A storage container for storing and preserving food items includes a base providing a storage cavity and an attachable lid. To evacuate air from the storage cavity after the base and lid have been attached, the storage container may include a one-way valve element communicating with the storage cavity. The overall storage container can be sufficiently rigid so that it has an initial size and volume when in its un-evacuated condition. During evacuation, the air pressure within the storage cavity is reduced compared to the air pressure of the surrounding environment. This pressure differential can result in a compressive force being applied about the container. At least one of the base or lid can be made relatively flexible so that, when evacuated, the volume of the storage container is reduced.
VACUUM STORAGE CONTAINER

BACKGROUND

[0001] A variety of different containers are available for storing and preserving food items for later consumption. Such containers may be flexible, as in the case of plastic storage bags, or may be rigid, as in the case of plastic storage containers. An advantage of rigid storage containers is that they can maintain their shape and thereby protect the stored food items from being crushed. Another advantage is that rigid containers are usually easily washable and therefore can be reusable. Also, it is desirable that rigid containers be temperature and microwave resistant to allow for heating, cooling and freezing of the stored food items within the container.

[0002] To accomplish these advantages, rigid containers are often made as a relatively thick-walled structure of a stiff material such as glass or polycarbonate plastic. Such materials, in addition to being relatively heavy, are also costly. It is also desirable to reduce the quantity of air that may become trapped within the container during storage.

BRIEF SUMMARY

[0003] A storage container for storing food items may include a base delineating a storage cavity and a detachable lid connectable to the base to seal the contents. To remove air trapped in the storage cavity after the base and lid have been attached, the storage container can include a one-way valve element that allows air to be evacuated. The one-way valve element is normally closed to seal the cavity with respect to the environment and thereby maintain the evacuated condition of the storage device.

[0004] At least one of the base and/or lid may be made of a flexible or semi-flexible material. For example, in one aspect, the lid can be made comparatively flexible with respect to a more rigid base. Under vacuum conditions, when the air pressure within the storage cavity is reduced with respect to the pressure of the environment surrounding the storage container, the flexible container can collapse or move into the storage cavity. Hence, the storage cavity can have an initial un-evacuated condition with a given initial volume and a subsequent evacuated condition which is less than the initial volume. Additionally, when in the evacuated condition, the storage container can have a reduced head space and smaller overall volume. In other embodiments, the base can be comparatively flexible with respect to the lid or both the lid and the base may demonstrate degrees of flexibility.

[0005] An advantage of the storage container is that it facilitates improving the freshness of food items by retaining those food items in an evacuated state. Another advantage is that, when evacuated, the container has a reduced size and head space for improved storage of the evacuated container. Additionally, the reduced size and/or head space can provide a visual indication to a user about the presence and prolonged maintenance of the evacuated condition of the container.

These and other advantages and features of the storage container will be apparent from the following drawings and detailed description of the embodiments.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0006] FIG. 1 is a perspective view of a vacuum storage container including a base and a comparatively flexible lid with a one-way valve element, all in relation to a handheld evacuation device.

[0007] FIG. 2 is a cross-sectional view taken along lines A-A illustrating the base and lid attached together and in a first un-evacuated condition with the lid covering the opening to the storage cavity.

[0008] FIG. 3 is a cross-sectional view taken along lines A-A illustrating the base and lid attached together and in an intermediate, partially evacuated condition with the lid partially depending into the storage cavity.

[0009] FIG. 4 is a cross-sectional view taken along lines A-A illustrating the base and lid attached together in a second evacuated condition with the lid depending into the storage cavity.

[0010] FIG. 5 is an exploded perspective view of another embodiment of a vacuum storage container including a base and a comparatively flexible lid, wherein the lid includes an elastic portion and a comparatively rigid periphery.

[0011] FIG. 6 is a perspective view of the base and lid of FIG. 5 attached together and in a first un-evacuated condition with the lid covering the opening to the storage cavity.

[0012] FIG. 7 is a perspective view of the base and lid of FIGS. 5 and 6 attached together and in a second evacuated condition with the lid depending into the storage cavity.

[0013] FIG. 8 is an exploded perspective view of another embodiment of a vacuum storage container including a base and a comparatively flexible lid, wherein the lid is made of a highly elastic material.

[0014] FIG. 9 is a perspective view of the base and lid of FIG. 8 attached together and in a second evacuated condition with the lid depending into the storage cavity.

[0015] FIG. 10 is a perspective view of another embodiment of a vacuum storage container including a base and a lid in the form of a flexible sheet or wrap.

[0016] FIG. 11 is a detailed view taken along circle B-B of FIG. 10 illustrating in detail the surface features of the sheet.

[0017] FIG. 12 is a perspective view of the base and the sheet of FIG. 10 attached together and in an evacuated condition with the flexible sheet wrapped to the base and depending into the storage cavity.

[0018] FIG. 13 is an exploded perspective view of another embodiment of a vacuum storage container including a comparatively flexible base and a lid, the base having a rim and a collapsible sidewall depending therefrom.

