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(54) VACUUM SEALING SYSTEM WITH A SEALING ELEMENT INSIDE AN EVACUATION CHAMBER

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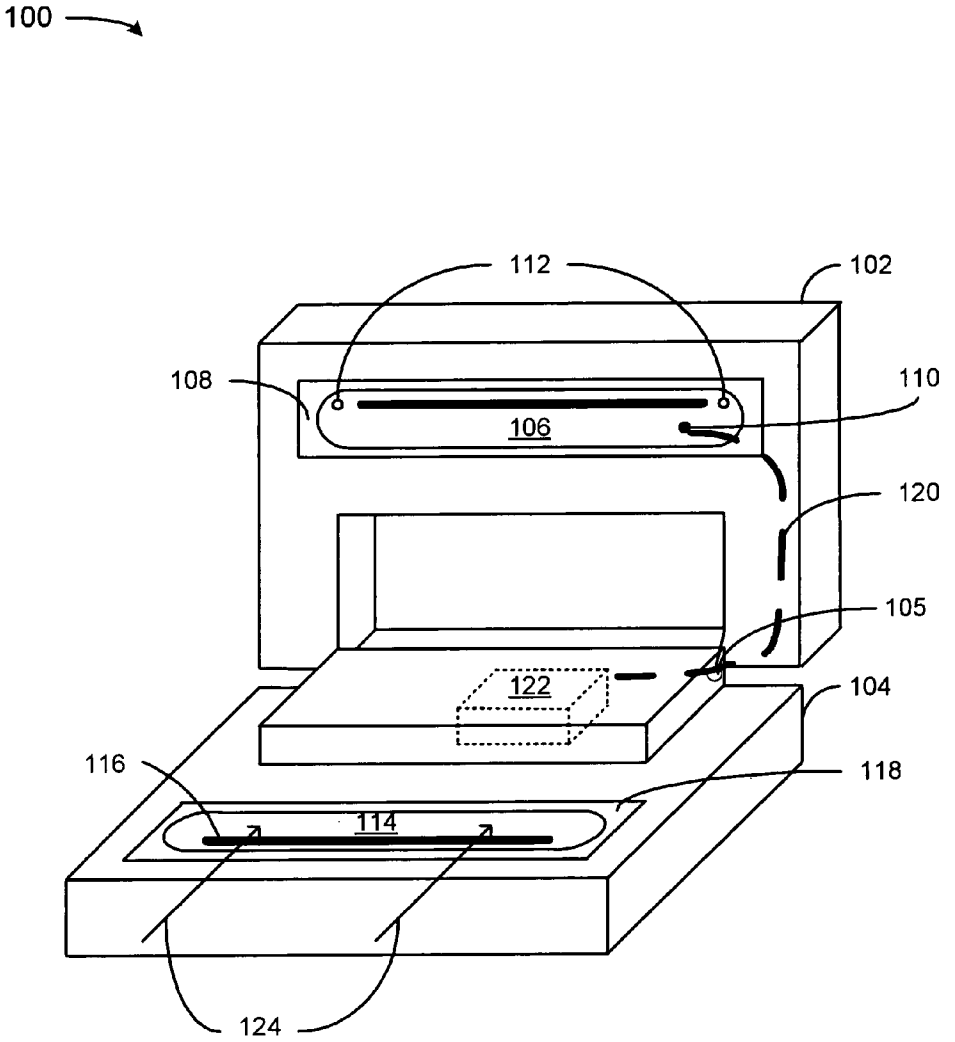
(52) **U.S. Cl.** **53/432**; 53/477; 53/510; 53/374.8

(57) **ABSTRACT**

A vacuum packaging appliance for sealing items in a plastic bag is disclosed. The appliance comprises a lid adapted to define a vacuum chamber when it is moved to a closed position relative to a trough in the base of the device. The trough in the lower portion of the device contains a heat-sealing element used to seal the contents of the bag once the vacuum packaging is complete. In another embodiment, the heat-sealing element is mounted on the lid of the device and comes into contact with the vacuum bag when the lid is in a closed position. The placement of the heat-sealing element minimizes wasted bag material as the heat seal is placed closer to the end of the bag itself



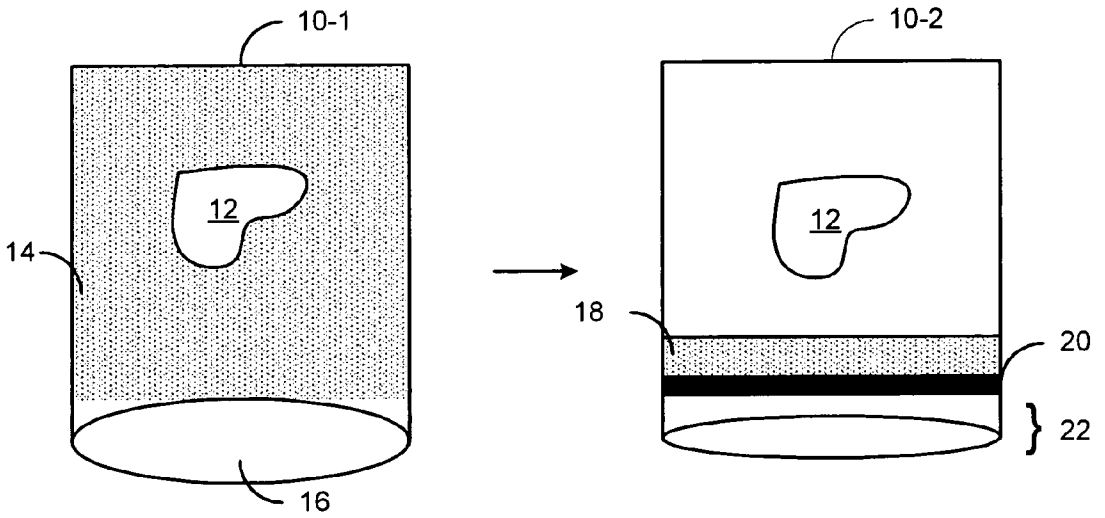


FIG. 1 (Prior Art)

