, further comprising:
- a fluid reservoir for receiving fluids from the tissue site;
- wherein the fluid reservoir is fluidly coupled to the reduced-pressure source and the reduced-pressure delivery conduit;
- wherein the fluid reservoir has a second moveable portion on a wall; and
- a second detector proximate to the second moveable portion of the fluid reservoir and fluidly isolated from the fluid reservoir, the second pressure detector operable to sense displacement of the second moveable portion.

9. A method for treating a tissue site on a patient with reduced pressure, the method comprising:
- disposing a treatment manifold proximate to the tissue site;
- disposing a sealing member over the treatment manifold and a portion of the patient's epidermis to form a fluid seal;
- providing a reduced-pressure source;
- fluidly coupling a reduced-pressure delivery conduit to the treatment manifold and to the reduced-pressure source;
- providing an assessment chamber;
- fluidly coupling a reduced-pressure assessment conduit to the assessment chamber and to the tissue site for delivering an assessment-reduced-pressure to the assessment chamber;
- wherein the assessment chamber has a first moveable portion on a wall;
- disposing a first pressure detector proximate the first moveable portion of the assessment chamber, wherein the first pressure detector is fluidly isolated from the assessment chamber; and
- using the first pressure detector to sense displacement of the first moveable portion.

10. The method of claim **9**, wherein the step of using the first pressure detector to sense movement further comprises indicating change in relative reduced pressure based on sensing displacement of the first moveable portion.

11. The method of claim **9**, wherein the first moveable portion comprises a first diaphragm member with ferrite and the first pressure detector comprises an electromagnet coil for sensing changes in flux density.

12. The method of claim **9**, wherein the first moveable portion comprises a first diaphragm member with a permanent magnet coupled to the first diaphragm and the first pressure detector comprises an a Hall Effect sensor for sensing changes in location of the first diaphragm.

13. The method of claim **9**, wherein the first moveable portion comprises a first diaphragm member with a ferrite coupled to the first diaphragm and the first pressure detector comprises a capacitive sensor for sensing changes in location of the first diaphragm.

14. The method of claim **9**, wherein the first moveable portion comprises a first diaphragm member and the first pressure detector comprises an ultrasonic sensor for sensing changes in location of the first diaphragm.

15. The method of claim **9**, wherein the first moveable portion comprises a first diaphragm member having a reflector, wherein the first detector further comprises a window on an exterior wall proximate the first diaphragm, and the first pressure detector comprises an infrared sensor for sensing changes in location of the first diaphragm.

16. The method of claim **9**, further comprising:

providing a fluid reservoir for receiving fluids from the tissue site, wherein the fluid reservoir is fluidly coupled to the reduced-pressure source and the reduced-pressure delivery conduit and wherein the fluid reservoir has a second moveable portion on a wall;

disposing a second detector proximate to the second moveable portion of the fluid reservoir, wherein the second detector is fluidly isolated from the fluid reservoir; and

using the second pressure detector to sense displacement of the second moveable portion.

17. A method for manufacturing a system for measuring reduced pressure at a tissue site, the method comprising:

forming an assessment chamber having a sealed enclosure with a first moveable portion;

forming a reduced-pressure assessment conduit having a distal end and a proximal end, the reduced-pressure assessment conduit for fluidly coupling at the distal end to the tissue site and at the proximal end to the assessment chamber; and

forming a first pressure detector disposed proximate the first moveable portion of the assessment chamber and fluidly isolated from the assessment chamber, the first pressure detector operable to sense displacement of the first moveable portion.

18. The method of claim **17**, further comprising an indicator coupled to the first pressure detector and wherein the first pressure detector is operable to indicate change in relative reduced pressure based on sensing displacement of the first moveable portion.

19. The method of claim **17**, wherein the first moveable portion comprises a first diaphragm member with ferrite and the first pressure detector comprises an electromagnet coil for sensing changes in flux density.

20. The method of claim **17**, wherein the first moveable portion comprises a first diaphragm member with a permanent magnet coupled to the first diaphragm and the first pressure detector comprises an a Hall Effect sensor for sensing changes in location of the first diaphragm.

21. The method of claim **17**, wherein the first moveable portion comprises a first diaphragm member with a ferrite coupled to the diaphragm and the first pressure detector comprises a capacitive sensor for sensing changes in location of the first diaphragm.

22. The method of claim **17**, wherein the first moveable portion comprises a first diaphragm member and the first pressure detector comprises an ultrasonic sensor for sensing changes in location of the first diaphragm.

23. The method of claim **17**, wherein the first moveable portion comprises a first diaphragm member having a reflector, wherein the first detector further comprises a window on an exterior wall proximate the first diaphragm, and the first pressure detector comprises an infrared sensor for sensing changes in location of the first diaphragm.

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