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(54) **Vessel stopper with a vacuum pressure indicator**

(57) Disclosed are systems and methods for preserving wine in a vessel. The system comprises a stopper (10) adapted for engaging and airtight sealing the mouth of the vessel; the stopper comprises a valve assembly (16) operable to draw and maintain a pressure differential within the vessel and a pressure indicator (18) operable to indicate vacuum pressure within the vessel. The system further comprises a pump (120) operable to engage the valve assembly (16) and to draw gas from within the vessel to an external atmosphere.

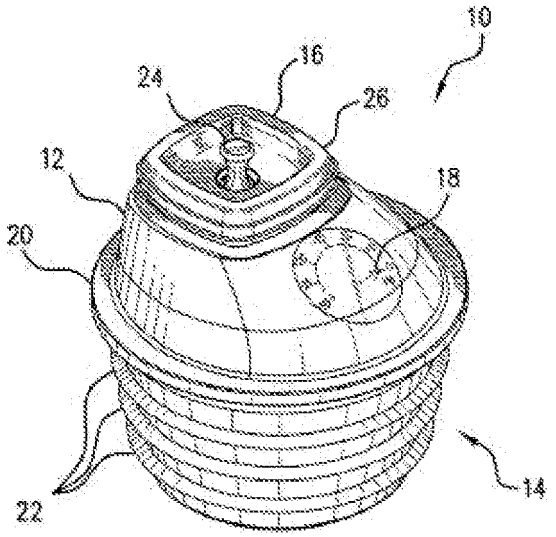

FIG.1a

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates generally to systems and methods for preserving beverages and more specifically to a vessel stopper having means for drawing and maintaining a vacuum within the vessel and a vacuum pressure indicator to indicate vacuum pressure within the vessel.

Description of the Related Art

[0002] It is to be understood that a "vessel" may be any container suitable for holding a liquid. In particular, a "vessel" shall refer to either a wine bottle or a decanter. A "wine bottle" is a vessel, usually made of glass, which is used to hold wine. Wine bottles come in different shapes and sizes depending upon the type of wine they hold. A wine bottle usually comprises a vessel having a cylindrical body and a relatively long, narrow, elongated neck. A standard wine bottle holds 750 ml of wine, although other volumes are common. Wine bottles are typically sealed with a stopper, typically made of cork, to prevent oxidation although plastic stoppers are also used. A "decanter" may be a vessel used for holding the results of decantation where a liquid beverage from another vessel is poured into the decanter and the sedimentary remainder of the liquid is left in the original vessel. Decanters are commonly used to store various alcoholic and non-alcoholic beverages including wines, juices and the like. Decanters come in various shapes and sizes and may be ornate and suitable for serving liquid beverages. A decanter usually comprises a vessel having a spherical body and a narrow, elongated neck. Decanters often come with stoppered lids, which, in addition to preventing accidental spilling of the liquid from the vessel, prevent excessive exposure of the beverage to the air, which may cause deterioration of the beverage contained therein.

[0003] For example, once an alcoholic beverage, such as wine, is transferred into the decanter, it is usually allowed to "breathe" for a half an hour or so. Exposing the wine to air for this short time is known to improve the wine. Exposure of the wine to air for longer periods, such as six hours or more, however, tends to deteriorate the wine. In particular, oxygen present in the air contacting the unconsumed wine in the decanter will oxidize the wine, resulting in off-flavors in the unconsumed wine. Similarly, the quality of non-carbonated soft drinks may deteriorate upon exposure to air due to oxidation or other chemical reactions. Therefore, the decanters are often sealed with a stopper shortly after transfer of the beverage thereto to prevent oxidation of the beverage. Similarly, wine bottles are often resealed with the cork or plastic stopper that came with the bottle to prevent the deterioration of leftover wine due to oxidation. Alternatively, an opened wine bottle may also be resealed with a new, aesthetically pleasing stopper.

[0004] Some wine enthusiasts go even further in the attempt to preserve the unconsumed wine. For example, one known method for saving the unconsumed wine from the oxidation caused by the air trapped in the partially filled stoppered vessel is to remove the trapped air using a pump system by drawing a vacuum within the vessel. Such systems comprise a vessel stopper having a valve therein and a vacuum pump. The operation of the pump may open the valve, and may then extract the air from the vessel drawing a vacuum therein. Once the pump is removed, the valve closes by the pressure difference across the valve or by other means; thereby the contents of the vessel are preserved in the substantially air-free environment. To open the vessel, the valve must be manually opened, which allows air to flow back into the vessel and the stopper to be removed.

[0005] Even though the above-described prior art systems are relatively simple to use and inexpensive to manufacture, they have several shortcomings. For one, a seal formed by the stopper valve is generally not very stable and prone to failure due to natural and mechanical causes. For example, the presence of liquid or dust particles on the valve may result in a leaky seal, depressurization of the vessel, and/ or inadvertent penetration of air into the vessel. Furthermore, repeated use of the stopper as well as the pressure differential across thereof may result in degradation of its elastic properties. Should the seal fail due to these or other reasons and allow air to enter the vessel, the wine will deteriorate due to oxidation or other chemical reactions. The system however provides no suitable means for detecting the failure of the seal and the resultant depressurization of the vessel. Such failure, if it remains undiscovered, will allow deterioration of the wine to progress undetected. Another shortcoming of the prior art pump systems is that the provided stoppers are usually configured to only fit a single size or standard-size wine bottle and thus are not suitable for non-standard sized wine bottles or decanters, which typically have much wider neck openings.

[0006] Therefore, there is a need in the art to provide an improved system for preserving wine and other beverages stored in a vessel from deterioration due to oxidation and other chemical reactions caused by the presence of air in the vessel. More specifically, there is a need to provide a stopper system having means for drawing and maintaining a vacuum within the vessel and for providing a visible indication in the event of the depressurization of the vessel. Furthermore, it is desirable for the stopper system to be readily manufactured using standard manufacturing processes and using commonly available materials.

SUMMARY OF THE INVENTION

[0007] According to one embodiment of the present

invention, a stopper system is provided comprising a cylindrical body having a lower portion adapted for insertion into the vessel mouth and for forming an airtight seal therein and an enclosed upper portion having a first and a second opening. The stopper further comprises a valve assembly disposed within the first opening of the upper portion of the cylindrical body. The valve assembly may be operable to draw and maintain a pressure differential within the vessel. The stopper further comprises a pressure indicator disposed within the second opening of the upper portion of the cylindrical body for measuring vacuum pressure within the vessel. The pressure indicator may comprise an analog or digital vacuum gauge. The stopper further comprises an elastic sheath dispose around the lower portion of the cylindrical body. The sheath may have a plurality of ridges extending radially outward for forming an airtight sealing contact with the vessel mouth.

[0008] In one embodiment, the valve assembly of the vessel stopper comprises a rigid cover having an orifice therethrough and a flange. It further comprises a biasing means and a valve extending through the biasing means and through the orifice of the cover. The valve assembly further comprises an elastic frame having a circumferential lip defining a groove for engaging the flange of the cover, wherein the lower portion of the frame is adapted for insertion into the first opening in the upper portion of the stopper and wherein the upper portion of the frame is adapted for engaging a pump.

[0009] In another embodiment, the valve assembly of the vessel stopper comprises an elastic outer frame having a lower flange extending radially inward to define a lower orifice having a sealing surface and an upper flange portion extending radially outward and having a circumferential groove on the inner surface thereof. The valve assembly further comprises a rigid inner frame having an upper flange extending radially outward to engage the circumferential groove and an upper flange extending radially inward to define an upper orifice. A valve extends through the upper orifice to the lower orifice and having a flange extending radially outward for engaging the inward extending upper flange of the inner frame and a lower portion for engaging the sealing surface of lower orifice of the outer frame.