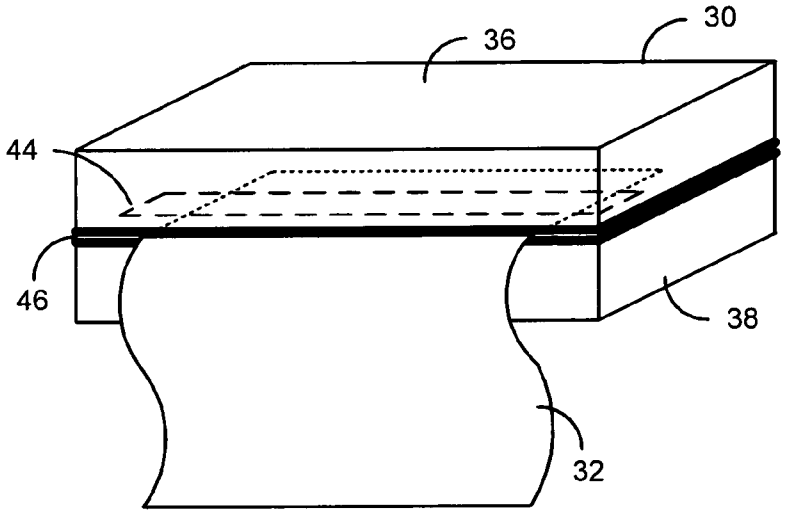


FIG. 2

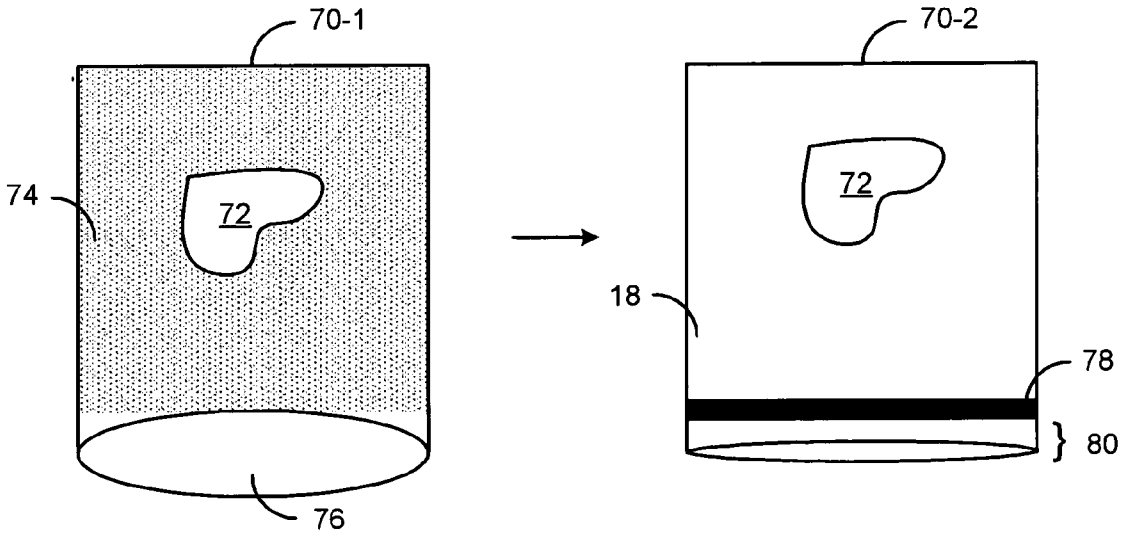


FIG. 4

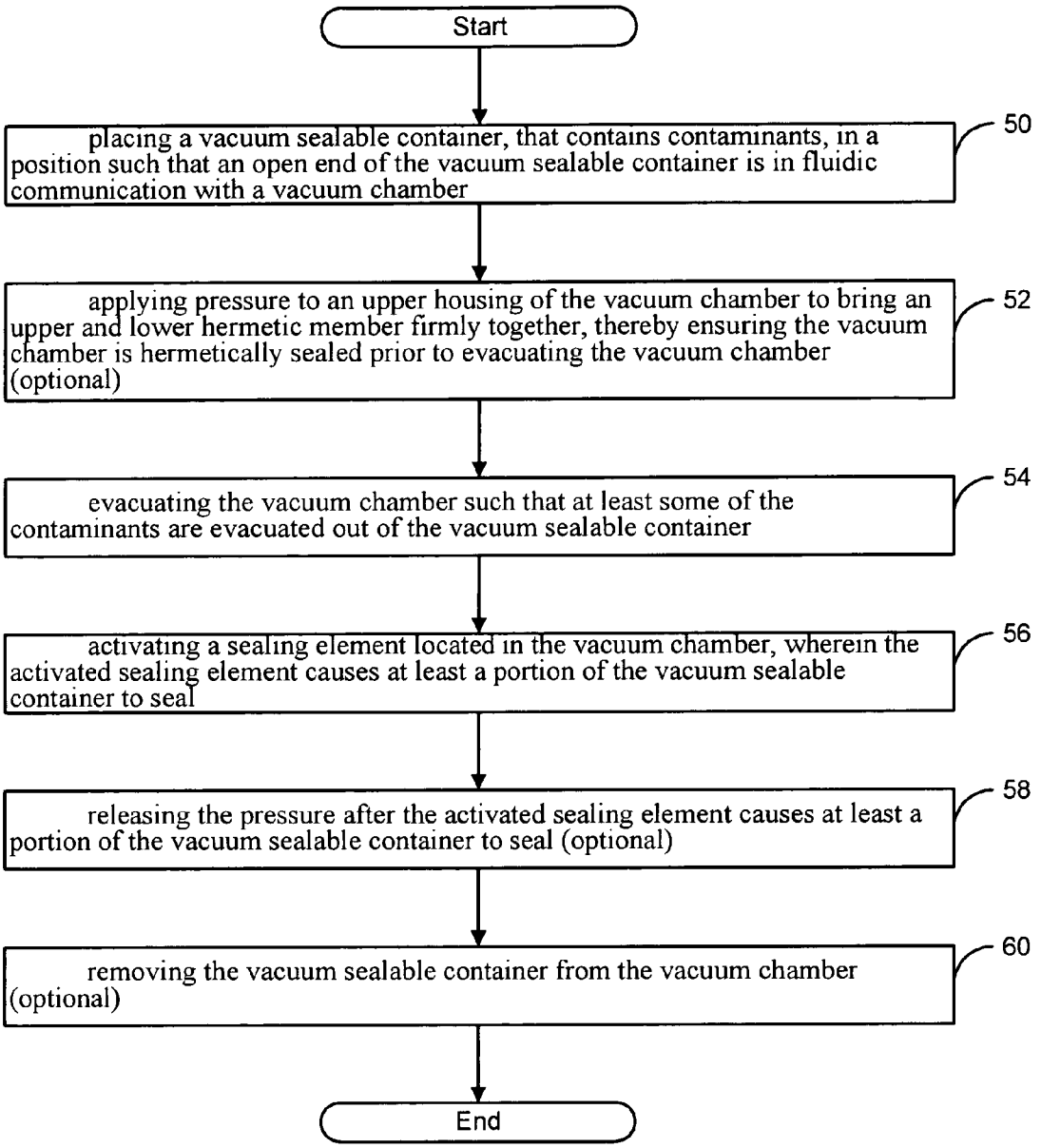

Start
placing a vacuum sealable container, that contains contaminants, in a position such that an open end of the vacuum sealable container is in fluidic communication with a vacuum chamber
50
applying pressure to an upper housing of the vacuum chamber to bring an upper and lower hermetic member firmly together, thereby ensuring the vacuum chamber is hermetically sealed prior to evacuating the vacuum chamber (optional)
52
evacuating the vacuum chamber such that at least some of the contaminants are evacuated out of the vacuum sealable container
54
activating a sealing element located in the vacuum chamber, wherein the activated sealing element causes at least a portion of the vacuum sealable container to seal
56
releasing the pressure after the activated sealing element causes at least a portion of the vacuum sealable container to seal (optional)
58
removing the vacuum sealable container from the vacuum chamber (optional)
60
End

FIG. 3

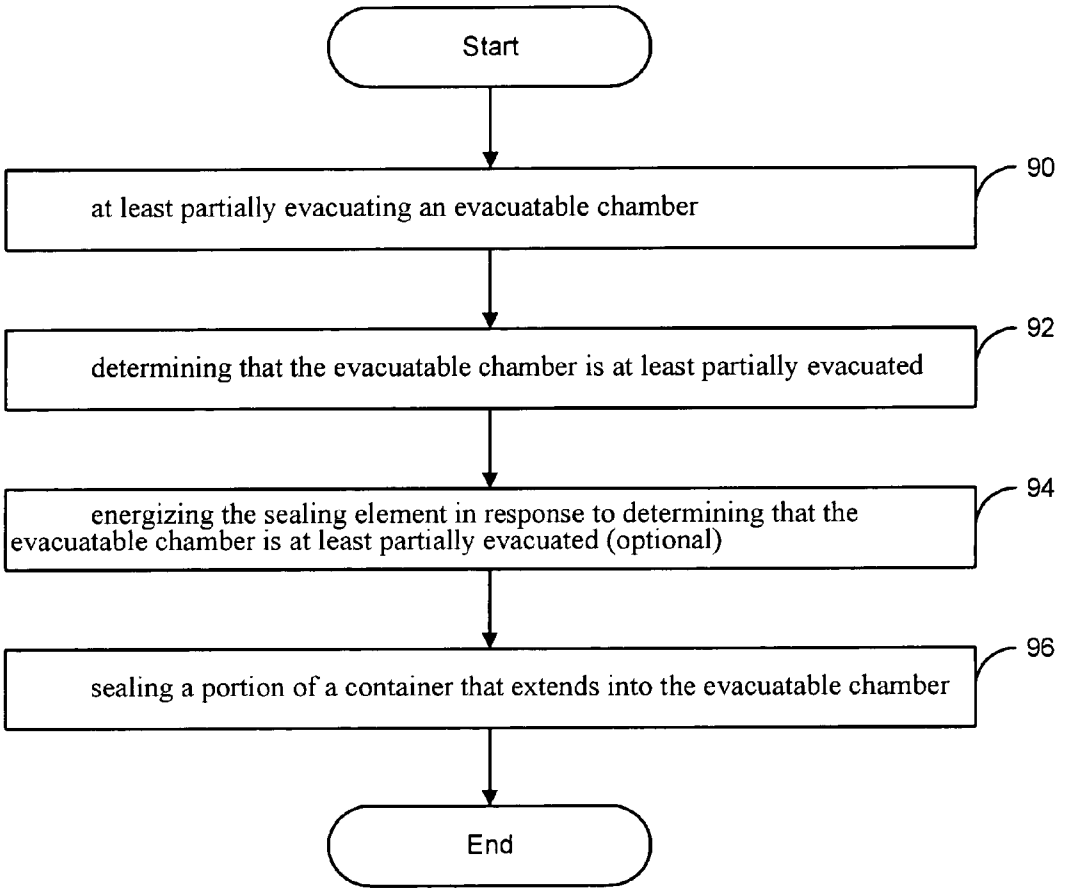

Start
at least partially evacuating an evacuatable chamber
90
determining that the evacuatable chamber is at least partially evacuated
92
energizing the sealing element in response to determining that the evacuatable chamber is at least partially evacuated (optional)
94
sealing a portion of a container that extends into the evacuatable chamber
96
End

