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(54) **AIRWAY INSERT FOR VACUUM SEALING PLASTIC BAG**

(76) Inventor: **Gregory P. Scanlan**, San Rafael, CA (US)

Correspondence Address:
Gregory P. Scanlan
P.O. Box 10465
San Rafael, CA 94912 (US)

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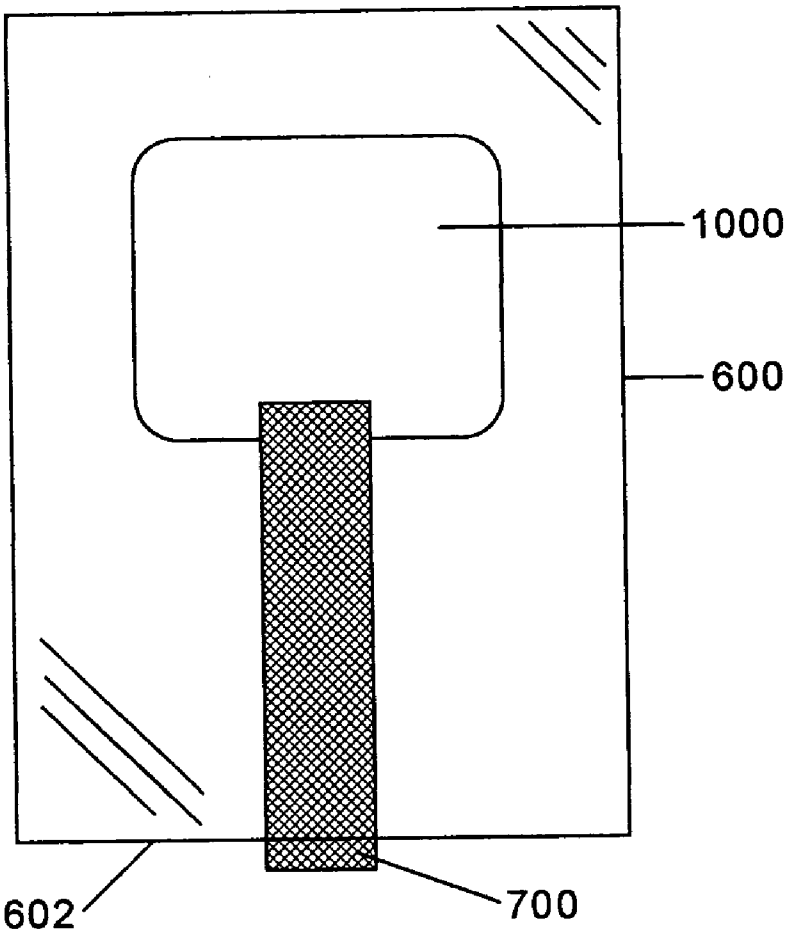
(57) **ABSTRACT**

An insertable airway member (**700, 1200, 1300**) provides an escape path for air during evacuation of a heat-sealable bag (**600**) to protect a perishable or vacuum-packable item (**1000**). The member (**700**) extends from the open edge (**602**) of the bag inwardly to the contents being sealed in the bag. The member is made of flexible, woven plastic mesh with open cells (**800**) comprising fiber strands (**705**) and knots (**805**) with holes (**900**). In an alternative embodiment, the airway member (**1200, 1300**) is rigid or semi-rigid and provided with channels (**1205**) or grooves (**1305**) to permit the escape of air from the bag during evacuation. The bag is evacuated and then heat-sealed. During heat-sealing of the bag, the sandwich comprising the airway member and the opposed sides of the bag near its open edge are forced together by heated clamps (**22**) of a known heat-sealing apparatus (**400**). The softened or melted plastic material comprising the inner layer of the bag fills voids in the airway member, optionally melting it as well, thus sealing the bag against the incursion of air.