[0019] FIG. 14 is a side elevational view of the base and lid of FIG. 13 illustrating the sidewall fully depending from the rim.

[0020] FIG. 15 is a side elevational view of the base and lid of FIG. 13 illustrating the sidewall partially collapsed toward the rim.

[0021] FIG. 16 is a side elevational view of the base and lid of FIG. 13 illustrating the sidewall fully collapsed with respect to the rim.

[0022] FIG. 17 is a perspective view of a storage container and another embodiment of a diaphragm type one-way valve element for attachment to and use with storage containers.

[0023] FIG. 18 is a cross-sectional view taken along line C-C of FIG. 17 showing the diaphragm type one-way valve element in a normal closed state whereby the valve seals the apertures communicating with a storage cavity.

[0024] FIG. 19 is a cross-sectional view taken along line C-C of FIG. 17 showing the diaphragm type one-way valve element in an opened state whereby the valve unseals the apertures.
FIG. 20 is a front perspective view of another embodiment of a rigid one-way valve element for use with the storage containers of the foregoing type.

FIG. 21 is a rear perspective view of the one-way valve element of FIG. 20.

FIG. 22 is a cross-sectional view taken along line D-D of FIG. 20 through the one-way valve element.

FIG. 23 is an exploded perspective view of a storage container and a flexible multi-ply one-way valve element for use with storage containers.

FIG. 24 is an exploded perspective view of a storage container and a flexible single ply one-way valve element for use with storage containers.

DETAILED DESCRIPTION OF THE EMBODIMENTS

FIG. 1 illustrates a vacuum storage container 100 that includes a base 102 and a detachable lid 104. To receive items for storage, the base 102 is shaped to delineate a storage cavity 106. In the illustrated embodiment, the base 102 may have a bowl-like shape and may include a generally flat, circular bottom wall 110 and a cylindrical, upward extending sidewall 112 joined to the bottom wall. The bottom wall 110 and the sidewall 112 can generally define a central axis line 114. In some embodiments, to facilitate nested stacking of multiple bases together, the sidewall can inversely taper or angle radially outwards from the axis line 114. The upper edge of the sidewall 112 provides a rim 116 that outlines an opening 118 through which the storage cavity 106 can be accessed. In other embodiments, the storage container can have different shapes including a different number and orientation of the bottom and sidewalls. For example, the storage container can be rectangular and the base can include four orthogonal sidewalls, such as the container shown in FIG. 17. The containers can also be provided in different sizes.

The base 102 can be made from any suitable, rigid material including, for example, tempered glass, polypropylene, polyethylene, polycarbonate, polystyrene, or polystyrene. Such materials may be sufficiently firm so as to maintain the set shape of the base under a variety of conditions. Hence, the base is generally free-standing and can be used for both storing and serving food items. Additionally, to facilitate food preparation and storage, the material of the base may be selected to enable washing, heating and freezing of the storage container. The base material may be transparent, translucent, or opaque.

To completely enclose the storage cavity 106, the lid 104 can be formed as another circular structure including having a peripheral edge 120 that corresponds to the rim 116. The lid 104 has a shape so that it may extend over and across the opening 118 to cover the storage cavity 106. In this embodiment, the lid 104 may have an overall planar shape. In other embodiments, the lid 104 can have other shapes and sizes depending upon the shape and arrangement of the base 102.

To securely attach the base 102 and the lid 104 together and facilitate an air tight seal between them, the upper rim 116 of the base can be configured as a projecting tongue. Specifically, the rim 116 can be formed by folding or bending the cylindrical sidewall 112 radially outward and downward so that the rim is generally shaped as an arch extending annularly around the axis line 114. Disposed into the lid 104 about the periphery 120 is a corresponding substantially U-shaped groove 122. In the illustrated embodiment, the groove 122 is provided by forming into the material of the lid 104 an upward arch 124 extending about the periphery 120 and in which the groove is located. Referring to FIG. 2, the U-shaped groove 122 can receive the correspondingly shaped rim 116 when the lid 104 and base 102 are attached. The groove 122 can have the same as or slightly smaller dimensions than the rim 116 so that the groove positively compresses or urges against and about the rim thereby retaining the lid and base together.

Referring back to FIG. 1, the container can include a one-way valve element 140 that communicates with the storage cavity 106. In the illustrated embodiment, the valve element 140 is attached at an outwardly exposed location which may correspond to the center point of the circular lid 104 but in other embodiments, could be located at other suitable locations on the storage container 100. The valve element 140 can be an umbrella-type valve element that can be made from a flexible material such as synthetic or natural rubber and includes a flexible skirt 142 and a neck 144 projecting from the skirt. To attach the valve element 140 to the lid 104 such that the valve element communicates with the storage cavity 106, there can be disposed through the center of the lid three closely-spaced holes or apertures 128 which may be in a straight line with each other. The neck 144 is inserted into the center aperture 128 to retain the valve element 140 to the lid 104 in such a manner that the flexible skirt 142 overlays the apertures. In other embodiments, the lid may include one, two, four, five or more apertures. For example, in one aperture embodiment, the center aperture may be used to retain the valve element and also allow the passage of air, such as, by a loose fit or by a groove in the neck of the valve element.