FIG. 5

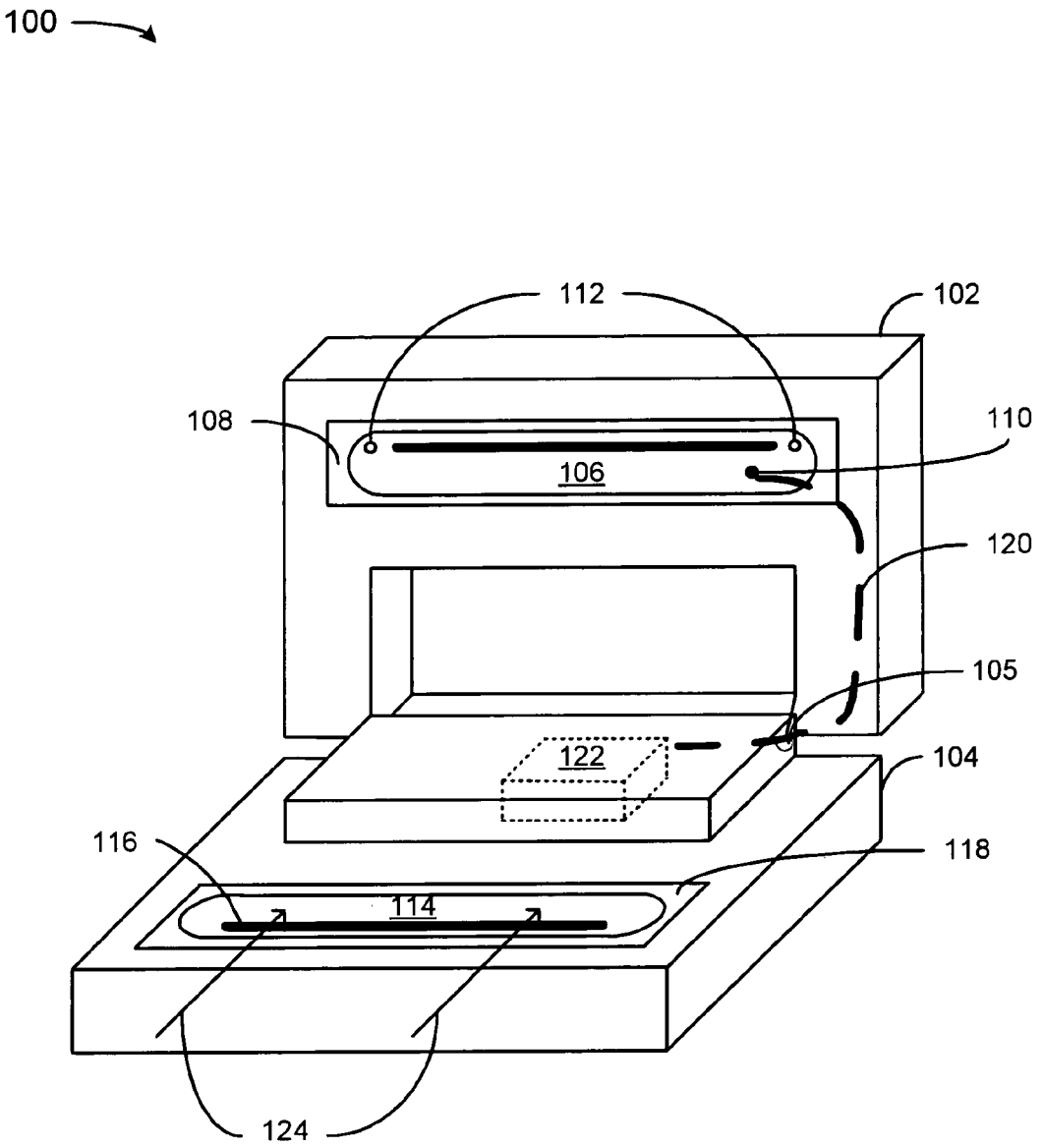


FIG. 6

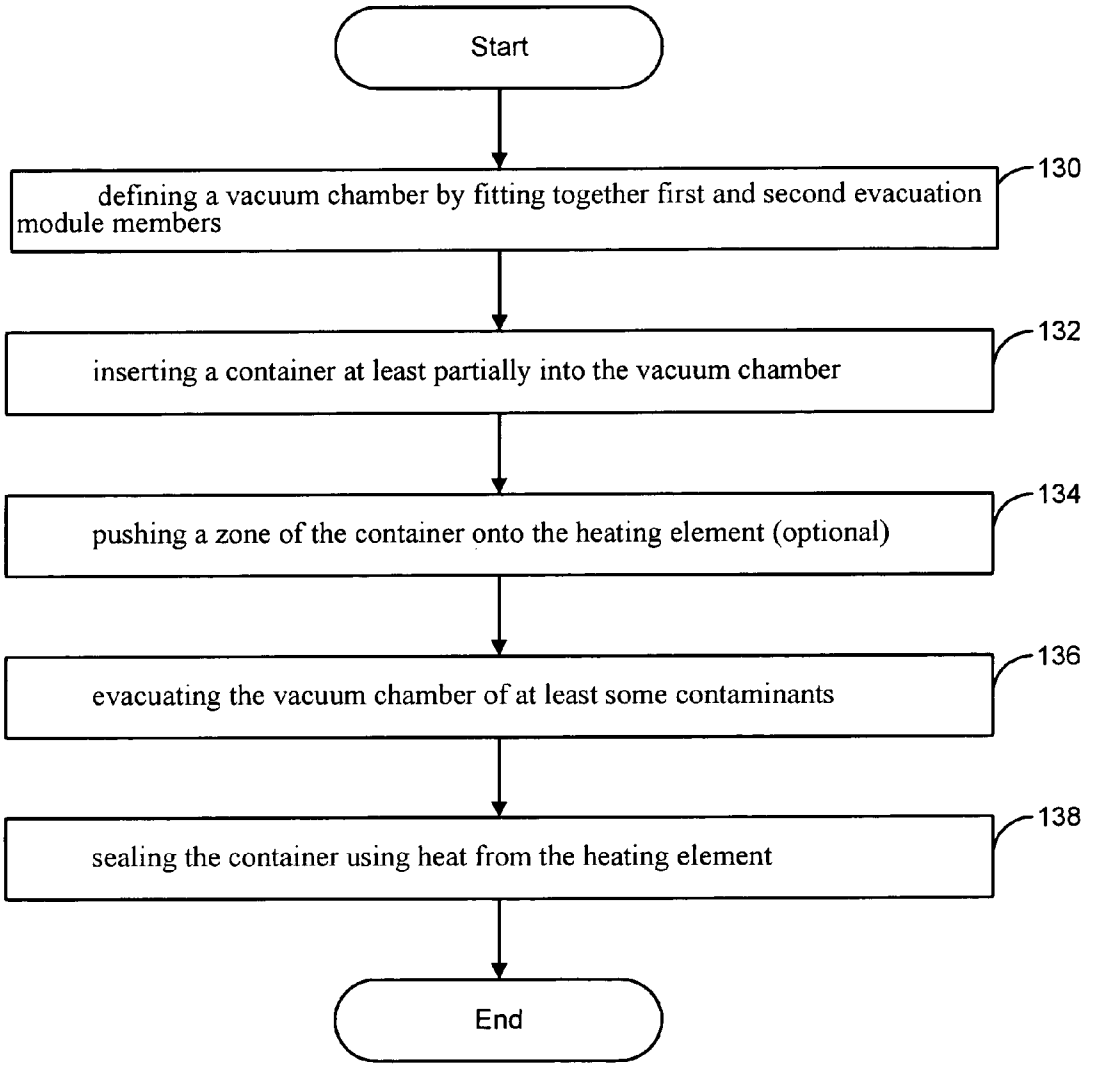

Start
defining a vacuum chamber by fitting together first and second evacuation module members
130
inserting a container at least partially into the vacuum chamber
132
pushing a zone of the container onto the heating element (optional)
134
evacuating the vacuum chamber of at least some contaminants
136
sealing the container using heat from the heating element
138
End