[0010] In one embodiment of the present invention, a method for preserving beverage in a vessel using a stopper adapted for insertion into the vessel mouth is disclosed. The method comprises the stopper airtight sealing the vessel mouth, providing a path through the stopper for withdrawing air from within the vessel into the external atmosphere, thereby drawing a vacuum therein, measuring the vacuum pressure within the vessel, displaying in a human-readable form the measured vacuum pressure, and airtight sealing the air path through the stopper to maintain the pressure differential within the vessel. The method further comprises detecting a vacuum pressure drop within the vessel and displaying in a human-readable form the detected vacuum pressure drop.

[0011] The method further comprises providing a valve assembly operable to provide the air path through the stopper and providing a valve operable to airtight seal the air path through the valve assembly. The method further comprises providing a pressure indicator operable to measure vacuum pressure within the vessel and display the measured pressure in a human-readable form. The method further comprises providing a pump adapted to engage the valve assembly and to draw air from within the vessel to an external atmosphere.

[0012] In another embodiment of the present invention, an insert for a vessel comprises a body adapted for insertion into a vessel and forming an airtight seal therewith. The insert further comprises a valve assembly disposed in the body for providing a passage into the vessel and for closing the passage. The insert further comprises a pressure indicator disposed in the body for indicating a pressure within the vessel.

[0013] The pressure indicator further comprises a pressure sensor for sensing the pressure and a display connected to the pressure sensor for displaying the pressure sensed by said pressure sensor.

[0014] The valve assembly further comprises a frame disposed in the body, wherein the frame has an orifice for providing fluid communication into the vessel and a valve stem disposed in the frame adapted for moving between an open position and a closed position with respect to the orifice.

[0015] In another embodiment of the present invention, a system for preserving a beverage comprises a vessel for storing a beverage therein, a body adapted for inserting into the vessel and forming an airtight seal therewith, a valve assembly disposed in the body for providing a passage into the vessel and for closing the passage, a pressure indicator disposed in the body for indicating a pressure within the vessel, and a pump for engaging the valve assembly and drawing the pressure.

[0016] In another embodiment of the present invention, a method for preserving a beverage within a vessel comprises sealing the vessel with an insert for creating an airtight seal therewith, opening a fluid pathway within the insert between the vessel and an external atmosphere, removing air from the vessel through the fluid pathway thereby creating a negative pressure within the vessel, closing the fluid pathway for maintaining the negative pressure within the vessel, and sensing the negative pressure within the vessel.

[0017] The disclosed systems and methods have several improvements and advantages over the prior art. One such advantage is that the invention provides means for drawing and maintaining vacuum within the vessel and thereby preserving unconsumed wine or other beverages stored in a vessel from deterioration due to oxidation and other chemical reactions. Another advantage of the present invention is that it provides means for indicating a depressurization of the vessel. Yet another advantage of the present invention is that is can be readily

manufactured using standard manufacturing processes and using commonly available materials. Other advantages of the invention will become apparent from the following drawings and detailed description of the specific embodiments of the invention.

BRIEF DESCRIPTION OF DRAWINGS

[0018] Various embodiments of the present invention are illustrated in the following drawings, which are meant to be exemplary only and are not limiting on the scope of the present invention, and in which

[0019] Fig. **1a** is an orthogonal view of the decanter stopper in accordance with one embodiment of the present invention;

[0020] Fig. **1b** is an orthogonal view of the wine bottle stopper in accordance with one embodiment of the present invention;

[0021] Fig. **2a** is a cross-section view of the decanter stopper in accordance with one embodiment of the present invention;

[0022] Fig. **2b** is a cross-section view of the wine bottle stopper in accordance with one embodiment of the present invention;

[0023] Fig. **3** is a cross-section view of the valve assembly in accordance with one embodiment of the present invention;

[0024] Fig. **4** is a cross-section view of the valve assembly in accordance with another embodiment of the present invention;

[0025] Fig. **5** is a cross-section view of the pressure sensor in accordance with one embodiment of the present invention;

[0026] Fig. **6a** is a cross-section view of the decanter stopper depicted as positioned on the neck of a decanter in accordance with one embodiment of the present invention;

[0027] Fig. **6b** is a cross-section view of the wine bottle stopper depicted as positioned on the neck of a wine bottle in accordance with one embodiment of the present invention and

[0028] Fig. **7** is a flowchart diagram depicting a method for preserving a beverage in a vessel in accordance with one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0029] In the following description of the various embodiments of the present invention, reference is made to the accompanying drawings that form a part hereof, and in which is shown by way of illustration various embodiments of the present invention. It is to be understood that the scope of the present invention is not limited by the following description and by the accompanying drawings.

[0030] The term "stopper", as it is used hereafter, shall be understood to refer to a device which is used to seal any vessel, including a stopper for a wine bottle and a stopper for a decanter. When reference is made to a stopper specifically designed for a wine bottle, the term "wine bottle stopper" shall be used. When reference is made to a stopper specifically designed for a decanter, the term "decanter stopper" shall be used. Figs. **1a**, **1b**, **2a**, and **2b** illustrate a stopper **10**. Figs. **1a** and **2a** illustrate orthogonal and sectional views, respectively, of a decanter stopper in accordance with an exemplary embodiment of the present invention. Figs. **1b** and **2b** illustrate orthogonal and sectional views, respectively, of a wine bottle stopper in accordance with an exemplary embodiment of the present invention. The stopper **10** comprises a one-piece, integral, cylindrical body having an upper enclosed portion **12** and lower portion **14,** which may be defined by a circumferential flange **20** extending radially outward. The enclosed upper portion **12** of the stopper **10** may comprise a semi-spherical or semi-cylindrical body having two openings **32** and **34.** The lower portion **14** is adapted to be inserted into the mouth of the vessel and thus may have an outside diameter **23** that is less than the inside diameter of the vessel neck. In one embodiment, the lower portion **14** of the stopper **10** may have a slightly conical shape to completely fit into the neck of the vessel, which may also have a conical shape. The lower edge **21** of the flange **20** acts as an index, abutting the lip of the vessel mouth when the lower portion **14** is properly positioned within the vessel neck. In one embodiment, the lower portion **14** may also comprise a flange **36,** which extends radially outward, thereby defining a circumferential groove **38** between flange **36** and flange **20.**

[0031] In one embodiment, the stopper **10** may also comprise an elastic tubular sheath **30,** which may be dispose around the lower portion **14** of the stopper **10.** The sheath **30** may comprise a flange **40** extending radially inward to engage the groove **38** of the lower portion **14** of the stopper **10.** The lower portion of sheath **30** may extend radially inward to hook around the edge of the lower portion **14** of the stopper **10.** In one embodiment, the sheath **30** may have a plurality of flexible ridges **22** extending radially outward. The ridges **22** may have diameter slightly larger than the inner diameter of the vessel neck. Consequently, the ridges **22** are resiliently compressed when the lower portion **14** of the stopper **10** is inserted into the vessel mouth and/or neck, thereby forming an airtight and fluid-tight seal between the lower portion **14** and the vessel mouth and/or neck, in accordance with one embodiment of the present invention.

[0032] In one embodiment, the stopper **10** may be manufactured from ABS, or other types of thermoformed plastic, which may be easily molded into the required form using standard manufacturing processes known to those skilled in the art. In other embodiments, the stopper **10** may be manufactured using other commonly available materials such as resin, silicon, or the like, or more rigid materials, such as Plexiglas, ceramic, metal, or the like. Furthermore, in one embodiment, the elastic sheath **30** may be manufactured from various resilient materials, such as resin, silicon or the like, using standard manu-

facturing processes known to those skilled in the art.

[0033] In one embodiment of the present invention, the upper portion **12** of the stopper **10** may comprise two openings **32** and **34,** which may be defined by longitudinal, cylindrical sleeves **33** and **35,** respectively. The opening **32** may house a valve assembly **16** which creates a passageway from the external atmosphere to inside the vessel and is operable to open and close the passageway. Valve assembly **16** is also operable to maintain a pressure differential within the vessel, in accordance with one embodiment of the present invention. The opening **34** may house a pressure indicator **18** operable to measure and display vacuum pressure within the vessel, in accordance with one embodiment of the present invention. It is to be understood that there are many ways of referring to the pressure within the vessel. Such pressure may be referred to as a "pressure differential" meaning the pressure difference that exists between the external atmosphere and within the vessel. Such pressure may also be referred to as "negative pressure" which is to be understood as referring to the fact that pressure within the vessel is less than the outside atmosphere. Such pressure may also be referred to as "vacuum pressure" since the pressure within the vessel is created by means of a vacuum pump. The various embodiments of the valve assembly **16** and pressure indicator **18** will be described next with reference to Figs. **3, 4**, and **5**.