To evacuate the storage cavity, referring to FIG. 1, the valve element 140 can interface with a vacuum device 150. The illustrated embodiment of the vacuum device 150 is configured as a handheld, electrically operated device which includes an elongated housing 154 which houses an airflow generating unit. Formed at one end of the housing 154 can be a nozzle 152 that communicates with the airflow generating unit. The tip of the nozzle 152 can include a gasket 156 that can be made from a resilient material such as foam to ensure a good seal between the vacuum device 150 and the storage container 100. The vacuum device can be electrically operated and powered by a cord terminating in a wall socket plug or can be powered by batteries such as rechargeable batteries.

During evacuation, the vacuum device 150 is placed adjacent to the lid 104 so that the nozzle 152 surrounds the valve element 140. When the airflow generating device is activated which draws air through the nozzle 152, the flexible skirt 142 of the valve element 140 lifts upward from the lid 104 exposing the apertures 128. Thus, air trapped in the storage cavity 106 can be removed by the vacuum device 150. When the vacuum device 150 is turned off or removed from the storage container 100, the skirt 142 resiliently falls adjacent the lid 104 covering the apertures 128 and thereby preventing environmental air from reentering the container 100. Moreover, the vacuum within the storage cavity 106 will tend to pull the flexible skirt 142 adjacent the lid 104 via the apertures 128 and thereby the apertures remain sealed.

To improve functionality and storage of the storage container 100, at least one of the base 102 and/or lid 104 can demonstrate some comparative or measurable flexibility. This flexibility enables the storage container to change in size and/or shape as air is evacuated from the storage cavity.
Hence, as the pressure inside the storage cavity is reduced from an initial pressure equal to the surrounding atmospheric pressure to an evacuated pressure substantially less than the surrounding atmospheric pressure, the initial volume of the storage container can likewise be reduced to a smaller evacuated volume. The smaller evacuated volume may result in improved food freshness in storage. The smaller evacuated volume may facilitate storage of the evacuated storage container in, for example, a crowded refrigerator. Additionally, the reduced volume can provide a visual indication to a user that the evacuated state of the storage container has or has not been maintained during storage.

[0038] In the illustrated embodiment of FIG. 1, the lid 104 can be relatively flexible compared to the more rigid base 102. In particular, the lid 104 can be formed from thermoplastic sheet material by a suitable process such as thermoforming or vacuum forming. While overall planar in shape, the formed thermoplastic lid 104 can include a centrally located, upward protruding button or boss 130 that can be circular in shape. Additionally, the peripheral edge 120 of the lid includes the upward protruding annular arch 124. As illustrated, the valve element 140 can be attached to the boss 130. The majority of the lid 104 can be sufficiently firm or stiff so as to maintain the overall set shape of the lid under normal conditions.

[0039] However, located radially or annularly between the central boss 130 and the peripheral arch 124 can be one or more concentric flexible zones 132. The flexible zone 132 can demonstrate increased flexibility with respect to the comparatively rigid zones that correspond to central boss 130 and peripheral arch 124. The increased flexibility can be provided by alternating the thickness of the lid or by altering the elasticity of the material of the lid in the appropriate areas. For example, the material thickness corresponding to the rigid zones can be in a range from about 0.13 to about 3.00 mm.

[0040] Referring to FIG. 2, in the normal un-evacuated state, the overall stiffness of the lid 104 including the flexible zone 132 suspends the lid as attached to the base 102 over and covering the opening 118 with the boss 130 directed away from the bottom wall 110. Referring to FIG. 3 however, during evacuation, as the surrounding environmental pressure increases with respect to the pressure internal to the storage cavity 106, this pressure differential is sufficient to overcome the initial rigidity of the lid 104 and forces the flexible zone 132 to bend or distort downward toward the bottom wall. The lid 104 including the boss 130 thereafter depends through the opening 118 into the storage cavity 106. Referring to FIG. 4, after evacuation is complete and vacuum conditions exist in the storage cavity, the flexible zone 132 is distorted such that the boss 130 is now directed toward the bottom wall. As can be appreciated from FIGS. 2 and 4, the volume of the overall storage container 100 and the storage cavity 106 as evacuated is smaller than the initial volume of storage container and storage cavity when in the un-evacuated condition. Also, as can be appreciated from FIG. 4, the evacuated container 100 has a reduced head space due in part to the inward directed boss 130.

[0041] When the storage cavity 106 is accessed by detach- ing the lid 104 from the base 102, the evacuated state of the container is eliminated and the flexible zone 132 can recover to its undistorted shape and the lid can return to its initial shape illustrated in FIG. 2. The container can thereafter be washed and reused. To facilitate removing the lid 104 from the base 102, referring to FIG. 1, a tab 134 can extend from the peripheral edge 120.