FIG. 7

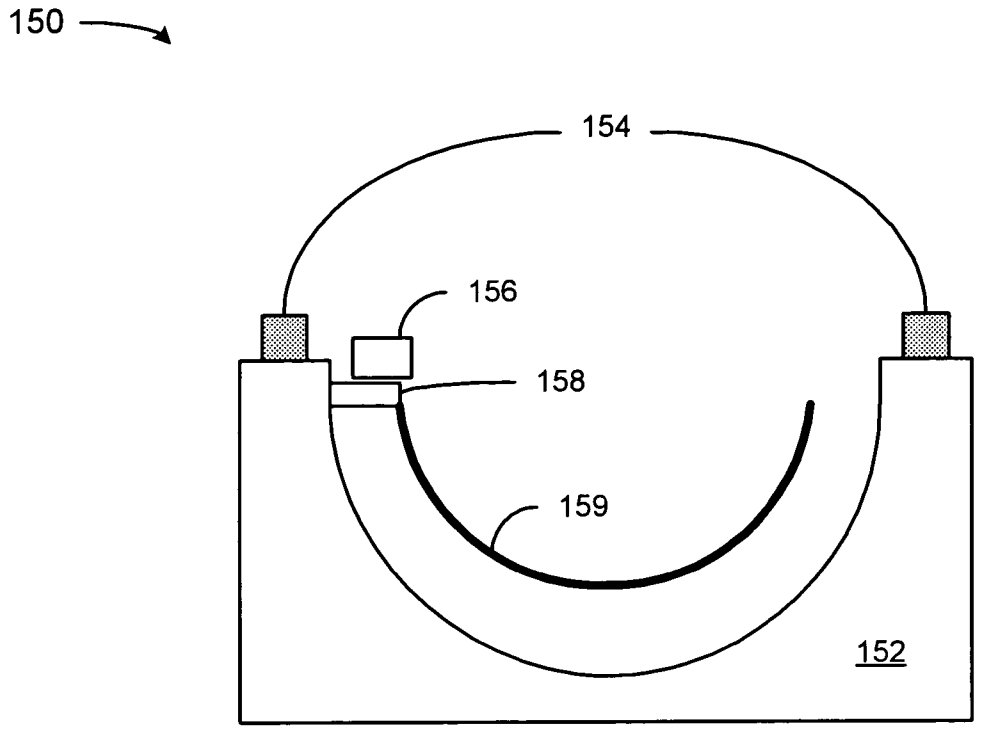


FIG. 8

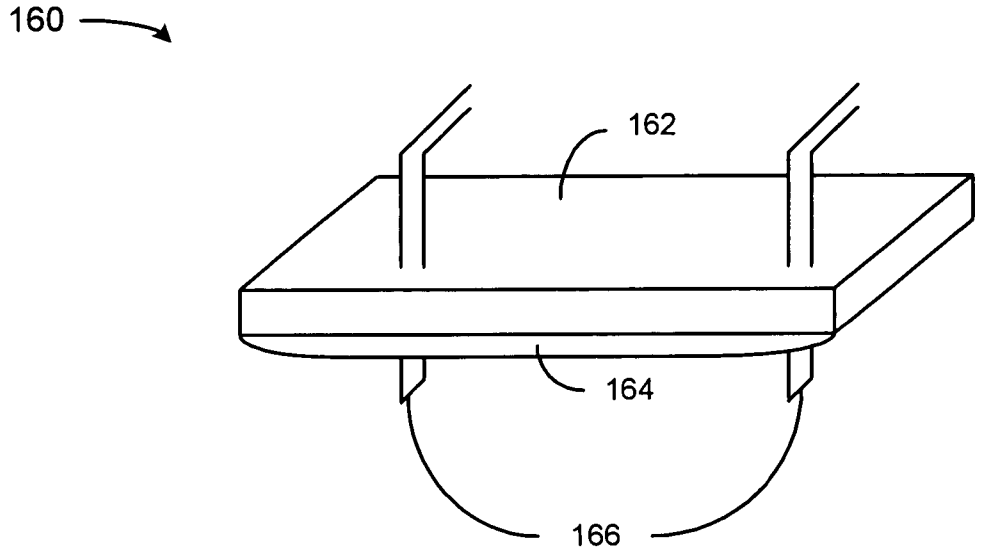


FIG. 9

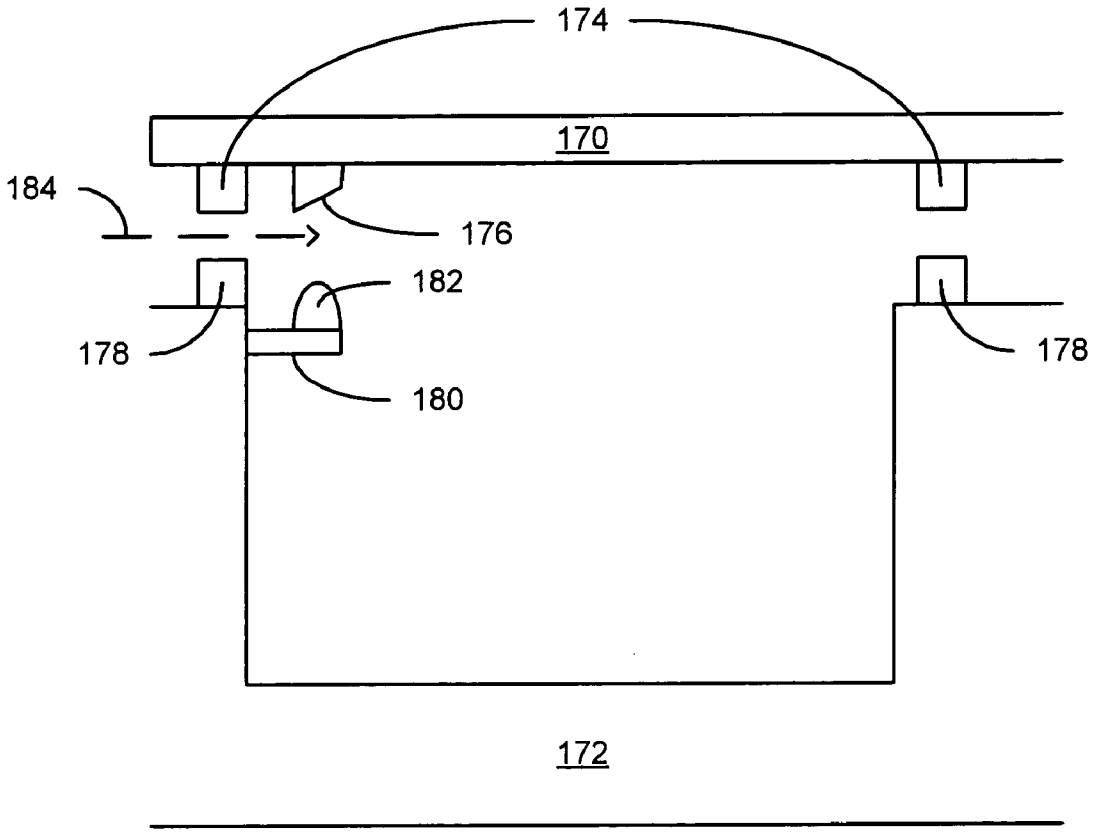


FIG. 10

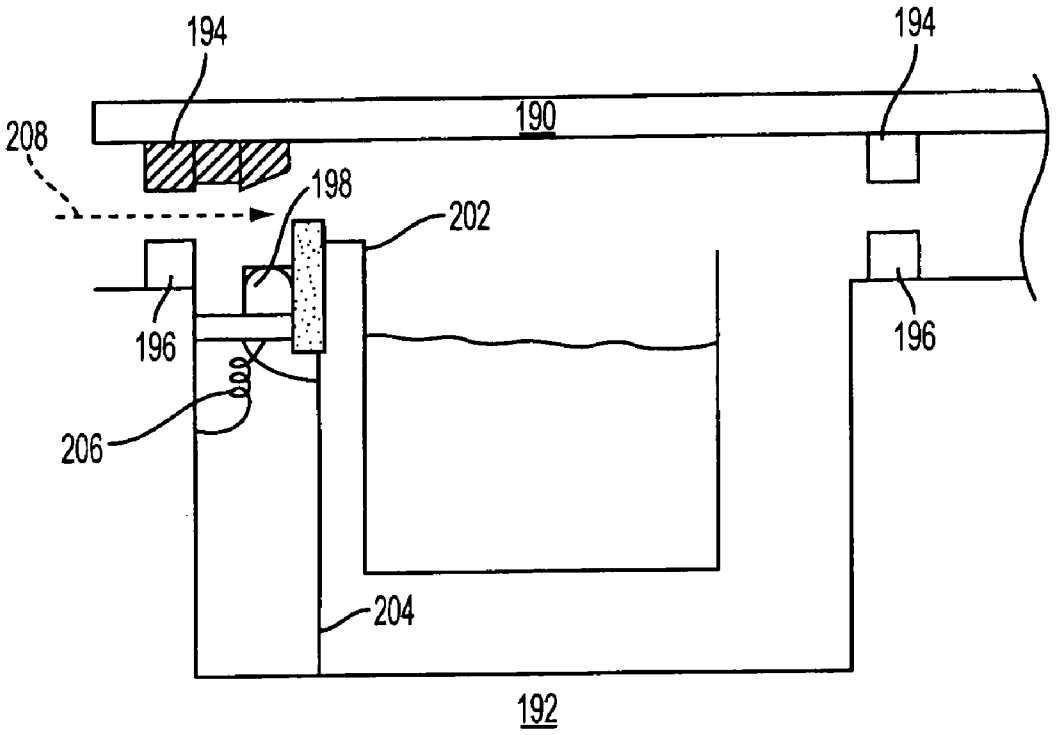


FIG. 11

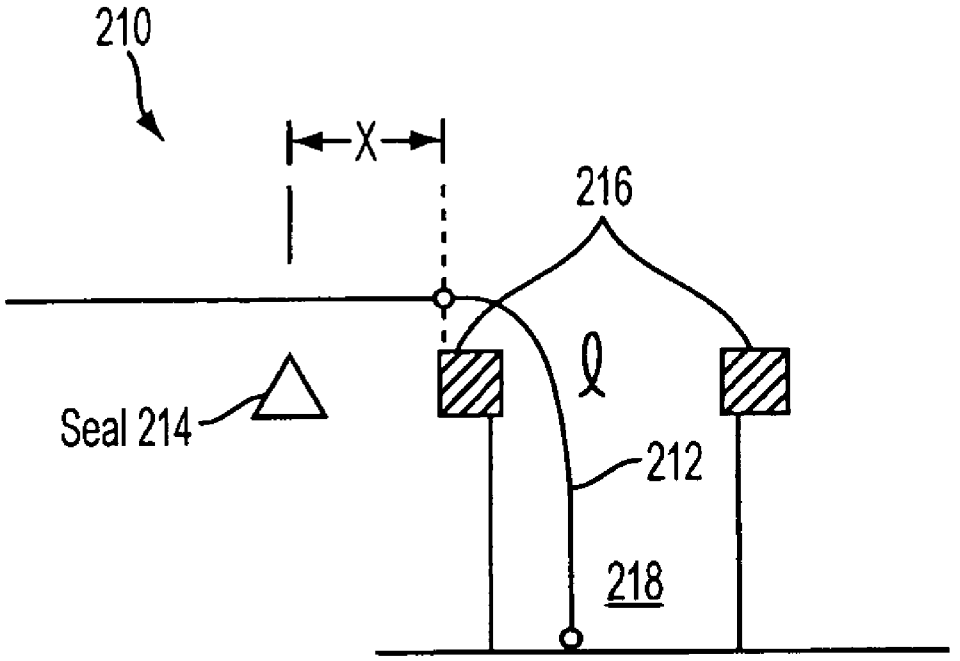


FIG. 12

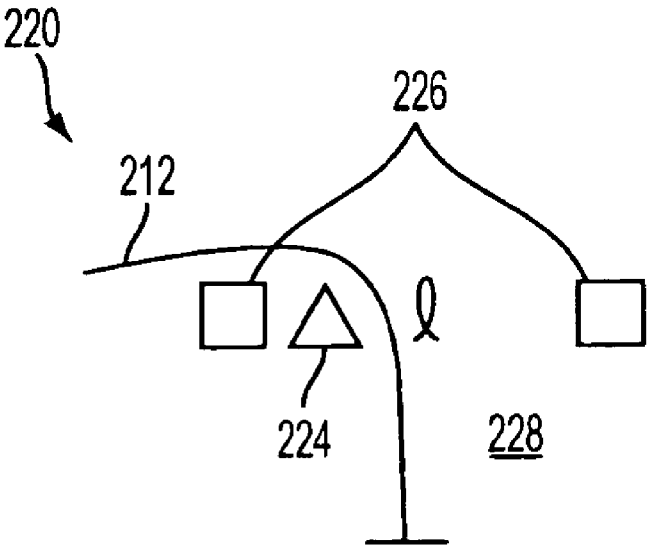


FIG. 13

VACUUM SEALING SYSTEM WITH A SEALING ELEMENT INSIDE AN EVACUATION CHAMBER

REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority under 35 U.S.C. §119(e) to U.S. Provisional Application No. 60/492,090 entitled VACUUM SEALING DEVICE WITH INTEGRATED SEALING ELEMENT(S) AND EVACUATION CHAMBER, by Landen Higer and Charles W. Albritton, and filed on Jul. 31, 2003, which is incorporated herein by reference for all purposes.

BACKGROUND

[0002] Vacuum sealing systems are used to evacuate a container of air and fluid. Vacuum sealing has advantages such as compression of items for easier handling and storage or removal of contaminants such as oxygen or other gases, fluids, or air-borne or fluid-borne particles from the vicinity of items that can be adversely effected by the contaminants. A vacuum sealing apparatus is described in Applicant's U.S. Pat. No. 4,941,310 by inventor Hanns J. Kristen dated Jul. 17, 1990, which is incorporated herein by reference. The apparatus is for vacuum sealing bags of the type disclosed in Applicant's U.S. Pat. No. 4,756,422 (referred to hereinafter as the '422 patent) by inventor Hanns J. Kristen dated Jul. 12, 1988, which is incorporated herein by reference. Container material for making vacuum sealing bags may be in the form of a roll of continuously bonded plastic as described in the '422 patent. The apparatus includes a hood adapted to define a vacuum chamber when it is moved to a closed position on a support surface. A sealing element, outside the vacuum chamber, is adapted to seal the bag. An alternative sealing element is described in Applicant's U.S. Pat. No. 6,058,998 by inventor Hanns J. Kristen dated May 9, 2000, which is incorporated herein by reference.