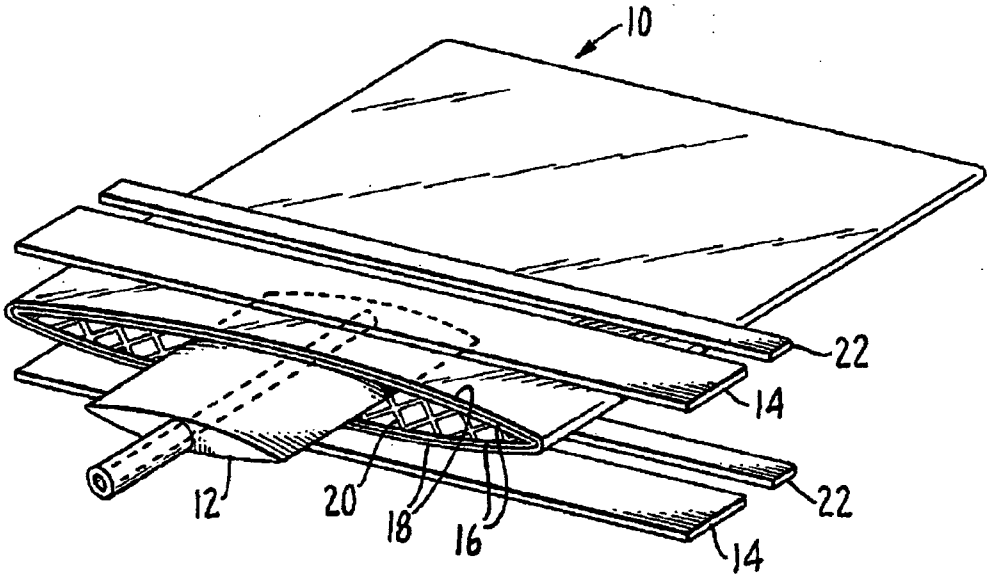


Fig. 1--Prior Art

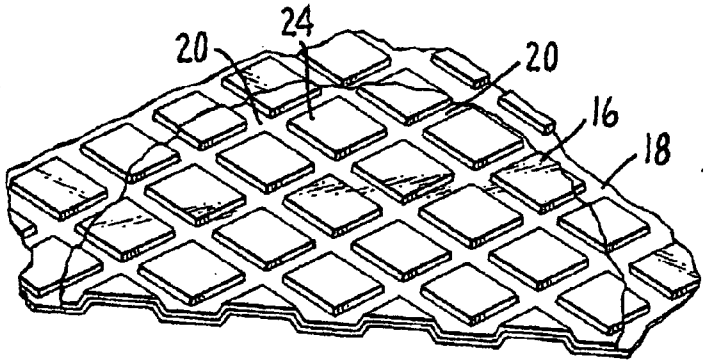


Fig. 2--Prior Art

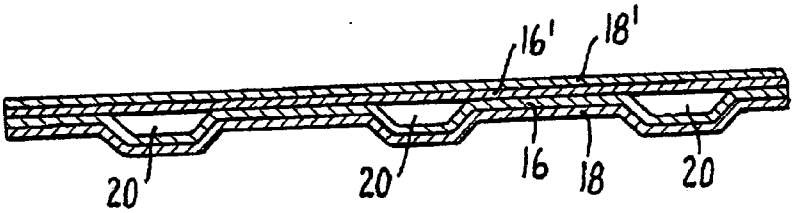


Fig. 3--Prior Art

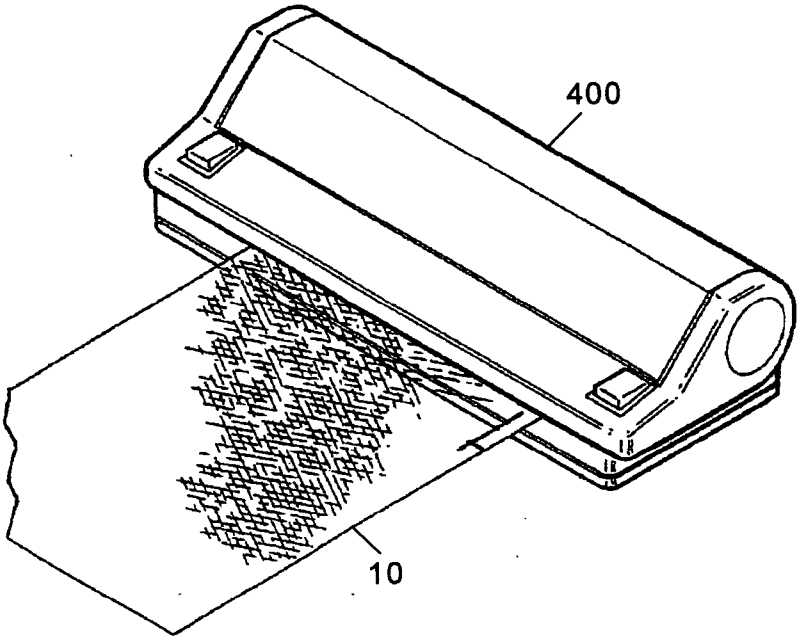


Fig. 4--Prior Art

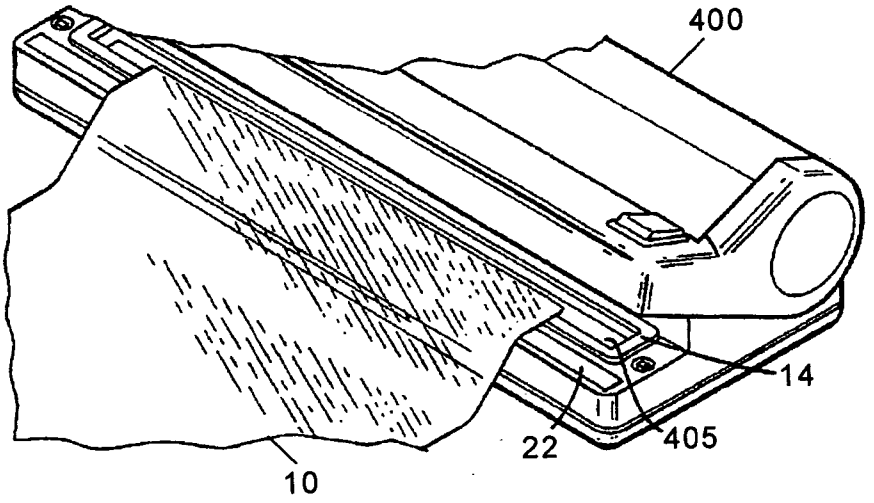


Fig. 5--Prior Art

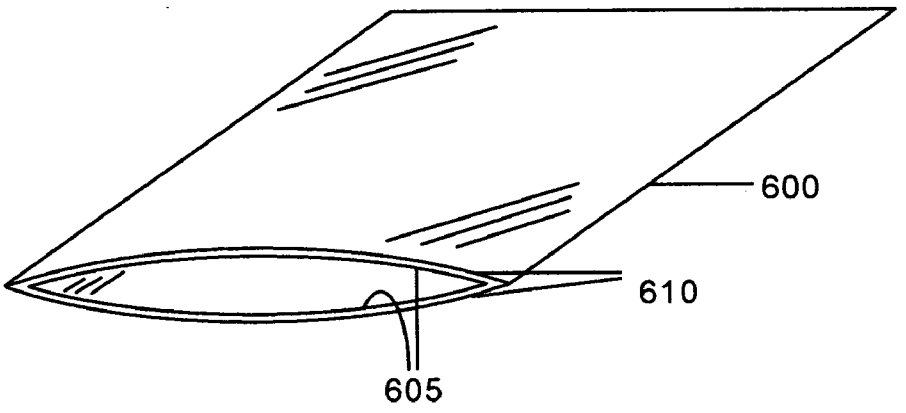


Fig. 6

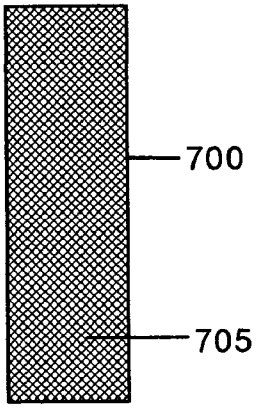


Fig. 7

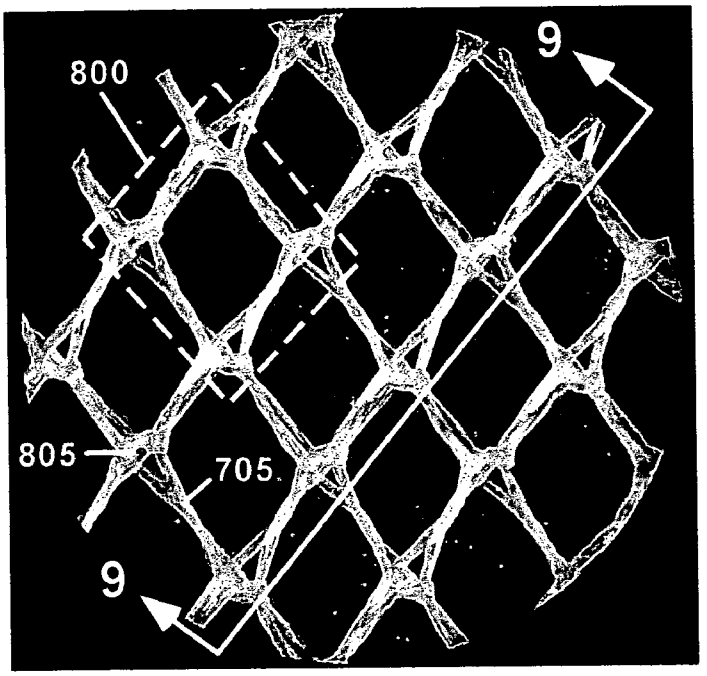


Fig. 8

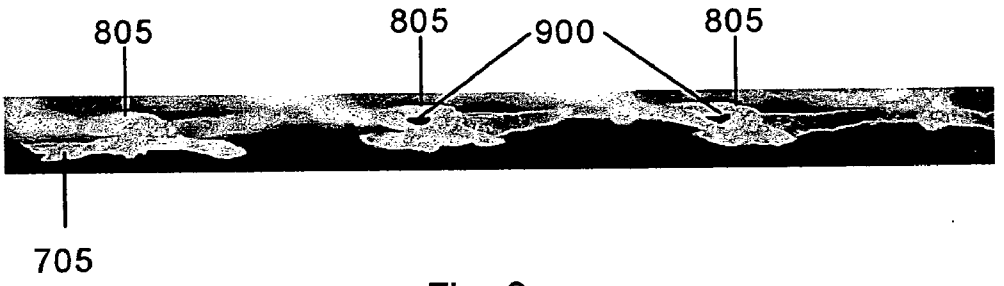


Fig. 9

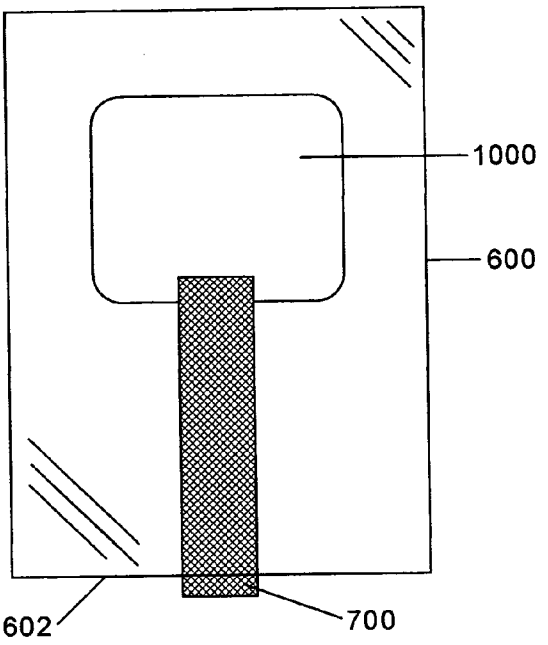

1000
600
602
700

Fig. 10

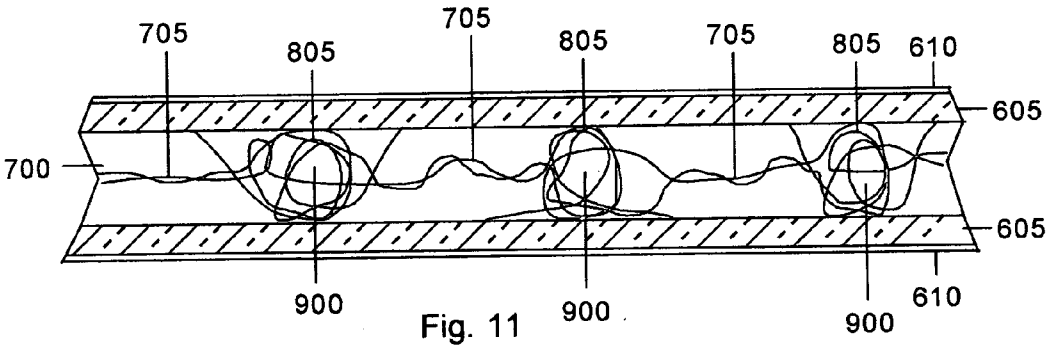

705
805
705
805
705
805
610
605
700
605
900
900
900
610

Fig. 11

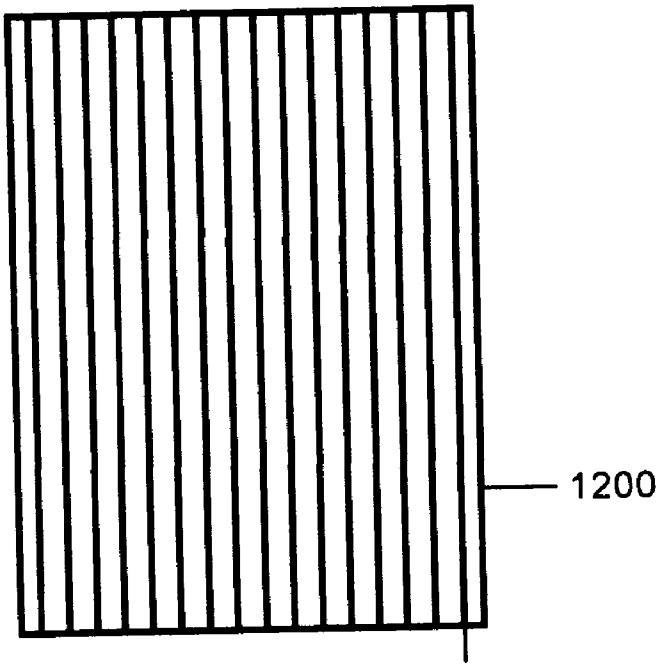


Fig. 12A

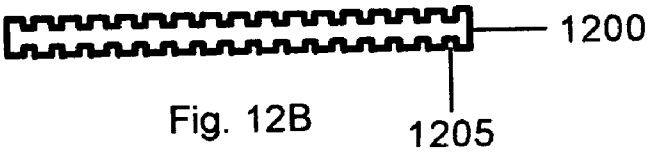


Fig. 12B

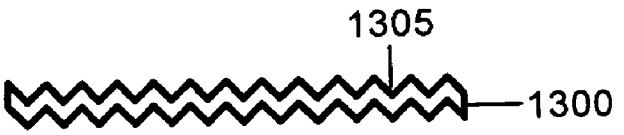


Fig. 13

Fig. 12

AIRWAY INSERT FOR VACUUM SEALING PLASTIC BAG

SEQUENCE LISTING

[0001] None

BACKGROUND

[0002] 1. Field of Invention

[0003] This invention relates generally to packaging materials, and in particular to a method and apparatus for facilitating the evacuation of plastic bags prior to sealing.