[0042] While evacuation of the above described storage container can be achieved by a vacuum device, it will be appreciated that in other embodiments, evacuation can occur by hand manipulation of the container. Particularly, referring to FIGS. 2, 3, and 4, it will be appreciated that a user can press the boss 130 down into the storage cavity 106 thereby displacing air from the storage cavity through the valve element 140.

[0043] Referring to FIGS. 5, 6, and 7, there is illustrated another embodiment of a vacuum storage container 200. The container 200 includes a base 202 having a bottom wall 210 and a sidewall 212 that delineate a storage cavity 206. The storage cavity 206 is accessible through the opening 218 delineated by the upper edge or rim 216 of the sidewall 212. The lid 204 can be attached to the base 202 to cover and enclose the storage cavity 206. The lid 204 may be circular in shape and terminates at a peripheral edge 220. To attach the base 202 and lid 204, the upper rim 216 and peripheral edge 220 can include an interlocking tongue and groove design. When attached to the base 202, as illustrated in FIG. 6, the lid 204 extends generally as a dome over the opening 218.

[0044] To enable evacuation of the storage cavity 206 after the base 202 and lid 204 are attached, the storage container 200 can include a one-way valve element 240 attached to the lid and which communicates with the storage cavity. Specifically, the valve element 240 is illustrated as being attached to the center portion 226 of the lid 204. As described herein, the valve element 240 can interface with a vacuum device to allow air that is drawn from the storage cavity 206. In other embodiments, the valve element could be in other locations.

[0045] At least one of the base and/or lid can demonstrate a relative flexibility that allows the storage container to alter shape and/or size between its normal, un-evacuated state and its evacuated state. For example, the base 202 can be sufficiently rigid or firm to maintain its shape under a number of conditions. However, the lid 204 can be formed with alternating zones of rigidity and relative flexibility or elasticity. The zones of rigidity can correspond to the center 226 of the lid 204 to which the valve element 240 is attached and to the peripheral edge 220, both of which can be made from a suitable rigid thermoplastic such as polypropylene, polyethylene, polyethylene terephthalate, nylon, polycarbonate, polystyrene or ethylene vinyl acetate. To provide the flexible zone 232, the material in the annular middle portion of the circular lid 204 can be made of a relatively flexible or elastic material such as: (1) block copolymers, such as, styrene butadiene-styrene triblocks, copolyesters, polyurethanes and polyamides; (2) elastomer/thermoplastic blends, such as, elastomer thermoplastic (TPO) blends with 20-30 parts of rubber based ethylene-propylene-diene monomer (EPDM) in a continuous phase of 70-80 parts of plastic such as isotactic polypropylene; or (3) elastomeric alloys, such as, elastomeric alloys (EA) which are highly vulcanized rubber systems with vulcanization having been done dynamically in the molded plastic phase. The hardness of the flexible or elastic zones can be in a range from about 3 to about 80 Shore A scale. The flexible or elastic zone 232 can include a plurality of annular corrugations 234 concentrically arranged about the comparatively rigid center 226 of the lid 204. The alternating zones within the lid can be produced by any suitable process including, for example, over-molding.

[0046] Referring to FIG. 6, prior to evacuation of the storage cavity 206, the lid 204 including the flexible zone 232 extends generally as a dome across the opening 218. Refer-
ring to FIG. 7, during evacuation, the reduced pressure in the storage cavity 206 causes the flexible zone 232 to distort so that the lid 204 including the center 226 depends through the opening 218 and into the storage cavity. As illustrated, depending the lid 204 into the storage cavity 206 can cause the corrugations 234 to appear as a plurality of steps. Thus, in the evacuated condition, the volume and shape of the storage container 200 and the storage cavity are smaller as compared to their initial, un-evacuated state. Upon releasing the evacuated condition of the storage cavity 206, the lid 204 can recover its initial condition with the flexible zone 232 extending across the opening 218.

[0047] Referring to FIGS. 8 and 9, there is illustrated another embodiment of a vacuum storage container 300 including a base 302 having a bottom wall 310 and a sidewall 312 that provides a storage cavity 306. The storage cavity 306 is accessible via an opening 318 outlined by the upper rim 316 of the sidewall 312. The base can be sufficiently rigid so as to retain its as-formed shape in a variety of conditions. To cover the storage cavity 306, the storage container can also include a detachable lid 304 in the form of a highly elastic cover which provides the flexibility that enables the storage container to adjust between its normal condition and an evacuated condition. To provide the elastic quality, the lid 304 can be made from a highly flexible or resilient material such as elastomers. The elastomers may be thermoplastic elastomers or silicone. The hardness of the lid material can be in a range from about 3 to about 80 Shore A. The hardness of the base material can be in a range from about 60 to about 96 Rockwell A. Moreover, the lid can be transparent, translucent, or opaque.