[0034] Fig. **3** illustrates a valve assembly in accordance with one exemplary embodiment of the present invention. The valve assembly may comprise an outer frame **40,** inner frame **42,** and valve **65.** Alternately, the valve assembly may comprise a single frame as opposed to an inner and outer frame. The one-piece, integral outer frame **40** may be composed of a resilient material, such as resin, silicon, or the like. The outer frame **40** may comprise a longitudinally extending, cylindrical sleeve portion **44,** an upper flange portion **46,** and a lower flange portion **48.** The sleeve portion **44** is inserted within the opening **32** and through sleeve **33** of the stopper **10,** and has an outside diameter **41** that is less than the inside diameter of the sleeve **33.** A number of thin sealing ridges **43** extend circumferentially around and laterally outward from the outer surface **45** of the sleeve portion **44.** The ridges **43** each have an outside diameter **47** which is slightly greater than the inside diameter of the sleeve **33.** Consequently, the ridges **43** are resiliently compressed when the sleeve portion **44** is inserted into the sleeve **33** of the stopper **10,** thereby forming an airtight and fluid-tight seal between the sleeve portion **44** and sleeve **33.**

[0035] The upper flange portion **46** extends laterally outward from the outer surface **45** of sleeve portion **44** and longitudinally upward from the upper end **49** of sleeve portion **44.** The lower edge **51** of the upper flange **46** acts as an index, abutting the upper edge of the sleeve **33** when the sleeve portion **44** is properly positioned within the sleeve **33** of the stopper **10.** A number of thin sealing ridges **57** extend circumferentially around and laterally outward from the outer surface of the upper flange **46.** The ridges **57** each have an outside diameter which is slightly greater than the inside diameter of the outer sleeve of a vacuum pump. Thus, the ridges **57** are resiliently compressed when the outer sleeve of a vacuum pump engages upper flange **46** of the outer frame **40.** An axial bore **52** extends longitudinally through the upper flange portion **46** and the sleeve portion **44.** The lower flange portion **48** may extend laterally inward to an axial orifice **54,** thereby partially closing bore **52.** The orifice **54** may have a tapered, conical-shaped, sealing surface forming a valve seat **56,** as further described below.

[0036] In one embodiment of the present invention, a rigid, one-piece, integral, inner frame **42** is disposed within the bore **52** of the outer frame **40** and is preferably composed of a hard polymeric material, such as plastic. The inner frame **42** includes a longitudinally extending, cylindrical sleeve portion **58** and an upper flange **60,** which extends laterally outward from the outer surface **59** of sleeve portion **58** and longitudinally upward from the upper end **62** of sleeve portion **58.** A stepped axial opening **64** extends longitudinally through the sleeve **58** and upper flange **60.** The diameter of the opening **61** in the sleeve portion **58** is greater than the diameter of the opening in the upper flange portion **60,** such that the upper flange portion **60** forms a downward facing shoulder **69.** The upper flange **60** is received in a circumferential groove **53** on the inner surface of upper flange **46.** Preferably, the outer diameter of the upper flange **60** is greater than the inside diameter of the opening **32** and sleeve **33** whereby the rigid material of upper flange **60** and the resilient material of upper flange **46** could not be inserted into the sleeve **33** of the stopper **10.**

[0037] In one embodiment of the present invention, a rigid, one-piece, integral, valve **65** is disposed in an opening **61** of the inner frame **42.** The valve **65** has an upper operator portion **66** connected to a lower valve body portion **68** by a longitudinally extending shaft portion **67.** The operator portion **66** has a knob-shape to facilitate gripping by a user's hand. The outside diameter of the operator portion **66** is greater than the diameter of the opening formed in the upper flange **60** of the inner frame **42** such that operator portion **66** cannot be pushed or pulled through opening **61.** The valve body portion **68** has a conical shape which is complementary to that of the orifice **54** in the lower flange portion **48** of the outer frame **40** such that the seating surface **56** of the orifice **54** may form an airtight and fluid-tight seal with the valve body portion **68** when the valve body portion **68** is urged into the orifice **54** under the vacuum pressure within the vessel. The tapered shape increases the frictional force between the seating surface **56** and valve body portion **68,** thereby providing improved resistance to air leakage into the vessel. A retainer flange **63,** which extends radially outward from shaft portion **67,** is disposed proximate to the upper operator portion **66.** The outside diameter of the retainer flange **60** is smaller than the diameter of the opening **61** in sleeve portion **58** but greater than the di-

ameter of the opening in upper flange portion **60** such that the retainer flange **63** engages shoulder **69** to prevent complete withdrawal of the valve **65** from the inner frame **42.**

[0038] Fig. **4** illustrates a valve assembly in accordance with another exemplary embodiment the present invention. The valve assembly may comprise a frame **70,** cover **72,** biasing means **74,** and valve **86.** Alternately, the valve assembly may be comprised of a single frame instead of a cover and a frame. The biasing means may be a tension or compression helical coil, a leaf spring, a compressible material or other biasing means which are well known in the art. The one-piece, integral frame **70** may be composed of a resilient material, such as resin, silicon, or the like. The frame **70** may comprise a cylindrical sleeve portion **76** having bore **79** and a valve seat assembly **78.** The sleeve portion **76** is inserted within the opening **32** and through the sleeve **33** of the stopper **10,** and has an outside diameter that is less than the inside diameter of the sleeve **33.** A number of thin sealing ridges **71** extend circumferentially around and laterally outwardly from the outer surface of the sleeve portion **76.** The ridges **71** each have an outside diameter which is slightly greater than the inside diameter of the sleeve **33.** Thus, the ridges **71** are resiliently compressed when the sleeve portion **76** is inserted into the sleeve **33** of the stopper **10,** thereby forming an airtight and fluid-tight seal between the sleeve portion **76** and the sleeve **33.**

[0039] In one embodiment of the present invention, the valve seat portion **78** of the frame **70** extends longitudinally upward and laterally outward from the sleeve portion **76** to define a flange **77.** The lower edge **75** of the flange **77** acts as an index, abutting the upper edge of the sleeve **33** when the sleeve portion **76** is properly positioned within the sleeve **33** of the stopper **10.** A number of thin sealing ridges **73** extend circumferentially around and laterally outward from the outer surface of the valve seat portion **78.** The ridges **73** each have an outside diameter which is slightly greater than the inside diameter of the outer sleeve of a vacuum pump. Thus, the ridges **73** are resiliently compressed when the outer sleeve of a vacuum pump engages valve seat portion **78.** The lower part of the valve seat portion **78** may extend radially inward to form an axial orifice **80,** which partially closes bore **79.** The valve seat portion **78** may also comprise a flange **81** extending radially inward and defining a circumferential groove **82** in a perimeter of a cavity **83.**

[0040] In one embodiment of the present invention, a rigid, one-piece, integral, valve **86** extends through an orifice **85** of the valve cover **72** and biasing means **74.** Alternately, valve **86** may be operably connected to biasing means **74.** The valve **86** and cover **72** may be formed of a rigid material such as ABS, or other type of, thermoformed plastic. The biasing means **74** may be formed of metal, plastic or the like. The valve **86** has an upper operator portion **87** connected to a lower valve portion **89** by a longitudinally extending shaft **88.** The valve shaft **88** passes through the biasing means **74,** whereby the biasing means **74** is compressed between the edge of the orifice **85** and the lower valve portion **89.** In one embodiment, the biasing means **74** may be thermally fused to the lower valve portion **89** using methods known to those of skill in the art. The operator portion **87** is knob-shaped to facilitate gripping by a user's hand. The outside diameter of the operator portion **87** may be greater than the diameter of the orifice **85** such that the operator portion **87** may not be pushed or pulled through the orifice **85.**

[0041] In one embodiment of the present invention, the frame **70** may be sufficiently elastic so that it can be stretched to allow a flange **84** of the cover **72** to be inserted into groove **82** of the frame **70** and be held in place by flange **81** to form the valve assembly. When the cover **72** is inserted into the frame **70,** the force of the biasing means **74** will work against the lower valve portion **89** and thus bring it into abutting contact with the lower potion of the valve seat assembly **78,** thereby airtight and fluid-tight sealing the orifice **80.** During pumping, however, the air inside the vessel pushes on the lower valve portion **89** with sufficient force to overcome the force of the biasing means **74** and allow air to flow out of the vessel through the orifice **85** into the atmosphere. When the pumping action stops, the valve **86** is drawn into its original sealing position by the operation of the biasing means **74** and the vacuum pressure within the vessel.