[0003] **FIG. 1** depicts an exemplary prior art vacuum sealing bag **10-1** before evacuation and the vacuum sealing bag **10-2** after evacuation. An item **12** and contaminants **14** are inside the bag **10-1**. Contaminants **14** may include moisture, atmospheric gases beyond a certain pressure, and other gas, liquid, or particulate impurities. The contaminants may be spread throughout the interior of the bag **10-1** and may be on the item **12**. The bag **10-1** is evacuated through the opening **16**. After evacuation, the item **12** remains inside the bag **10-2**, but a large proportion of the contaminants **14** have been evacuated. Nevertheless, some contaminants **18** may remain near the seal zone **20**. In addition, a portion **22** of the bag material may be wasted.

[0004] It would be advantageous to provide an apparatus that can reduce the contaminants that are trapped near the seal zone of a vacuum sealing bag or to reduce the amount of wasted bag material.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] **FIG. 1** depicts a prior art vacuum sealing container before and after evacuation.

[0006] **FIG. 2** depicts a conceptual isometric view of an exemplary vacuum sealing system according to an embodiment of the invention.

[0007] **FIG. 3** depicts a flowchart of an exemplary method for vacuum sealing using the system of **FIG. 2**.

[0008] **FIG. 4** depicts an exemplary vacuum sealing container before and after evacuation using the method of **FIG. 3**.

[0009] **FIG. 5** depicts a flowchart of an exemplary method for vacuum sealing according to an embodiment of the invention.

[0010] **FIG. 6** depicts an isometric view of an exemplary vacuum sealing apparatus according to an embodiment of the invention.

[0011] **FIG. 7** depicts a flowchart of an exemplary method for vacuum sealing using the apparatus of **FIG. 6**.

[0012] **FIG. 8** depicts a cross-sectional view of an exemplary trough with integrated sealing element according to an embodiment of the invention.

[0013] **FIG. 9** depicts an isometric view of an exemplary vacuum chamber lid with integrated power coupling according to an embodiment of the invention.

[0014] **FIG. 10** depicts a cross-sectional view of an exemplary vacuum chamber lid with integrated sealing element and trough according to an embodiment of the invention.

[0015] **FIG. 11** depicts a cross-sectional view of an exemplary vacuum chamber lid and trough with integrated sealing element according to an embodiment of the invention.

[0016] **FIG. 12** depicts a stylized prior art system for sealing a vacuum bag with or without evacuating the bag.

[0017] **FIG. 13** depicts a stylized system, according to an embodiment of the invention, for sealing a vacuum bag with or without evacuating the bag.

DETAILED DESCRIPTION

[0018] The descriptions below are provided for illustrative purposes only. Unless specifically stated, the following descriptions should not be limited to the specific structure or instances taught in the application. Moreover, the figures are for exemplary purposes only. The figures generally illustrate but one of many alternatives.

[0019] The following discussion, with reference to **FIGS. 2-5**, provides a conceptual overview of an embodiment of the invention. Later, after presentation of this overview, other embodiments are discussed with reference to the remaining figures.

[0020] **FIG. 2** depicts a conceptual isometric view of an exemplary vacuum sealing system according to an embodiment of the invention. The depicted system is but one of many alternatives. The system includes a vacuum sealing device **30** and a vacuum sealable container **32**. Inside the vacuum sealing device **30** is a vacuum chamber (not shown) that includes a hermetic inlet **46** configured to receive at least a portion **34** of the vacuum sealable container **32**. The vacuum chamber is configured for evacuation by a vacuum source (not shown) that is in fluidic communication with the vacuum chamber during an evacuation procedure. The evacuation procedure entails substantially evacuating the vacuum chamber. The system may include a power conduit (not shown) that is configured to provide power from a power source (not shown) to drive the vacuum source during the evacuation procedure.

[0021] The vacuum sealing device **30** includes an upper housing member **36**, a lower housing member **38**, an upper hermetic member **40**, a lower hermetic member **42**, and a sealing element **44**. The upper hermetic member **40** is connected to the upper housing member **36** and the lower hermetic member **42** is connected to the lower housing member **38**. When the upper housing member **36** abuts the lower housing member **38**, the upper hermetic member **40** and lower hermetic member **42** form a barrier, which substantially prevents air from entering the vacuum chamber of the vacuum sealing device **30**. Pressing the upper housing member **36** and lower housing member **38** together may help to form a better barrier. The inner surfaces of the housing, which includes the upper housing member **36** and the lower housing member **38**, defines the vacuum chamber therein.

[0022] The sealing element **44**, which may be a heat sealing element, is located within the vacuum chamber. The sealing element **44** is configured to secure a first part of the portion **34** of the vacuum sealable container to a second part of the vacuum sealable container when the portion **34** is proximate to the sealing element **44** at least during a time period in which the vacuum chamber is substantially evacuated during the evacuation procedure. Conceptually, the sealed parts of the vacuum sealable container are the sides of the container, which are stuck together to form a seal. The system may include a power conduit (not shown) that is configured to provide power from a power source (not shown) to drive the sealing element **44** at least during the time period in which the vacuum chamber is substantially evacuated. The sealing element **44** may complete the seal during that time period. The sealing element **44** may be energized in response to an evacuation detection mechanism determining that the vacuum chamber has been at least partially evacuated. Evacuation detection mechanisms are well-known in the art of vacuum packaging so a detailed description of such mechanisms is omitted herein.

[0023] The upper housing member **36** may serve as a lid for the vacuum sealing device **30**. The upper housing member **36** may be detachable or affixed to the lower housing **34**. If the upper housing member **36** is affixed to the lower housing **34**, it may be affixed by a hinge. Assuming the upper housing member **36** can be opened, when the upper housing member **36** is open, the vacuum sealable container may be easier to place than when the upper housing member **36** is closed. When the upper housing member **36** is closed, the upper hermetic member **40** contacts the lower hermetic member **42**, thereby forming a barrier to prevent air from entering the vacuum chamber via the hermetic inlet **46** through which the vacuum sealable container **32** extends.

[0024] **FIG. 3** depicts a flowchart of an exemplary method for vacuum sealing using a vacuum sealing system, such as the system depicted in **FIG. 2**. The depicted method is but one of many alternatives. The flowchart begins at block **50** with placing a vacuum sealable container, that contains contaminants, in a position such that an open end of the vacuum sealable container is in fluidic communication with a vacuum chamber. The flowchart continues at optional block **52** with applying pressure to an upper housing of the vacuum chamber to bring an upper and lower hermetic member firmly together, thereby ensuring the vacuum chamber is hermetically sealed prior to evacuating the vacuum chamber. The flowchart continues at block **54** with evacuating the vacuum chamber such that at least some of the contaminants are evacuated out of the vacuum sealable container. The flowchart continues at block **56** with activating a sealing element located in the vacuum chamber, wherein the activated sealing element causes at least a portion of the vacuum sealable container to seal. The flowchart continues at optional block **58** with releasing the pressure after the activated sealing element causes at least a portion of the vacuum sealable container to seal. The flowchart ends at optional block **60** with removing the vacuum sealable container from the vacuum chamber.

[0025] **FIG. 4** depicts an exemplary vacuum sealing container **70-1** before evacuation and the vacuum sealing container **70-2** after evacuation using the method just described with reference to **FIG. 3**. An item **72** and contaminants **74** are inside the container **70-1**. Contaminants **74** may include moisture, atmospheric gases beyond a certain pressure, and other gas, liquid, or particulate impurities. The contaminants **74** may be spread throughout the interior of the container **70-1** and may be on the item **72**. The container **70-1** is evacuated through the opening **76**. After evacuation, the item **72** remains inside the container **70-2**, but a large proportion of the contaminants **74** have been evacuated. There is little or no contamination near the seal zone **78** because the seal was made inside the vacuum chamber. Moreover, only a small portion **80** of the container material may be wasted because the seal was made close to the opening **76**. In fact, in an embodiment, the portion **80** may not exist (e.g., the seal zone **78** extends to the end of the container).

[0026] **FIG. 5** depicts a flowchart of an exemplary method for vacuum sealing according to an embodiment of the invention. The flowchart starts at block **90** with at least partially evacuating an evacuatable chamber. The flowchart continues at block **92** with determining that the evacuatable chamber is at least partially evacuated. The flowchart continues at optional block **94** with energizing the sealing element in response to determining that the evacuatable chamber is at least partially evacuated. The flowchart ends at block **96** with sealing a portion of a container that extends into the evacuatable chamber.

[0027] As previously mentioned, the description with reference to **FIGS. 2-5** provides a conceptual overview of the invention. However, the invention is not simply a more complex version of the embodiments described with reference to **FIGS. 2-5**. The invention is limited only by the claims.

[0028] **FIG. 6** depicts an isometric view of an exemplary vacuum sealing apparatus **100** according to an embodiment of the invention. The illustrated apparatus **100** is but one of many alternatives. For example, apparatuses suitable to be adapted for use according to an embodiment of the invention are also disclosed in U.S. Pat. No. 4,941,310 and co-pending patent application 60/450,295 filed on Feb. 27, 2003 by inventor Alexandre Baptista, which are incorporated herein by reference. Another apparatus suitable to be adapted for use according to an embodiment of the invention is a portable vacuum sealing apparatus with an evacuation chamber in a hand-held housing. Making use of the portable vacuum sealing apparatus may include clamping the hand-held housing over the opening of a vacuum sealable container, then evacuating the evacuation chamber. Another apparatus suitable to be adapted for use according to an

embodiment of the invention is a vacuum sealing apparatus with a side-opening housing. The housing may have a narrow profile that is lowered across the opening of a vacuum sealable container prior to vacuum sealing the container. Another apparatus suitable to be adapted for use according to an embodiment of the invention is a lidless vacuum sealing apparatus, such as described in the co-pending patent application bearing the attorney docket number 37469-8023-001, which is incorporated herein by reference for all purposes. The apparatuses described are for exemplary purposes only. One who is skilled in the art should be able to adapt other vacuum sealing systems for use according to an embodiment of the invention.