[0048] To form the illustrated embodiment of the lid 304, a thin-walled sheet or membrane can be molded to include a central portion 320 and a downward depending sidewall 322. The size and shape of the central portion 320 and the depending sidewall 322 corresponds in size and shape to the sidewall 312 of the base 302. Thus, the lid 304 can be pulled over the base 302 so as to cover the opening 318 as illustrated in FIG. 9. The central portion 320 becomes the top surface of the storage container 300. To facilitate attachment of the base 302 and lid 304, the lid can include one or more tabs 326 extending from the sidewall. Moreover, the elastic material of the lid 304 can allow the lid to stretch about the circumference of the rim 316 and secure itself to the base 302. To facilitate evacuation of the storage cavity 306 after the base 302 and lid 304 are attached, the storage container 300 can include a one-way valve element 340 which can be attached to the center of the central portion 320 of the lid 304.

[0049] When the base 302 and the lid 304 are attached and the container 300 is in its normal un-evacuated state, the central portion 320 of the elastic lid can be stretched over the opening 318 and is generally parallel to the bottom wall 310 of the base. Additionally, the elastic material of the lid helps maintain this arrangement. However, in the evacuated state when the air pressure within the storage cavity 306 is reduced with respect to the surrounding environmental air pressure, the elastic material allows the central portion 320 of the lid to depend through the opening 318 and into the storage cavity 306 as illustrated in FIG. 9. Thus, the evacuated container can have an inwardly dished appearance which may be enhanced by yielding or stretching of the lid into the storage cavity. The elastic material of the lid 304 can also maintain an elastic grip of the depending sidewall 322 about the circumference of the rim 316 to maintain a seal therebetween. The evacuated storage container therefore has a smaller shape and reduced volume as compared to its initial un-evacuated state.

[0050] In another embodiment, the lid 304 may include a flexible central portion 320 and a rigid sidewall or rim 322. The rigid sidewall 322 may be attached to the flexible central portion 320. The flexible central portion 320 may be made from the materials noted above. The rigid sidewall 322 may be made from a suitable rigid thermoplastic such as polypropylene, polyethylene, polyethylene terephthalate, nylon, polycarbonate, polystyrene or ethylene vinyl acetate. The rigid sidewall 322 may allow for easier attachment and removal of the lid 304 from the base 302.

[0051] Referring to FIGS. 10, 11 and 12, there is illustrated another embodiment of a storage container 400 that includes a rigid base 402 having a bottom wall 410 and an upward extending sidewall 412 which provides a storage cavity 406. The storage cavity 406 can be accessed through an opening 418 outlined by a rim 416 formed by the upper edge of the sidewall 412. To cover the opening 418 and thereby enclose the storage cavity 406, a lid 404 in the form of a sheet of flexible material can be wrapped about the rim 416 of the base 402. To facilitate evacuation of the storage cavity 406 after the lid 404 of flexible material has been attached to the base 402, a one-way valve element 440 can be attached to the flexible material.

[0052] As shown in the illustrated embodiment, the lid 404 of flexible material can be initially provided as a square or rectangular sheet 420 with the valve element 440 generally located at the center. The sheet 420 can be made from a thin, flexible web of thermoplastic material such as polypropylene, polyethylene, EVA, thermoplastic polyester, or combinations thereof. The flexible nature of the sheet material allows it to wrap and gather about the rim of the base in a manner that thereby securely attaches the sheet and base together. Desirably, the strength of the grip or adhesion between the sheet and base is such as to effect a substantially air-tight seal therebetween.

[0053] Moreover, as illustrated in FIG. 11, the surface of the sheet 420 can be textured by including a plurality of densely spaced protrusions 422 projecting upwards from the surface of the sheet. The protrusions 422 can be randomly shaped and spaced about. The protrusions can cause the sheet to cling or grip to various surfaces or even to other parts of the sheet when pressure is applied. Additionally, the sheet 420 can include cling or other adhering additives to improve adhesion of the sheet to the base 402. Also, an adhesive may be applied to the sheet. The sheet of flexible material can be provided as a plurality of sheets packaged together for commercial distribution or as a continuous web that can be cut to the appropriate size at the time of use. One example of a suitable sheet is available from The Glad Products Company of Oakland, Calif. under the trade name Press’n’ Seal®.

[0054] When the sheet 420 is wrapped or attached to the base 402, the sheet can typically extend or be stretched across the opening 418 generally planar to the bottom wall 410. However, when the storage container 400 is in the evacuated condition and the air pressure within the storage cavity 406 is reduced with respect to the surrounding environment, the flexible sheet 420 can be partially drawn through the opening 418 and into the storage cavity 406 as illustrated in FIG. 12. Thus, as illustrated, the sheet 420 appears to be dish般 inward of the base 402. The degree which the sheet 420 is drawn into the storage cavity 406 may depend upon the vacuum pressure within the storage cavity and the elasticity associated with the
sheet. It is desirable that the strength with which the sheet grips about the rim of the base is such that the sheet is not entirely drawn into the storage cavity or that seal between the sheet and base is otherwise compromised. After use of the storage container, the plastic sheet can be discarded.