[0042] In accordance with one embodiment of the present invention, the stopper **10** may comprise a pressure indicator operable to sense and display in a human-readable format the level of vacuum pressure within the stoppered decanter. The pressure indicator may comprise any vacuum pressure-measuring device, such as a pressure gauge, pressure sensor, or the like. In some embodiments of the present invention, the pressure indicator may comprise a mechanical pressure sensor, such as a bourdon tube pressure gauge, diaphragm element pressure gauge, capsule element pressure gauge, absolute pressure gauge, differential pressure gauge, or the like. In another embodiment, the pressure indicator may comprise an electronic (or digital) pressure sensor, such as a thermocouple gauge, Penning gauge, thermistor gauge or the like.

[0043] Fig. **5** illustrates an exemplary embodiment of a pressure indicator in accordance with the present invention. An exemplary pressure indicator comprises a mechanical pressure sensor **90** operable to sense vacuum pressure within the vessel and to display the sensed vacuum pressure in a human-readable format. The pressure sensor **90** is disposed within the sleeve **35** of the upper portion of the stopper **10.** The pressure sensor **90** may comprise a sealing sleeve **91,** a cylindrical frame **92,** an inner T-shaped frame **93,** a piston **94,** a biasing means **95,** a card face **96,** a cover **97,** and a gear train **98.** The biasing means may be a tension or compression helical coil, a leaf spring, a compressible material or other biasing means which are well known in the art. Those of skill in the art may recognize that various other elements

and configuration of mechanical and electronic elements may be used in connection with the pressure sensor **90** to sense and display vacuum pressure within the vessel in accordance with various embodiments.

[0044] In one embodiment, the cylindrical sealing sleeve **91** may be formed of resilient material, such as resin, silicon, or the like, and disposed around the cylindrical frame **92** to provide an airtight and fluid-tight seal between the sleeve **34** and the frame **92** when the pressure sensor **90** is inserted into the sleeve **34** of the upper portion **12** of the stopper **10.** The lower portion of the seating sleeve **91** may extend radially inward to form an orifice **99.** The upper portion of the sealing member may comprise a flange **101** extending radially outward to engage in an airtight manner the lower edge of a radial flange **102** of the frame **92.** The upper edge of the flange **102** may engage in an airtight manner the cover **97,** which may be formed of rigid and transparent material, such as glass, Plexiglas, plastic or the like.

[0045] The cylindrical frame **92** may be formed of a rigid material, such as plastic. The cylindrical frame **92** may define a chamber **103.** The lower portion of the cylindrical frame **92** may extend radially inward to define an orifice **104** having diameter smaller than the diameter of the chamber **103.** The biasing means **95** may be disposed within the chamber **103** to abut the edge of the orifice **104.** The piston **94** may comprise a cylindrical shaft having a bore therein. The shaft of the piston **94** extends through the chamber **103,** biasing means **95,** orifice **104,** and orifice **99.** The piston **94** may further comprise a plug **106** that may be inserted at the bottom into the bore of the piston **94** to seal in an airtight manner the orifice **99** and a bore of the piston **94.** The piston **94** may also comprise a flange **105** extending radially outward for engaging the biasing means **95.** In one embodiment, the biasing means **95** may be thermally fused at one end with the flange **105** of the piston **94** and at the other end with the bottom portion of the frame **92** to form a pressure sensor, operation of which will be described in more detail below. The T-shaped frame **93** may extend through the piston **94.** The upper, horizontal portion of the T-shaped frame **93** may support an indicator needle **107** and comprise a card face **96** inscribed with the pressure indication scale, such as centimeters of mercury vacuum (cmHg), associated with particular needle deflections. The card face may also be inscribed with indicia to indicate the amount of vacuum pressure within the vessel. Alternatively, a color code indicating that sufficient vacuum pressure has been achieved may be used. For example, one or more colors may be used to indicate too little vacuum pressure within the vessel. A different color(s) may be used to indicate that sufficient vacuum pressure has been achieved within the vessel. A different color(s) may also be used to indicate too much vacuum pressure within the vessel. A link or the gear train **98** may be used to connect piston **94** with the T-shaped frame **93** and the indicator needle **107** in a manner known to those of skill in the art, and which therefore is not described here in detail.

[0046] The above-described vacuum pressure sensor operates as follows. As the air is withdrawn from the vessel to the external atmosphere through the valve assembly **16,** a vacuum is drawn inside the vessel and the vacuum pressure increases inside the vessel. This vacuum pressure is exerted on the plug **106** of the piston **94** and lower portion of the sealing sleeve **91** of the pressure sensor **90** so that the piston **94** and the sleeve **91** are being pulled into the vessel. Once the vacuum pressure exceeds the force of the biasing means **95** disposed within the pressure sensor **90,** the piston **94** will start moving downward into the vessel. The downward motion of the piston **94** may be transferred from a vertical plane into the horizontal plane through a link or gear train **98** to the T-shaped frame **93** and the indicator needle **107** of the pressure sensor **90,** which in turn will move along the inscribed scale on the card face **96** and indicates vacuum pressure within the vessel.

[0047] With reference to Fig. **6a** and Fig. **6b,** a separate pump **120** may be used in connection with the stopper of the present invention to withdraw the air from the vessel **110** and to draw the vacuum therein. In Fig. **6a** the vessel **110** is shown to be a decanter and the stopper **10** is shown to be a decanter stopper whereas in Fig. **6b** the vessel **100** is shown to be a wine bottle and the stopper **10** is shown to be a wine bottle stopper. In one embodiment, the pump **120** may comprise a pump sleeve **122** with cylindrical chamber **132** having a piston **128** and a chamber **130** disposed therein. A pipe-shaped piston rod **124** extends from the piston **128** to a handle **126.** A check valve, such as a mushroom-shaped non-return valve (not shown), may be mounted in an opening (not shown) in the piston **128** in accordance with one embodiment of the present invention. The pump sleeve **122** is configured to engage the upper frame portion of valve **16,** which protrudes from the upper portion of the stopper **10.** The piston **128** may be manually or electrically actuated to withdraw the air through the valve assembly **16** from the vessel **110** and thus to draw vacuum therein. When the piston rod **124** and piston **128** move upwards, the check valve prevents flow through the opening in the piston **128,** thereby extracting air into chamber **130** from the vessel via valve **16.** When the piston **128** is subsequently moved downwards, the air passes from chamber **130** through the opening in the piston **128** and exhausts through an opening **134** in the upper portion of the pump sleeve **122.**

[0048] In one embodiment of the present invention, the vessel **110** may comprise any type of vessel capable of holding a fluid therein. The vessel **110** may be manufactured using standard manufacturing processes known to those of skill in the art. In one embodiment, the vessel **110** may be manufactured from various rigid and preferably transparent materials such as glass, Plexiglas, plastic, ABS or the like. The thickness of the walls of the vessel **110** should be sufficient to withstand vacuum pressures lower than the external atmospheric pressure. Total vacuum is defined as a vacuum pressure of 72 cm-

Hg. Typically, the maximum vacuum pressure that can be created by a manual vacuum pump is only 55 cmHg. In one embodiment, the thickness of the vessel walls may range from 2-7 mm to withstand vacuum pressures from at least about 50 cmHg up to about 71 cmHg. In another embodiment of the invention, the vessel walls are designed to withstand a vacuum pressure of at least approximately 55 cmHg. Those of skill in the art may recognize that the vessel's pressure resistance may depend on the type of the material from which the vessel is manufactured and the thickness of the vessel walls.