[0029] As depicted in **FIG. 6**, the apparatus **100** includes an upper housing **102** and a lower housing **104**, which are connected to one another by a hinge **105**. The upper housing **102** and lower housing **104** may be made of, for example, molded plastic, ceramic, metal, or some other material. The upper housing **102** and lower housing **104** may be referred to collectively as a housing. The hinge **105** may be a mechanism that serves to pivotally mount the upper housing **102** on the lower housing **104**, such that the upper housing **102** is moveable to a closed position. For example, the upper housing **102** may be pivotally mounted on the lower housing **104** by a pair of longitudinally spaced pins. The hinge **105** may also include a torsion spring mounted on each pin to normally bias the upper housing **102** in an open position. It should be noted that the upper housing **102** and lower housing **104** need not be connected by a hinge and, indeed, need not be connected at all (e.g., the upper housing could be a lid that is separable from the lower housing). Alternatively, the upper housing could be fixed in place above the lower housing.

[0030] The upper housing **102** includes a first evacuation module member **106**, a gasket **108**, an evacuation port **110**, a pressure profile **111**, and two contact points **112**. The lower housing **104** includes a second evacuation module member **114**, a heating element **116**, and a gasket **118**. Prior to carrying out an evacuation procedure to evacuate contaminants, such as air, from a container (not shown) and then seal the container, an operator, such as a human being or robotic mechanism, closes the upper housing **102** onto the lower housing **104**. When closed, the first evacuation module member **106** fits together with the second evacuation module member **114** such that a vacuum chamber is defined by the inner surfaces of the evacuation module members.

[0031] Since the first evacuation module member **106**, in the example of **FIG. 6**, fits over the second evacuation module member **114**, the first evacuation module member **106** may be referred to as a lid, a cap, or a cover. It should be noted that the first evacuation module member **106** could, in alternate embodiments, be slid over the second evacuation module member **114**, or screwed on, or fastened with a clamp or other securing device. Moreover, the first evacuation module **106** member could be fixed in place, capping the second evacuation module member **114**, or pivotally mounted on the second evacuation module member **114**. Since the second evacuation module **114**, in the example of **FIG. 6**, defines a volumetric depression, the second evacuation module **114** may be referred to as a trough, a cavity, or a trench. The volumetric depression may function to collect liquids and powder particles that are exhausted from the container to prevent their ingress into a vacuum pump. The first and second evacuation module members may be made of any gas impermeable material, including molded plastic, ceramic, metal, or some other material.

[0032] When the evacuation module members are fit together to form the vacuum chamber, the gasket **108** and the gasket **118** contact one another, forming a hermetic seal between the evacuation module members. In this way, the evacuation module members may not actually contact one another while fit together to form the vacuum chamber. The hermetic seal is a barrier that prevents gas or other contaminants from entering the vacuum chamber during an evacuation procedure. The gaskets may be formed of an elastomeric material. However, in an embodiment, the gaskets are formed of different materials and the contact surface of one or both gaskets may be rigid. For example, in an alternative, the gasket **108** is formed of an elastomeric material while the gasket **118** is formed of a rigid material. As depicted in **FIG. 6**, the gaskets **108** and **118** extend completely around the periphery of the vacuum chamber. While the gaskets **108** and **118** in the example of **FIG. 6** are approximately elliptical in shape, in other embodiments, the gaskets **108** and **118** may be rectangular, polygonal, or of some other shape. It should be noted that the hermetic seal could be formed using a single gasket or more than two gaskets.

[0033] In the example of **FIG. 6**, the evacuation port **110** is formed in the first evacuation module member **106**. An evacuation channel **120** extends from the evacuation port **110** to a vacuum module **122**. The evacuation channel **120** may be a plastic tube. In the example of **FIG. 6**, the evacuation channel **120** extends from the upper housing **102** to the lower housing **104**. The vacuum module **122** is located in the lower housing **104**. The vacuum module may include a vacuum motor (not shown) and a vacuum pump (not shown). The vacuum motor drives the vacuum pump. The vacuum pump communicates with the evacuation channel **120**, which is exposed at the evacuation port **110** to the vacuum chamber, to draw a vacuum therein. The drawing of a vacuum in the chamber may create a differential pressure on opposite sides of the first and second evacuation module members to aid in the static sealing of the vacuum chamber and the container at the hermetic seal, while simultaneously evacuating the container and vacuum chamber. Since evacuation pumps and drive mechanisms are well known in the art, further description of the vacuum module is deemed unnecessary. It should be noted that the evacuation port **110** need not be formed in the first evacuation module member **106**. For example, the evacuation port could be formed in the second evacuation module member **114**, or the evacuation port could be affixed to the end of a hose or tube that extends between the gaskets **108** and **118**. It should further be noted that the vacuum module **122** need not be located in the lower housing **104**. For example, the vacuum module **122**, or a portion thereof, could be located in the upper housing **102** or external to the housing.

[0034] In the example of **FIG. 6**, the heating element **116** is connected to an inner surface of the second evacuation module **114**. However, the placement of the heating element **116** need not be as depicted in **FIG. 6**. For example, the heating element. **116** could be affixed to an inner surface of the first evacuation module **106**. Moreover, the heating element **116** could be affixed to an inner surface by an adjustable support, a detachable support, or a flexible support, such as a spring. The heating element **116** includes at

least one electrically conductive wire or sealing element that produce heat when a voltage differential is applied across the length of the wire. The heating element may be a low voltage heating element. The heating element **116** may be covered with a material to prevent the heating element **116** from adhering to a container material when the heating element **116** is used to form a heat seal on the container. The heating element **116** could be covered for other reasons, as well, such as safety or to make cleaning easier. The covering material of the heating element **116** could be Teflon® (polytetrafluroethylene) tape or some other relatively heat-resistant material. The heating element **116** or individual wires of the heating element could be wrapped in a material or otherwise coated to protect the heating element **116** from exposure to, for example, liquid. The coating can also serve to protect the apparatus or an operator from the voltage across the heating element **116**.

[**0035**] In the example of **FIG. 6**, the contact points **112** are positioned in such a way that when the first evacuation module member **106** and the second evacuation module member **114** are fit together to form the vacuum chamber, the contact points **112** contact the heating element **116**. The contact points **112** are part of a power coupling that provides power to the heating element **116**. The contact points **112** may include exposed conductive nodes that conduct electrical current from a power source (not shown) to the heating element **116**, thereby energizing the heating element **116**. Since the contact points **112** are connected to the first evacuation module member **106**, when the evacuation module members are not fit together, the heating element does not receive current through the conductive nodes. Positioning the contact points **112** in this manner results in the equivalent of a switch that disengages the heating element **116** when the evacuation module members are not fit together. This may, for example, prevent an operator from suffering injury. In addition, the contact points **112** may be disengaged from the power source using a switch (not shown) that is open when the evacuation module members are not fit together and is closed when the evacuation module members are fit together, thereby reducing the risk of injury, such as electrical shocks, to an operator.

[**0036**] The pressure profile **111** may be a longitudinally extending elongated elastomeric member. The pressure profile **111** serves to push a zone of the container into the heating element **116** to assist in forming a seal on the container substantially along the zone. The pressure profile **111** may ensure that adequate pressure is applied on the container over the heating element **116** so that a full seal is made via heat conduction through upper and lower panels of the container to seal heat sealable layers of the container together.

[**0037**] In operation, an operator, such as a human or robotic mechanism, places a container (not shown) over the heating element **116**. The operator then closes the upper housing **102** onto the lower housing **104**. This has the effect of fitting the first evacuation module member **106** to the second evacuation module member **114** to form the vacuum chamber. The container may extend between the gaskets **108** and **118** through what may be referred to as a hermetic ingress, which is represented in **FIG. 6** by arrows **124**. The hermetic ingress is so named because the gaskets **108** and **118** form a barrier between the container and the gasket **108** and between the container and the gasket **118** that substantially block the amount of contaminants, such as air, that pass into the vacuum chamber from ambient while the container is positioned between the gaskets **108** and **118**. While so positioned, the container may be in fluidic communication with the vacuum chamber such that if the vacuum chamber is evacuated, the container is similarly evacuated.

[**0038**] As previously indicated, the power coupling engages the heating element **116** through the contacts **112** that contact the heating element **116**. In an embodiment, the power coupling engages the heating element **116** for the entire period of time during which the vacuum chamber is defined by the inner surfaces of the first and second evacuation module members. However, in an alternative, the power coupling need not engage the heating element **116** for the entire period. For example, the power coupling could be set to engage the heating element **116** only when a switch is closed, when a button is pressed, or in response to some other stimulus.

[**0039**] As previously indicated, the evacuation channel **120** is coupled to the vacuum module **122**. The vacuum module **122** evacuates the vacuum chamber of at least some contaminants through the evacuation channel **120** for at least a period of time during which the vacuum chamber is defined by the inner surfaces of the first and second evacuation module members. This evacuation procedure may begin in response to the first and second evacuation module members being fit together. Alternatively, the evacuation procedure may begin in response to pressure on the upper housing **102** that activates the vacuum module **122** or in response to some other stimulus, such as activating a button, switch, or knob that activates the vacuum module **122**. The evacuation procedure may continue until a vacuum detector (not shown), such as a pressure sensor, determines that the vacuum chamber is sufficiently evacuated. Alternatively, the evacuation procedure may continue until some other stimulus, such as the end of a predetermined or determinable period of time, occurs.

[**0040**] When the vacuum chamber has been at least partially evacuated, the heating element **116** is energized by power received through the power coupling for at least a period of time during which the vacuum chamber is defined by the inner surfaces of the evacuation module members. The heating element **116** should be energized while the vacuum chamber is defined because if the vacuum chamber integrity is compromised, such as by unfitting the evacuation module members, the integrity of the evacuated container may be adversely effected. The heating element **116** may be energized for a predetermined period of time, such as five seconds, or for a period of time that is determined according to a plurality of factors, such as the initial temperature of the heating element **116** or the presence of liquid or other substance within the vacuum chamber. Moreover, the heating element **116** could be energized at any time by an operator, if desired. For example, an operator may wish to seal a container that has not been evacuated at all.