[0055] Referring to FIG. 13, there is illustrated another embodiment of a storage container 500 for receiving food items and which includes a base 502 defining a storage cavity 506 and a detachable lid 504. The base 502 can include a bottom wall 510 and an upward extending sidewall 512 which terminates in a circular rim 516. To access the storage cavity 506, there is disposed through and outlined by the rim 516 a circular opening 518. The sidewall 512 can generally taper or narrow between the rim 516 and the bottom wall 510 so that the base 502 has a bowl-like shape. The lid 504 can be substantially planar and correspond in diameter to the circular rim 516. To attach the base 502 and lid 504 together, the lid can include a ridge 522 extending generally around and proximate to its circular peripheral edge 520 and into which is disposed a groove 524 (shown in cutaway). The groove 524 can receive a corresponding circular tongue 514 that projects upward from the rim 516. The lid 504 can include a tab 526 extending outward from the peripheral edge for assisting in attaching and detaching the lid to the base 502. To facilitate evacuation of the storage cavity 506, a one-way valve element 540 can be attached to the proximate center of the lid 540.

[0056] The base 502 can be designed to be comparatively flexible with respect to the more rigid lid 504. Specifically, the base 502 can be designed to collapse upon itself. To facilitate collapsing of the base 502, the sidewall 512 can be comprised of a material that is comparatively flexible with respect to the lid 502 and with respect to the bottom wall 510 and rim 516. The flexibility can be achieved by selecting suitable materials and/or additives or by altering dimensions and thickness of the materials. Different materials can be formed together by any suitable process including, for example, overmolding. Additionally, the base 502 can be formed with a plurality of telescoping or nesting folds in the form of hollow circular bands that are operatively connected together. Referring to FIGS. 13 and 14, the base includes a first fold 530 depending from the rim 516, a smaller diameter second fold 532 depending from the first fold, and a yet smaller diameter third fold 534 between the second fold and the bottom wall 510. When the storage container 500 is in its un-evacuated normal state, as illustrated in FIG. 14, the plurality of folds fully extend from the rim 516 and thereby maximize the volume of the storage cavity 506.

[0057] As the storage container 500 is evacuated and the pressure within the storage cavity 506 is reduced with respect to the surrounding environment, the folds 530, 532, 534 of the sidewall 512 can begin to collapse together. Referring to FIG. 15, the first fold 530 can telescope or nest within the rim 516 and thereby reduce the overall volume and size of the storage container. At this stage of evacuation, only the second and third folds 532, 534 remain extended with respect to the rim 516. As evacuation continues, referring to FIG. 16, the second fold 532 can telescope or nest into the first fold 530 and the third fold 534 can nest into the second fold. The folds can collapse in any sequence or partially collapse in any sequence. In the evacuated condition, the storage container 500 has a flatter appearance than in the un-evacuated condition and correspondingly has a smaller volume and size. Thus, the evacuated storage container is easier to store and can provide a visual indication of its evacuated state.

[0058] Referring to FIGS. 17, 18, and 19 there is illustrated another embodiment of a one-way valve element 640, specifically a diaphragm type valve element, which can be used with storage containers described herein. The storage container 600 can be rectangular in shape and include a base 602 and detachable lid 604. The diaphragm type valve element 640 may be positioned in a depressed region 626 disposed into the lid 604 such that the valve element is generally recessed below the plane of the lid in order to protect the valve element. In its normally closed position, illustrated in FIGS. 17 and 18, the diaphragm valve 640 may include a generally planar flexible diaphragm 642 with a circular peripheral edge 644 and a central aperture 646 disposed therein. Excess material 648 in the form of a folded collar or sleeve is included within the plane of the diaphragm 642 and extends annularly and concentrically about the aperture 646. To enable communication between the diaphragm valve element 640 and the storage cavity 606, one or more holes 628 are disposed through the depressed region 626 of the lid 604. The diaphragm valve 640 is then attached by its peripheral edge 644 to the lid 604 such that the valve material 648 can generally align over the lid holes 628. The inner portion of the diaphragm 642 including the central aperture 646 adjoinly overliea a solid portion of the depressed region 626. Thus, fluid communication between the lid holes 628 and the diaphragm aperture 646 is not normally possible as shown in FIG. 18.

[0059] Referring to FIG. 19, when the nozzle of a vacuum device 650 is interfaced with the diaphragm valve element 640 and suction is applied, the valve material 648 unfurls and allows the central portion of the flexible diaphragm 642 to lift away from the lid 604. Air from the storage cavity 606 can move through the lid holes 628 and exit through the diaphragm aperture 646. Once the nozzle of the vacuum device 650 is removed or the vacuum device is turned off, the valve material 648 may return to its prior shape so that the central portion of the diaphragm 642 again overlies the depressed lid region 626 sealing the storage cavity 606 as illustrated in FIG. 18.