[0049] The operation of the wine preserving system of the present invention will be described next with reference to Fig **7** as well as Figs. **2a, 2b, 3, 5, 6a** and **6b. Figs. 6a** and **6b** show a cross-section view of a partially filled vessel **110** into which the stopper **10** has been inserted and a cross-section view of pump **120** positioned on the stopper **10.** In operation, the stopper **10** is inserted into the neck **114** of the vessel **110,** preferably until the lower surface **21** of ledge **20** of stopper **10** (see Figs. **2a** and **2b)** sits on the lip **116** of the vessel mouth **112.** The flexible ridges of the lower portion of the stopper come into the sealing contact with the throat **114** of the vessel **110** to airtight seal it, step **710.** Then, the sealing end of sleeve **122** of the pump **120** may be installed on the stopper **10,** preferably with the sealing end of sleeve **122** pressing against and sealing to upper surface **27** of ledge **26** of the valve **16.** Although it is not necessary, the sealing end of sleeve **122** of the pump **120** may also press against the inner surface **28** of the valve **16** to provide a stronger seal with the valve **16.**

[0050] With reference to Fig. **3,** during the suction stroke of the pump **120,** air inside the vessel **110** pushes the valve **65** upward, unseating valve body portion **68** from the orifice **54,** and establishing an air path through the stopper **10,** step **720.** The air flows through the orifice **54** and out of the stopper **10** via the stepped opening **61** of the inner frame **42.** When the pumping action stops, the vacuum in the vessel draws the valve **65** downward to engage the valve body portion **68** within orifice **54,** thereby sealing the air passage, step **730.** The pressure differential across the valve **65** will further urge the valve **65** downward, thereby pushing the flexible lower flange portion **48** of the outer body **40** down towards the inside of the vessel **110.** To remove the stopper **10,** the vacuum may be released by grasping operator portion **66** of the valve and pulling the valve **65** upward, thereby unseating the valve body portion **68** from orifice **54.**

[0051] With reference to Fig. **5,** the vacuum in the vessel **110** acts on the plug **106** of the piston **94** and lower portion of the sealing sleeve **91** of the pressure sensor **90** so that the piston **94** and the sleeve **91** are being pulled into the vessel **110** due to the vacuum pressure. Once the vacuum pressure exceeds the force of the biasing means **95** disposed within the pressure sensor **90,** the piston **94** will start moving downward into the vessel **110,** thereby sensing vacuum pressure within the vessel **110,** step **740.** The downward motion of the piston **94** is transferred through gear train **98** to the indicator needle **107** of the pressure sensor **90,** which in turn will move along the inscribed scale on the card face **96** and indicate vacuum pressure within the vessel **110,** step **750.** Once the desired vacuum pressure is achieved within the vessel **110,** the pumping may subside, thereby preserving the wine in the vessel **110** in the substantially air free atmosphere, i.e., vacuum.

[0052] Again with reference to Figs. **3** and **5,** should the airtight seal between the valve body portion **68** and orifice **54** leak, or should the vessel depressurize in any other way, the vacuum pressure within the vessel **110** will begin dropping. This vacuum pressure drop will be detected by the pressure sensor **90,** step **760.** The indicator needle **107** of the pressure sensor **90** will move to indicate the drop in vacuum pressure, step **770.** Once such a drop in the pressure has been observed, the user may again utilize pump **120** to withdraw the excess air from the vessel 110 thereby bringing vacuum level within the vessel **110** to the desired level and reestablishing an airtight seal between valve body portion **68** and orifice **54** of the valve assembly **16.** This process may be periodically repeated thereby ensuring that the unconsumed wine stored in the vessel **110** is preserved without oxidation or other chemical reactions until it is completely consumed.

[0053] In the foregoing specification, the invention has been described with reference to specific embodiments thereof. It will, however, be evident that various modifications and changes may be made thereto without departing from the broader spirit and scope of the invention. The specification and drawings are, accordingly, to be regarded in an illustrative rather than a restrictive sense.

Claims

1. An insert for a vessel, comprising:

a body adapted for inserting into the vessel and forming an airtight seal therewith;
a valve assembly disposed in said body for providing a passage into the vessel and for closing said passage; and
a pressure indicator disposed in said body for indicating a pressure within the vessel.

2. The insert of Claim 1, wherein said pressure indicator comprises:

a pressure sensor for sensing said pressure; and
a display connected to said pressure sensor for displaying said pressure sensed by said pressure sensor.

3. The insert of Claim 2, wherein said display comprises:

a face;
a plurality of pressure indicia inscribed on said face, wherein each indicium represents a different pressure; and
an indicator disposed upon said face and connected to said pressure sensor for indicating at least one of said indicia.

4. The insert of Claim 2, wherein said display comprises:

a face;
a plurality of colors inscribed on said face, wherein each color represents a range of different pressures; and
an indicator disposed upon said face and connected to said pressure sensor for indicating at least one of said colors.

5. The insert of Claim 1, further comprising:

a sheath disposed around said body; and
a plurality of ridges extending radially outward from said sheath, wherein said plurality of ridges are wider than the mouth of the vessel, for forming an airtight seal between said body and the vessel.

6. The insert of Claim 1, wherein said valve assembly comprises:

a frame disposed in said body, wherein said frame has an orifice for providing fluid communication into the vessel; and
a valve stem disposed in said frame adapted for moving between an open position and a closed position with respect to said orifice.

7. The insert of Claim 6, wherein said valve assembly further comprises:

a biasing means operatively connected to said valve stem for biasing said valve stem towards said closed position.

8. The insert of Claim 1, wherein said valve assembly is adapted for engaging a vacuum pump.

9. A system for preserving a beverage within a vessel, the system comprising:

a body adapted for inserting into the vessel and forming an airtight seal therewith;
a valve assembly disposed in said body for providing a passage into the vessel and for closing said passage;
a pressure indicator disposed in said body for indicating a pressure within the vessel; and
a pump for engaging said valve assembly and drawing said pressure.

10. The system of Claim 9, wherein said pressure indicator comprises:

a pressure sensor for sensing said pressure; and
a display connected to said pressure sensor for displaying said pressure sensed by said pressure sensor.

11. The system of Claim 10, wherein said display comprises:

a face;
a plurality of pressure indicia inscribed on said face, wherein each indicium represents a different pressure; and
an indicator disposed upon said face and connected to said pressure sensor for indicating at least one of said indicia.

12. The system of Claim 10, wherein said display comprises:

a face;
a plurality of colors inscribed on said face, wherein each color represents a range of different pressures; and
an indicator disposed upon said face and connected to said pressure sensor for indicating at least one of said colors.

13. The system of Claim 9, further comprising:

a sheath disposed around said body; and
a plurality of ridges extending radially outward from said sheath, wherein said plurality of ridges are wider than the mouth of the vessel, for forming an airtight seal between said body and the vessel.

14. The system of Claim 9, wherein said valve assembly comprises:

a frame disposed in said body, wherein said frame has an orifice for providing fluid communication into the vessel; and
a valve stem disposed in said frame adapted for moving between an open position and a closed position with respect to said orifice.

15. The system of Claim 14, wherein said valve assembly further comprises:

a biasing means operatively connected to said valve stem for biasing said valve stem towards

said closed position.

16. The system of Claim 9, wherein said pump is selected from the group consisting of a manual pump and an electric pump.