[**0041**] **FIG. 7** depicts a flowchart of an exemplary method for vacuum sealing using the apparatus of **FIG. 6**. The flowchart starts at block **130** with defining a vacuum chamber by fitting together first and second evacuation module members. The flowchart continues at block **132** with inserting a container at least partially into the vacuum chamber. It

should be noted that, as described previously with reference to **FIG. 6**, inserting a container may involve positioning a container and then closing an upper housing. When the upper housing is closed, the vacuum chamber is defined. For this reason, the block **132** may describe an action that begins prior to the action described in block **130**, but the actions end at approximately the same time. The flowchart continues at optional block **134** with pushing a zone of the container onto the heating element. The flowchart continues at block **136** with evacuating the vacuum chamber of at least some contaminants. The flowchart continues at block **138** with energizing a heating element located within the vacuum chamber. The flowchart ends at block **140** with sealing the container using heat from the heating element. If the act described in optional block **134** was executed, the act of sealing the container (block **140**) includes sealing the container substantially along the zone.

[**0042**] The techniques described with reference to **FIGS. 6 and 7** allow for improvements over the prior art. For example, the seal on a container is closer to the opening because the sealing element is located inside the vacuum chamber. This results in the consumption of less container material each time a container is sealed, especially when a container is openend and resealed more than once. Moreover, the seal may be better because the seal is made inside the vacuum chamber instead of outside the hermetic seal. Contaminants may be more likely to be trapped just behind the hermetic seal and may be located between the upper and lower panels of the container at the seal zone, thereby reducing the quality of the seal.

[**0043**] **FIGS. 8-10** depict alternative embodiments of the invention. These figures are intended for exemplary purposes only and generally illustrate but one of many alternatives.

[**0044**] **FIG. 8** depicts a cross-sectional view of an exemplary trough with integrated sealing element **150** (referred to hereinafter as the integrated trough **150**) according to an embodiment of the invention. The integrated trough **150** includes a trough **152**, a gasket **154**, a heat sealing element **156**, a support member **158**, and a removable drip tray **159**. The trough **152** defines a volumetric depression that makes up a portion of an evacuatable chamber when a lid (not shown) is fitted over the trough **152**. The gasket **154** is used to form a hermetic seal around a perimeter of the evacuatable chamber when the lid is placed over the gasket **154**. The heat sealing element **156** is connected to the trough **152** by the support member **158**. The support member supports the heat sealing element **156** at at least one point along the length of the evacuatable chamber such that the sealing element extends along at least a portion of the trough **152**. The support member **158** may be, for example, a sequence of studs along the length of the evacuatable chamber, or an elongated baffold that extends the length of the evacuatable chamber. The heat sealing element **156** is enclosed within the evacuation chamber when the integrated trough **150** is operationally configured for use in a vacuum packaging system. The removable drip tray **159** may be suspended on a flange connected to the stud **158** or some other portion of the trough **152**.

[**0045**] In operation, a container (not shown) is placed over the gasket **154** arid across the heat sealing element **156**. When the container is evacuated in an evacuation procedure, liquid or particulate contaminants may be caught in the removable drip tray **159**. The sealing element **156** then seals the container. The removable drip tray **159** may be conveniently removed for cleaning. It should be noted that the removable drip tray **159** is one way to implement the functionality of a removable trough. The removable drip tray implementation could cost less than a removable trough with integrated heating element. Alternatively, the removable drip tray could make providing power to the heating element easier, such as by providing a power coupling by wiring through the surface of the trough into the heating element.

[**0046**] An alternative technique for providing power to the sealing element is described with reference to **FIG. 9**. **FIG. 9** depicts an isometric view of an exemplary vacuum chamber lid with integrated power coupling **160** (referred to hereinafter as the integrated lid **160**) according to an embodiment of the invention. The integrated lid **160** includes a lid **162**, a gasket **164**, and a "vampire wing" power coupling **166**. The integrated lid **160** could be used with, for example, the integrated trough **160** (**FIG. 8**). The lid **162** may fit over a trough to define an evacuatable chamber and the gasket **164** may form part of a hermetic seal around a perimeter of the evacuatable chamber. The "vampire wing" power coupling **166** is configured for coupling at or near the ends of a sealing element, such as a heating wire, such that a current flows through the sealing element. The "vampire wings" may be associated with respective positive and negative poles. Current may or may not flow through the sealing element when the "vampire wing" power coupling **166** is engaged. For example, there may be a switch that must be closed in order for the current to flow. The switch may be closed when the "vampire wing" power coupling **166** is engaged, or the switch may be closed in response to some other stimulus, such as substantial evacuation of the evacuation chamber.

[**0047**] **FIG. 10** depicts a cross-sectional view of an exemplary vacuum chamber lid with integrated sealing element and trough according to an embodiment of the invention. **FIG. 10** includes a lid **170**, a trough **172**, a gasket **174**, a heat sealing element **176**, a gasket **178**, a support member **180**, and a pressure profile **182**. The lid **170** is for covering the trough **172**. The trough **172** defines a volumetric depression and the lid **170** and trough **172** together define an evacuatable chamber that includes the volumetric depression when the lid **170** and trough **172** are operationally configured in a vacuum packaging system. Operationally configuring the lid **170** and trough **172** may include fitting the lid **170** and trough **172** together such that the gasket **174** and the gasket **178** form a hermetic inlet **184** and the heat sealing element **176**, which is connected to the lid **170**, rests on the pressure profile **182**. The pressure profile **182** is connected to the trough **172** by the support member **180**. The heat sealing element **176** may receive power through a power conduit (not shown) that extends through the lid **170**.

[**0048**] In operation, a portion of a heat sealable bag that is within the evacuatable chamber and proximate to the heating sealing element **176** is sealed by the heat sealing element **176**. For example, the heat sealable bag could be positioned between the heat sealing element **176** and the pressure profile **182** when the heat sealing element **176** is energized, thereby forming a seal on the heat sealable bag.

[**0049**] **FIG. 11** depicts a cross-sectional view of an exemplary lid **190** and trough **192** according to an embodiment of

the invention. The lid **190** includes a gasket **194**. The trough **192** includes a gasket **196**, a sealing element **198**, a support member **200**, baffolding **202**, a power conduit **204**, and a barrier wall **206**. A hermetic inlet is represented by the arrow **208**.

[**0050**] When the lid **190** is engaged with the trough **192**, the gasket **194** forms a hermetic seal with the gasket **196**. In addition, the gasket **194** acts as a pressure profile, much like the pressure profile **182** (**FIG. 10**), that presses a vacuum sealable container (not shown) onto the sealing element **198**. In the example of **FIG. 11**, the gasket **194** is larger than the respective gasket **196** and sealing element **200**. In an embodiment, the gasket **194** may have a width dimension that extends from an outer edge of the gasket **196** to the inner edge of the sealing element **200**. In another embodiment, the gasket **194** may extend up to but not over the baffolding **202**. In another embodiment, the gasket **194** may extend over the baffolding **202**. In fact, the gasket **194** could be of any practicable width so long as it performs its function as an upper part of a hermetic seal when the lid **190** and trough **192** are engaged. The baffolding **202** helps to prevent intake of fluid from the vacuum sealable container into the trough **192**. A drip tray (not shown) could also be used to catch fluids or other matter that enters the trough, either in conjunction with the baffolding **202** or in lieu of the baffolding **202**. In the example of **FIG. 11**, the sealing element **198** receives power via a power conduit **204**. The barrier wall **206** segregates the power conduit **204** from the vacuum chamber that is defined by inner walls of the lid **190** and trough **192** when the lid and trough are engaged. The barrier wall **204** is not necessary if power is supplied to the sealing element in some other manner, such as those described with reference to **FIGS. 8-10**, above. Alternatively, a power conduit may extend through the support member **200** without becoming exposed as depicted in **FIG. 11**.

[**0051**] **FIG. 12** depicts a stylized prior art system **210** for sealing a vacuum bag **212** with or without evacuating the bag. The system **210** includes a bag sealer **214**, an air barrier **216**, and part of a vacuum chamber **218**. In this system, the bag is normally sealed at a distance x+1 from the end of the bag that opens into the vacuum chamber **218**. When the trough is evacuated, the bag sealer **214** may seal the bag automatically. For example, the bag sealer **214** may be energized when a vacuum exists in the vacuum chamber **218**. Notably, if the bag opening extends past the bag sealer **214**, but not past the air barrier **216**, then when the vacuum chamber **218** is evacuated, the bag can be sealed automatically, as well. This technique consumes less than a length x of bag material, but does not allow for a vacuum seal. The technique is particularly useful when a partial bag, with two open ends, is to be sealed at one of the open ends, filled with materials that are to be vacuum packaged, and vacuum sealed. Since the partial bag need not extend past the air barrier **216**, the vacuum chamber **218** may be evacuated normally and the partial bag automatically sealed when the vacuum chamber **218** has a requisite pressure.

[**0052**] **FIG. 13** depicts a stylized system **220**, according to an embodiment of the invention, for sealing a vacuum bag **222** with or without evacuating the bag. The system **220** includes a bag sealer **224**, an air barrier **226**, and a part of a vacuum chamber **228**. In this system, if the bag **222** extends past the bag sealer **224**, the bag invariably extends past the air barrier **226** into the vacuum chamber **228** because the bag sealer **224** is located inside the vacuum chamber **228**. This may be an issue when, for example, a partial bag is cut from a roll of material and has two open ends. If one end of a partial bag is inserted into the vacuum chamber **228**, the vacuum chamber **228** may not be able to evacuate, since air is drawn through one end of the partial bag into the vacuum chamber **228**. According to the usual technique, only a bag (not a partial bag) can be sealed in this manner, since the bag can be evacuated simultaneously with the vacuum chamber **228**, thereby allowing the vacuum chamber **228** to be evacuated. To make the first seal on a partial bag, a technique that avoids evacuating the vacuum chamber **228** or enables evacuation of the vacuum chamber **228** even though a partial bag is inserted into the vacuum chamber **228**. Such techniques may include, but are not limited to, applying sufficient pressure to the air barrier **226** that substantially less air passes from the partial bag into the vacuum chamber **228** than usual, enclosing the partial bag in a bladder that is evacuated simultaneously with the vacuum chamber **228**, providing a latch that can close over a portion of the partial bag such that a significant air barrier is formed at the location of the latch due to pressure on the sides of the bag, or providing a seal-only mode of operation wherein the system does not attempt to evacuate the vacuum chamber **228** prior to energizing the bag sealer **224**.