[0060] Referring to FIGS. 20, 21, and 22, there is illustrated another embodiment of a one-way valve element 740 that can be used with storage containers described herein. The illustrated one-way valve element 740 can include a rigid valve body 742 that cooperates with a movable disk 744 to open and close the valve element. The valve body 742 may include a circular flange portion 746 extending between parallel first and second flange faces 750, 752. Concentric to the flange portion 746 and projecting from the second flange face 752 may be a circular boss portion 748 which terminates in a planar boss face 754 that is parallel to the first and second flange faces. The circular boss portion 748 may be smaller in diameter than the flange portion 746 so that the outermost annular rim of the second flange face 752 remains exposed. The valve body 742 can be made from any suitable material such as a moldable thermoplastic material like nylon, HDPE, high impact polystyrene (HIPS), polycarbonates (PC), and the like.

[0061] Disposed concentrically into the valve body 742 may be a counter-bore 760. The counter-bore 760 may extend from the first flange face 750 part way towards the boss face 754. The counter-bore 760 may define a cylindrical bore wall 762. Because it extends only part way towards the boss face 754, the counter-bore 760 may form within the valve body 742 a planar valve seat 764. To establish fluid communication
across the valve body 742, there is disposed through the valve seat 764 at least one aperture 766. In the illustrated embodiment, a plurality of apertures 766 may be arranged concentrically and spaced inwardly from the cylindrical bore wall 762.

[0062] To cooperatively accommodate the moveable disk 744, the disk is inserted into the counter-bore 760. Accordingly, the disk 744 may be smaller in diameter than the counter-bore 760 and has a thickness as measured between a first disk face 770 and a second disk face 772 that may be substantially less than the length of the counter-bore 760 between the first flange face 750 and the valve seat 764. To retain the disk 744 within the counter-bore 760, there may be formed proximate to the first flange face 750 a plurality of radially inward extending fingers 776. The disk 744 can be made from any suitable material such as, for example, a resilient elastomer.

[0063] Referring to FIG. 22, when the disk 744 within the counter-bore 760 is moved adjacent to the fingers 776, the valve element 740 is in its open configuration allowing air to communicate between the first flange face 750 and the boss face 754. However, when the disk 744 is seated in the valve seat 764 thereby covering the apertures 766, the valve element 740 is in its closed configuration. To assist in sealing the disk 744 over the apertures 766, a sealing liquid can be applied to the valve seat 764. Furthermore, a piece of foam or other resilient member may be placed in the counter-bore 760 to provide a tight fit of the disk 744 and the valve seat 764 in the closed position. However, when the valve element 740 is attached to the storage containing the apertures 766 exposed to the interior cavity, air escaping from the internal cavity will move the movable disk 744 against the fingers 776 and allowing air to escape to the environment. Afterwards, the disk 744 can again move adjacent the valve seat 764 to cover the apertures 766.

[0064] Referring to FIG. 23, there is illustrated another embodiment of a one-way valve element 840 for use with the storage containers described herein. The valve element 840 can be constructed as a flexible, multi-layered valve element that includes a flexible, circular base layer 842 that cooperates with a correspondingly circular shaped, resilient top layer 844 to open and close the valve element. The top and bottom layers can be made from any suitable material such as, for example, a flexible thermoplastic film. Disposed through the center of the base layer 842 is an aperture 846, thus providing the base layer with an annular shape. The top layer 844 may be adhered to the base layer 842 by two parallel strips of adhesive 848 that extend along either side of the aperture 846, thereby covering the aperture with the top layer and forming a channel. The base layer 842 is then adhered by a ring of adhesive 850 to the lid 804 of a storage container 800 so as to cover the hole 828 disposed through lid 804.

[0065] When storage container 800 is being evacuated, air from the storage cavity can pass through the hole 828 disposed through the lid 804 and the aperture 846 thereby partially displacing the top layer 844 from the base layer 842. The air can then pass along the channel formed between the adhesive strips 848 and escape to the environment. When the force driving evacuation subsides or ceases, the resilient top layer 844 will return to its prior configuration covering and sealing the aperture 846. The valve element 840 may also contain a viscous material such as an oil, grease, or lubricant between the two layers in order to prevent air from reentering the storage container. In an embodiment, base layer 842 may also be a rigid sheet material. In another embodiment, the base layer 842 may be eliminated and the top layer 844 may be adhered directly to the lid 804 by strips of adhesive. In another embodiment, the hole 828 in the lid 804 may be a slit or slits in the sidewall.

[0066] Illustrated in FIG. 24 is another embodiment of the valve element 940 that can be attached to the storage containers described herein. The valve element 940 may be a rectangular piece of flexible thermoplastic film that includes a first end 942 and a second end 944. The valve element 940 is attached to the lid 904 of the storage container 900 so as to cover and seal a hole 928 disposed through the lid. The valve element 940 can be attached to the lid 904 by patches of adhesive 948 placed on either side of the hole 928 so as to correspond to the first and second ends 942, 944. When the storage container 900 is being evacuated, air being directed from the storage cavity displaces the flexible valve element 940 so as to unseal the hole 928. After evacuation of air from the storage cavity, the valve element 940 will cover and seal the hole 928. In another embodiment, the hole may be a slit or slits in the lid.