17. A method for preserving a beverage within a vessel, the method comprising:

sealing the vessel with an insert for creating an airtight seal therewith;
opening a fluid pathway within said insert between the vessel and an external atmosphere;
removing air from the vessel through said fluid pathway thereby creating a negative pressure within the vessel;
closing said fluid pathway for maintaining said negative pressure within the vessel; and
sensing said negative pressure within the vessel.

18. The method of Claim 17, further comprising a step of displaying said negative pressure.

19. The method of Claim 15, further comprising a step of providing a valve assembly for opening and closing said fluid pathway.

20. The method of Claim 15, further comprising a step of providing a pressure sensor for sensing said negative pressure.

21. The method of Claim 15, further comprising a step of providing a vacuum pump for removing air from the vessel.

22. A system for preserving a beverage, the system comprising:

a vessel for storing a beverage therein;
a body adapted for inserting into the vessel and forming an airtight seal therewith;
a valve assembly disposed in said body for providing a passage into the vessel and for closing said passage;
a pressure indicator disposed in said body for indicating a pressure within the vessel; and
a pump for engaging said valve assembly and drawing said pressure.

23. The system of Claim 22, wherein said pressure indicator comprises:

a pressure sensor for sensing said pressure; and
a display connected to said pressure sensor for displaying said pressure sensed by said pressure sensor.

24. The system of Claim 23, wherein said display comprises:

a face;
a plurality of pressure indicia inscribed on said face, wherein each indicium represents a different pressure; and
an indicator disposed upon said face and connected to said pressure sensor for indicating at least one of said indicia.

25. The system of Claim 23, wherein said display comprises:

a face;
a plurality of colors inscribed on said face, wherein each color represents a range of different pressures; and
an indicator disposed upon said face and connected to said pressure sensor for indicating at least one of said colors.

26. The system of Claim 22, further comprising:

a sheath disposed around said body; and
a plurality of ridges extending radially outward from said sheath, wherein said plurality of ridges are wider than the mouth of the vessel, for forming an airtight seal between said body and the vessel.

27. The system of Claim 22, wherein said valve assembly comprises:

a frame disposed in said body, wherein said frame has an orifice for providing fluid communication into the vessel; and
a valve stem disposed in said frame adapted for moving between an open position and a closed position with respect to said orifice.

28. The system of Claim 27, wherein said valve assembly further comprises:

a biasing means operatively connected to said valve stem for biasing said valve stem towards said closed position.

29. The system of Claim 22, wherein said pump is selected from the group consisting of a manual pump and an electric pump.

30. The system of Claim 22, wherein said vessel is adapted to withstand a negative pressure of about 50 cmHg or more.

31. The system of Claim 22, wherein said vessel is manufactured of a material selected from the group con-

sisting of glass, Plexiglass, and plastic.