[**0053**] Although it is presented here that the present invention is designed primarily for use in food preservation, it is contemplated that the improved vacuum sealing would allow for use in other types of preservation systems. For example, the use of toxic dessicants for the shipment of electronic components could be eliminated. The invention could be applied to medical as well as pharmaceutical use. The scope of the invention is not to be restricted by the above descriptions which are provided for illustrative and enablement purposes, but rather should be defined by the claims listed below.

I claim:

1. A vacuum sealing system, comprising:

a housing, including a hermetic inlet configured to receive at least a portion of a vacuum sealable container, wherein inner surfaces of said housing define a vacuum chamber therein;

a vacuum source, in fluidic communication with said vacuum chamber, configured to substantially evacuate said vacuum chamber during an evacuation procedure; and

a sealing element, located within the inner surfaces of said housing, configured to secure a first part of said portion of said vacuum sealable container to a second part of said portion of said vacuum sealable container when said portion of said vacuum sealable container is proximate to said sealing element at least during a time period in which said vacuum chamber is substantially evacuated during said evacuation procedure.

2. The system of claim 1, wherein said hermetic inlet is between an upper hermetic member and a lower hermetic member, wherein said housing further includes:

an upper housing member, including an upper hermetic member, that is configured to be opened to facilitate placement of said vacuum sealable container; and

a lower housing member, wherein during said evacuation procedure said upper housing member is closed such that said upper hermetic member contacts said lower hermetic member, thereby forming a barrier to substantially prevent air from entering said vacuum chamber via said hermetic inlet.

3. The system of claim 1, wherein said sealing element includes a heat sealing element.

4. The system of claim 1, further comprising a power conduit configured to provide power from a power source to drive said sealing element at least during said time period.

5. A system for vacuum sealing a container, comprising:

an evacuation means for evacuating a vacuum chamber during an evacuation procedure;

a hermetic inlet means for facilitating insertion of at least a portion of a vacuum sealable container into said vacuum chamber;

a sealing means, located within said vacuum chamber, for securing a first part of said portion of said vacuum sealable container to a second part of said portion of said vacuum sealable container during said evacuation procedure;

6. The system of claim 5, wherein said sealing means includes a heat sealing means.

7. The system of claim 5, further comprising a power conduit means for providing power to drive said sealing element.

8. A method for vacuum sealing a container, including the acts of:

placing a vacuum sealable container, that contains contaminants, in a position such that an open end of said vacuum sealable container is in fluidic communication with a vacuum chamber;

evacuating said vacuum chamber such that at least some of said contaminants are evacuated out of said vacuum sealable container; and

activating a sealing element located in said vacuum chamber, wherein the activated sealing element causes at least a portion of said vacuum sealable container to seal.

9. The method of claim 8, further comprising:

applying pressure to an upper housing of said vacuum chamber to bring an upper and lower hermetic member firmly together, thereby ensuring said vacuum chamber is hermetically sealed prior to evacuating said vacuum chamber;

releasing said pressure after the activated sealing element causes at least a portion of said vacuum sealable container to seal; and

removing said vacuum sealable container from said vacuum chamber.

10. A vacuum sealing device, comprising:

a housing, wherein inner surfaces of said housing define an evacuatable chamber therein when said housing is operationally configured;

an evacuation detection mechanism for determining whether said evacuatable chamber is at least partially evacuated; and

a sealing element, coupled to said housing, inside the evacuatable chamber, positioned such that said sealing element seals a container that is at least partially inserted into said evacuatable chamber when said vacuum detection mechanism determines that said evacuatable chamber is at least partially evacuated.

11. The device of claim 10, further comprising:

a power conduit for providing power to said sealing element at least when said vacuum detection mechanism determines that said evacuatable chamber is at least partially evacuated.

12. A method for vacuum sealing a container, comprising:

at least partially evacuating an evacuatable chamber;

determining that the evacuatable chamber is at least partially evacuated; and

sealing a portion of a container that extends into the evacuatable chamber.

13. The method of claim 12, further comprising:

energizing the sealing element in response to determining that the evacuatable chamber is at least partially evacuated.

14. A vacuum sealing apparatus for sealing a container using a heating element located within a vacuum chamber, said vacuum sealing apparatus comprising:

a first evacuation module member;

a second evacuation module member, wherein said first evacuation module member and said second evacuation module member are configured to fit together such that a vacuum chamber is defined by inner surfaces of said first evacuation module member and said second evacuation module member;

a heating element connected to at least one of said inner surfaces;

a power coupling that engages said heating element for at least a first period of time during which said vacuum chamber is defined by said inner surfaces; and

an evacuation channel that extends from said vacuum chamber when said vacuum chamber is defined by said inner surfaces;

a vacuum module, coupled to said evacuation channel, that evacuates said vacuum chamber of at least some contaminants through said evacuation channel for at least a second period of time during which said vacuum chamber is defined by said inner surfaces,

wherein said heating element is energized by power received through said power coupling for at least a third period of time during which said vacuum chamber is defined by said inner surfaces.

15. The apparatus of claim 14, wherein said first evacuation module member has an evacuation port formed therein, wherein said evacuation channel is connected to said first evacuation module member at said evacuation port, and wherein said contaminants are evacuated from said vacuum chamber through said evacuation port.

16. The apparatus of claim 14, wherein said second evacuation module member includes a trough.

17. The apparatus of claim 16, wherein said first evacuation module member is a lid that covers said trough while said inner surfaces define said vacuum chamber.

18. The apparatus of claim 14, wherein said power coupling includes two contact points connected to said first evacuation module member, and wherein said contact points contact said heating element when said first evacuation module member and said second evacuation module member fit together to define said vacuum chamber.

19. The apparatus of claim 14, further comprising:

a first gasket connected to said first evacuation module member;

a second gasket connected to said second evacuation module member, wherein said first gasket and said second gasket are positioned between said first evacuation module member and said second evacuation module member when said first evacuation module member and said second evacuation module member fit together to define said vacuum chamber, wherein said first gasket and said second gasket together form a hermetic barrier into said vacuum chamber, and wherein a container is insertable between said first and second gasket without substantially degrading the hermetic barrier, such that said container extends at least partially into said vacuum chamber.

20. The apparatus of claim 19, wherein said first gasket includes a pressure profile to push a zone of said container into said heating element to assist in forming a seal on said container substantially along said zone when said container is at least partially inserted into said vacuum chamber.

21. The apparatus of claim 14, further comprising a pressure profile to push a zone of a container, that is at least partially inserted into said vacuum chamber, into said heating element to assist in forming a seal on said container substantially along said zone.

22. The apparatus of claim 14, further comprising a barrier wall configured to segregate said power conduit from said vacuum chamber.

23. A method for sealing a container using a heating element located within a vacuum chamber, said method comprising the acts of:

defining a vacuum chamber by fitting together first and second evacuation module members;

inserting a container at least partially into the vacuum chamber;

evacuating the vacuum chamber of at least some contaminants;

energizing a heating element located within the vacuum chamber; and

sealing the container using heat from the heating element.

24. The method of claim 23, further comprising pushing a zone of the container onto the heating element, wherein the act of sealing the container includes sealing the container substantially along the zone.

25. A trough module for use with a vacuum packaging system, said trough module comprising:

a trough that defines a volumetric depression that, when said trough is operationally configured for use in a vacuum packaging system, makes up part of an evacuation chamber; and

a heat sealing element connected to said trough, said heat sealing element extending along at least a portion of said trough, wherein, when said trough is operationally configured for use in said vacuum packaging system, said heat sealing element is enclosed within said evacuation chamber.

26. The trough module of claim 25, further comprising a removable drip tray suspended within said trough, wherein, when said trough is operationally configured in a vacuum packaging system, said drip tray is positioned beneath at least a portion of a heat sealable bag that extends into said evacuation chamber.

27. The trough module of claim 25, further comprising a power conduit connecting a power source to said heat sealing element.

28. The trough module of claim 27, further comprising a barrier wall that makes up part of said evacuation chamber, wherein said barrier wall segregates said power conduit from said evacuation chamber.

29. The trough module of claim 25 further comprising baffolding to prevent liquid intake into said evacuation chamber from a heat sealable bag that extends into said evacuation chamber.

30. A vacuum chamber lid with integrated power coupling for use with a vacuum packaging system, comprising:

a lid for covering a trough that defines a volumetric depression, wherein said trough includes an integrated sealing element, and wherein said lid and trough together define an evacuatable chamber that includes said volumetric depression; and

a power coupling connected to said lid, wherein said power coupling contacts said integrated sealing element, thereby facilitating powering said integrated sealing element.

31. The vacuum chamber lid with integrated power coupling of claim 30, wherein said power coupling has a vampire wing configuration.

32. A vacuum chamber lid with integrated heat sealing element for use with a vacuum packaging system, said vacuum chamber lid comprising:

a lid for covering a trough that defines a volumetric depression, wherein said lid and trough together define an evacuatable chamber that includes said volumetric depression when said lid and trough are operationally configured in a vacuum packaging system; and

a heat sealing element connected to said lid; wherein, when said lid and trough are operationally configured in a vacuum packaging system, a portion of a heat sealable bag that is within said evacuatable chamber and proximate to said heating sealing element is sealed by said heat sealing element.

33. The vacuum chamber lid of claim 32 wherein said heat sealing element is configured to rest against a pressure profile connected to said trough.

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