[0067] All references, including publications, patent applications, and patents, cited herein are hereby incorporated by reference to the same extent as if each reference were individually and specifically indicated to be incorporated by reference and were set forth in its entirety herein.

[0068] The use of the terms "a" and "an" and the similar referents in the context of describing the invention (especially in the context of the following claims) are to be construed to cover both the singular and the plural, unless otherwise indicated herein or clearly contradicted by context. The terms "comprising," "having," "including," and "containing" are to be construed as open-ended terms (i.e., meaning "including, but not limited to,") unless otherwise noted. Recitation of ranges of values herein are merely intended to serve as a shorthand method of referring individually to each separate value falling within the range, unless otherwise indicated herein, and each separate value is incorporated into the specification as if it were individually recited herein. All methods described herein can be performed in any suitable order unless otherwise indicated herein or otherwise clearly contradicted by context. The use of any and all examples, or exemplary language (e.g., "such as") provided herein, is intended merely to better illuminate the invention and does not pose a limitation on the scope of the invention unless otherwise claimed. No language in the specification should be construed as indicating any non-claimed element as essential to the practice of the invention.

[0069] Exemplary embodiments are described herein. Variations of those embodiments may become apparent to those of ordinary skill in the art upon reading the foregoing description. The inventor(s) expect skilled artisans to employ such variations as appropriate, and the inventor(s) intend for the invention to be practiced otherwise than as specifically described herein. Accordingly, this invention includes all modifications and equivalents of the subject matter recited in the claims appended hereto as permitted by applicable law. Moreover, any combination of the above-described elements in all possible variations thereof is encompassed by the invention unless otherwise indicated herein or otherwise clearly contradicted by context.
1. A storage container comprising:
a base including a base sidewall providing a storage cavity
accessible by an opening;
a lid attachable to the base for covering the opening; and
a one-way valve element communicating with the storage
cavity;
wherein at least one of the base and lid is relatively flexible.
2. The storage container of claim 1, wherein the lid is
comparatively flexible with respect to the comparatively rigid
base.
3. The storage container of claim 2, wherein the container
has a first condition in which the lid attached to the base is
generally planar across the opening and a second condition in
which the lid depends through the opening into the storage
cavity.
4. The storage container of claim 2, wherein the lid
includes flexible zones and rigid zones.
5. The storage container of claim 4, wherein the flexible
zones have a first material thickness and the rigid zones have
a second material thickness, the first material thickness being
less than the second material thickness.
6. The storage container of claim 4, wherein the flexible
zones have a first modulus of elasticity and the rigid zones have
a second modulus of elasticity, the first modulus being less than the second modulus.
7. The storage container of claim 2, wherein substantially
the whole lid is elastic.
8. The storage container of claim 7, wherein the material of
the lid includes a thermoplastic elastomer or a silicone.
9. The storage container of claim 2, wherein the lid is
comprised of a flexible sheet of thermoplastic material attach-
able to the base.
10. The storage container of claim 9, wherein the flexible
sheet includes a plurality of protrusions formed on its surface.
11. The storage container of claim 1, wherein the base is
comparatively flexible with respect to the comparatively rigid
lid.
12. The storage container of claim 11, wherein the base
includes a relatively rigid rim and a collapsible sidewall
operatively connected to the rim.
13. The storage container of claim 12, wherein the base has
a first normal condition in which the sidewall depends from
the rim and a second evacuated condition in which the side-
wall is substantially collapsed within the rim.
14. The storage container of claim 11, wherein the base
includes a plurality of telescoping folds nestable together.
15. A storage container comprising:
a base including a base sidewall having a circular tongue
projecting upwards from the sidewall, the base provid-
ing a storage cavity accessible by an opening:
a lid including a ridge having a groove and extending
generally around and proximate to the lid peripheral
eedge, the lid attachable to the base for covering the
opening; and
a one-way valve element communicating with the storage
cavity;
wherein at least one of the base and lid is relatively flexible.
16. The storage container of claim 15, wherein the lid is
comparatively flexible with respect to the comparatively rigid
base.
17. The storage container of claim 16, wherein the con-
tainer has a first condition in which the lid attached to the base
is generally planar across the opening and a second condition in
which the lid depends through the opening into the storage
cavity.
18. The storage container of claim 16, wherein the lid
includes flexible zones and rigid zones.
19. The storage container of claim 18, wherein the flexible
zones have a first material thickness and the rigid zones have
a second material thickness, the first material thickness being
less than the second material thickness.
20. A method of storing and preserving food items compr-
ising:
(i) providing a storage container including a base defining
a storage cavity, an attachable lid, and a valve element
communicating with the storage cavity, wherein at least
one of the base and lid is flexible;
(ii) inserting food items into the storage cavity;
(iii) attaching the lid to the base to enclose the storage
cavity;
(iv) evacuating air from the storage cavity through the
one-way valve element while simultaneously reducing
the volume of the storage container.

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