32. The system of Claim 22, wherein the thickness of the walls of said vessel is greater than 3 mm.

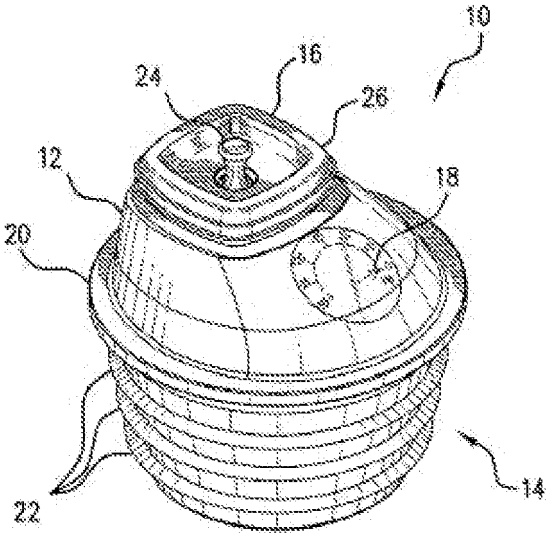

FIG.1a

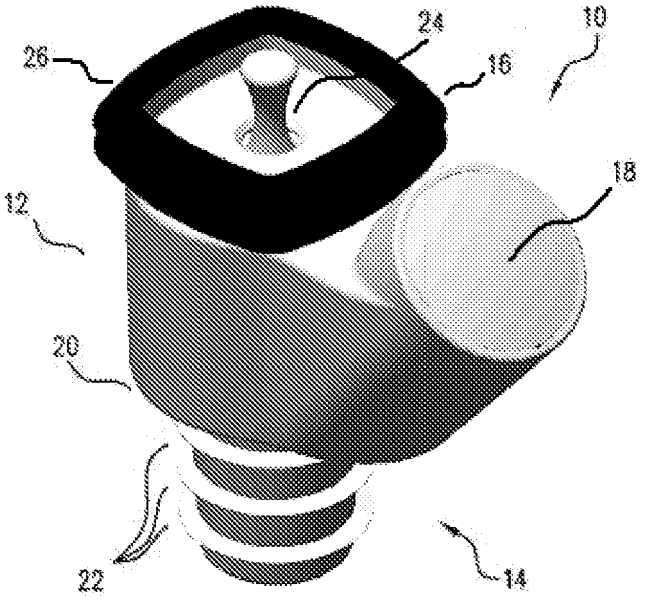

FIG.1b

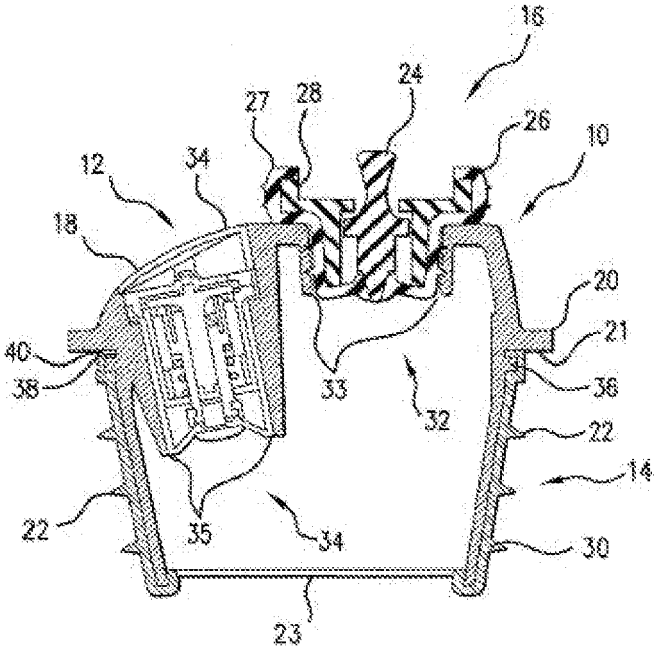

FIG.2a

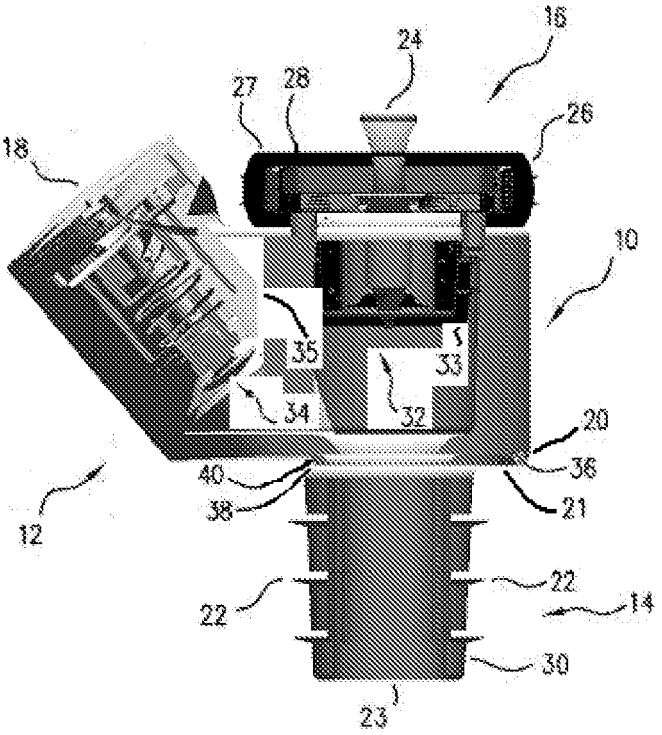

FIG.2b

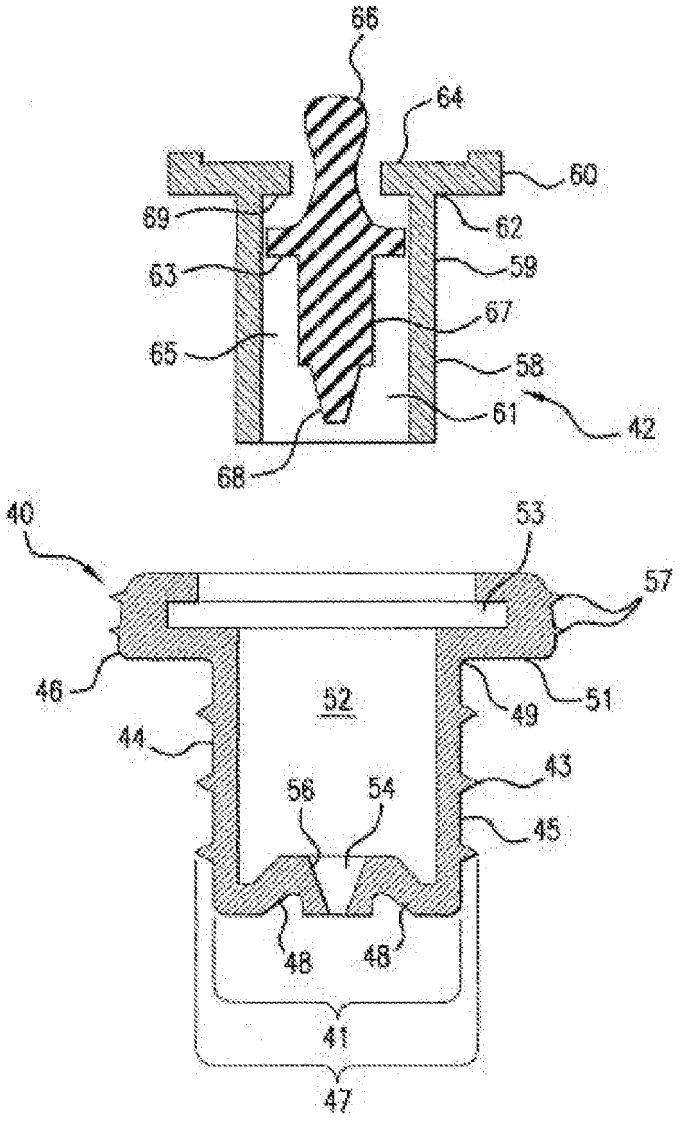
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FIG.3

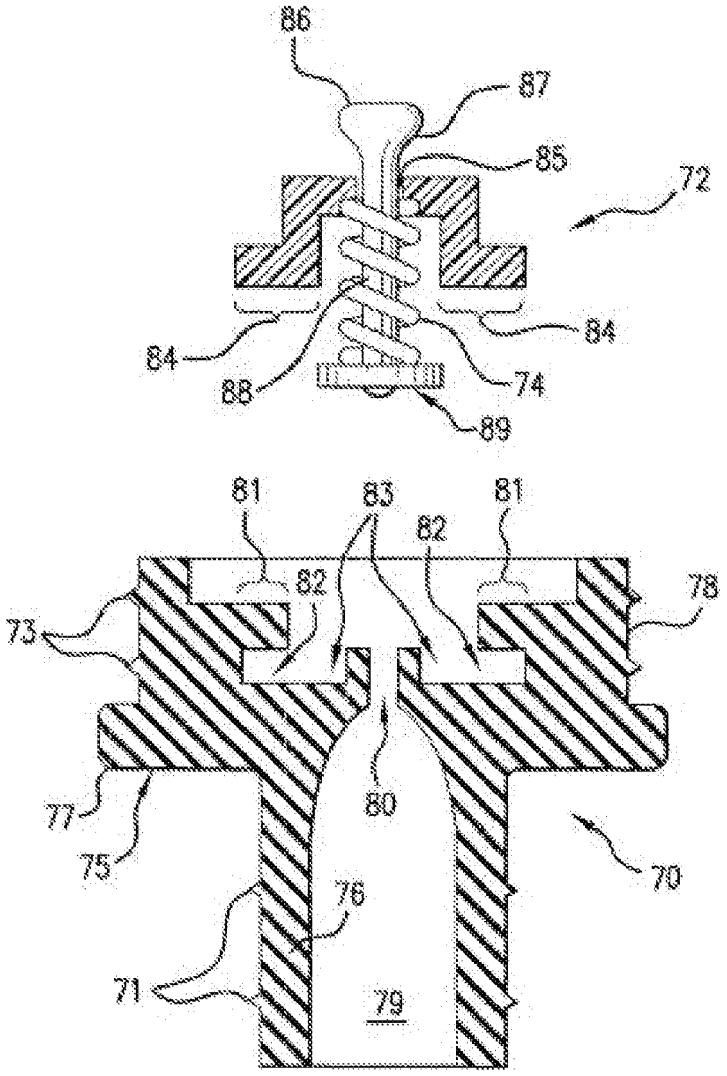

FIG.4

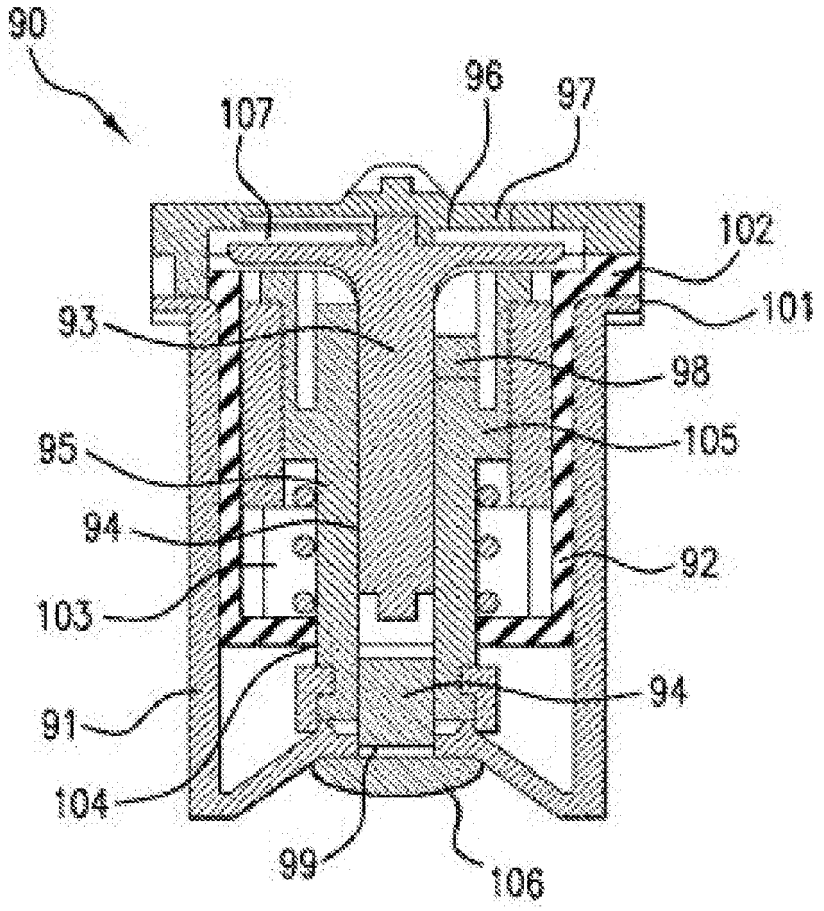

FIG.5

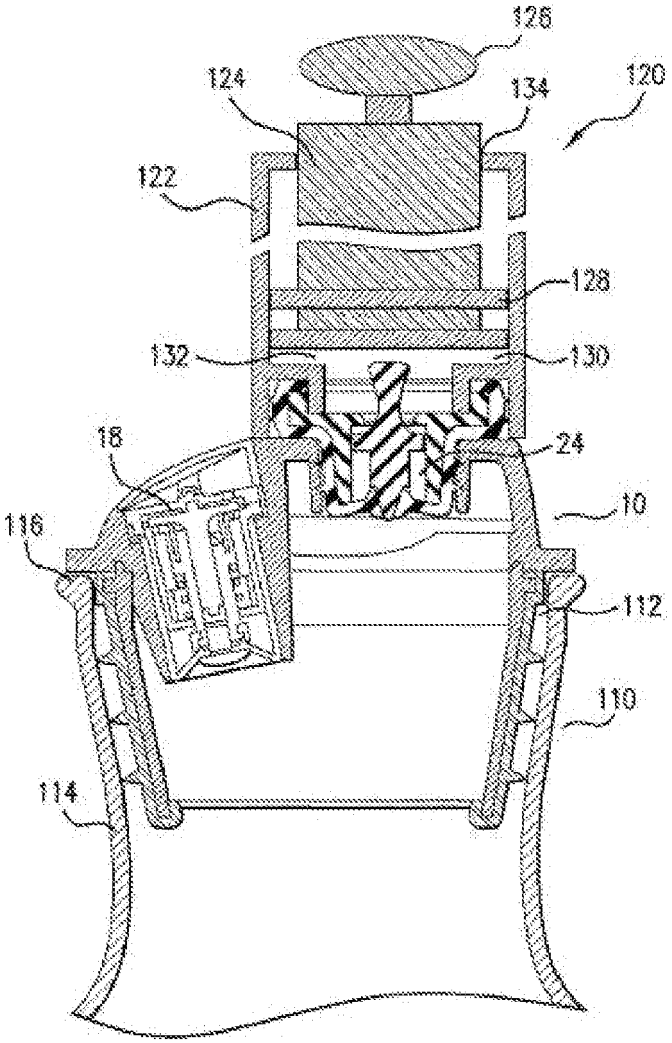

FIG.6a

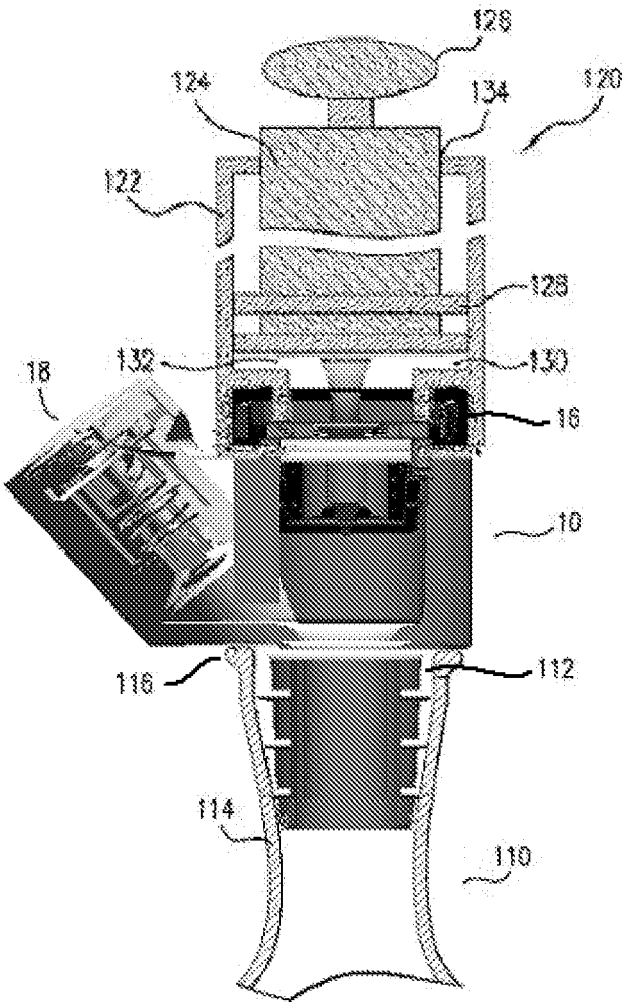

FIG.6b

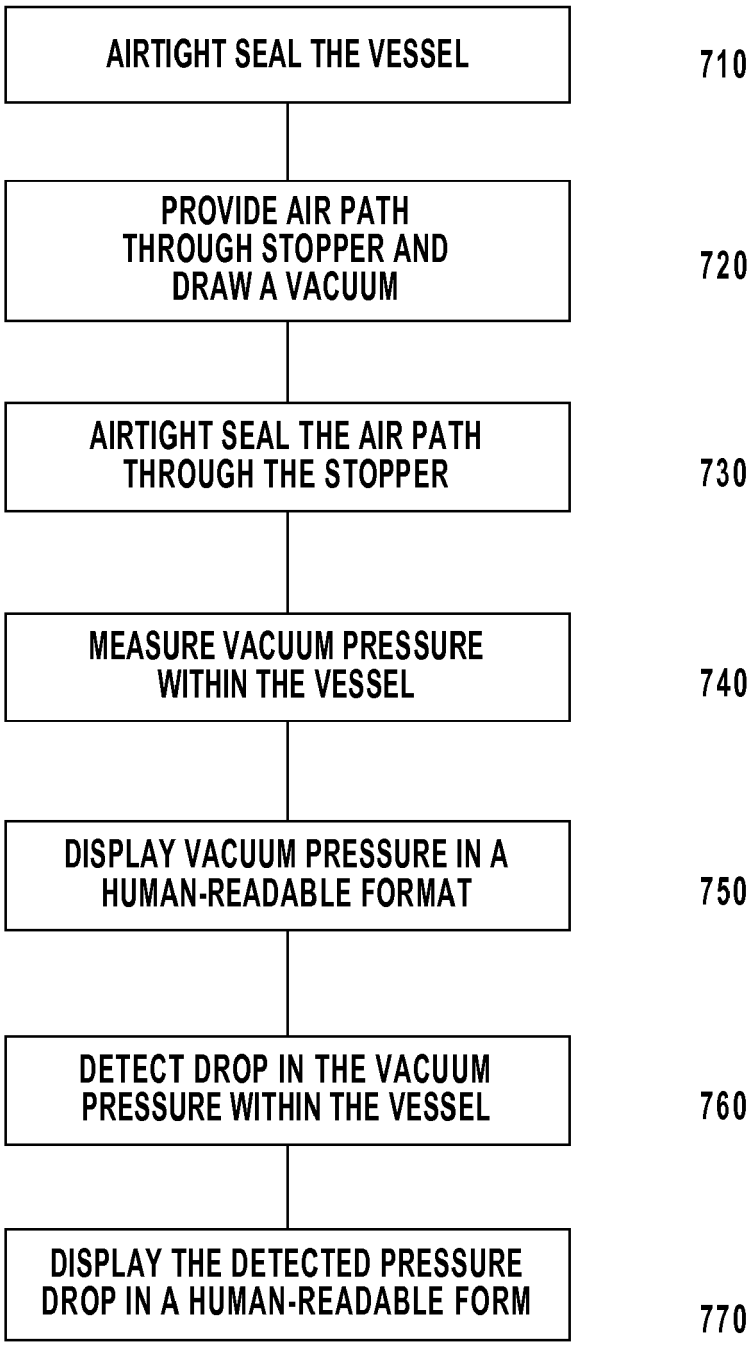
AIRTIGHT SEAL THE VESSEL
710
PROVIDE AIR PATH THROUGH STOPPER AND DRAW A VACUUM
720
AIRTIGHT SEAL THE AIR PATH THROUGH THE STOPPER
730
MEASURE VACUUM PRESSURE WITHIN THE VESSEL
740
DISPLAY VACUUM PRESSURE IN A HUMAN-READABLE FORMAT
750
DETECT DROP IN THE VACUUM PRESSURE WITHIN THE VESSEL
760
DISPLAY THE DETECTED PRESSURE DROP IN A HUMAN-READABLE FORM
770

FIG.7