[0004] 2. Prior Art—**FIGS. 1-3**

[0005] In U.S. Pat. No. 4,756,422 (1988), Kristen teaches a heat-sealable plastic bag **10** shown in perspective view (in **FIG. 1** of this patent) with an embossed inner layer **16**. Inner layer **16** comprises a heat-sealable, food-safe plastic material such as polyethylene. **FIG. 1** also shows some elements of an apparatus for heat-sealing bag **10**. Bags of this type are sold by Tilia, Inc. of San Francisco, Calif., USA, under the mark FoodSaver.

[0006] Layer **16** is a food-safe and sealable plastic material which is generally gas permeable. In order to maintain a vacuum within bag **10** and prevent the entry of air, a gas-impermeable outer layer **18**, such as nylon, is joined to inner layer **16**. (The term "vacuum" as used in this patent means a partial vacuum, in accordance with conventional usage.)

[0007] Three of the edges of bag **10** are sealed prior to use. The fourth edge is interfaced with a nozzle **12** connected to a vacuum source (not shown) which removes air from within bag **10** via airway channels in embossed inner layer **16**.

[0008] Rubber heat-sealing clamps **14** seal the edges of bag **10** during evacuation. Clamps **22** are also pressed against the outer sides of bag **10**. After the air is removed from bag **10**, clamps **22** are activated. Clamps **22** typically comprise resistive heating elements which become hot upon the application of electrical current. Upon activation, clamps **22** reach a temperature sufficiently high to melt inner layer **16**, while not melting outer layer **18**. Inner layer **16** typically has a lower softening and melting temperature than outer layer **18**. The application of this heat causes the inner surfaces of layer **16** to flow together. Clamps **22** are then de-activated and the sealing operation is complete. Thus bag **10** is sealed along the fourth edge. At this point, clamps **14** and **22**, and nozzle **12** are withdrawn. Bag **10** may then be stored and will maintain its inner vacuum until its contents (not shown) are needed.

[0009] **FIG. 2** shows a perspective view of embossed airway channels **20** on the inner layer **16** of bag **10**. Note that the surface of layer **16** comprises upstanding, spaced blocks or bosses with patent air channels **20** between bosses.

[0010] **FIG. 3** is a cross-sectional view of the material of bag **10** showing airway channels **20** amid layers **16** and **18**.

[0011] While Kristen's bag and sealing system work as described, they require the use of a bag with an embossed inner surface. This requires an additional embossing step, which substantially increases the cost of the bag. This requirement further requires the use of embossing machinery which may not be available to all manufacturers of plastic bag materials. This reduces the potential for competition among plastic bag manufacturers, again resulting in higher cost for the consumer.

[0012] In U.S. Pat. No. 4,941,310 (1990), Kristen teaches an apparatus **400** (shown in **FIGS. 4 and 5** of the present patent) for evacuating and sealing a plastic bag. In its closed position, apparatus **400** grips the edge of a bag **10** using clamping surfaces **14**. The clamping force is sufficient to hold bag **10** in place, but not so great as to collapse airways **20** on layer **16**. Apparatus **400** then draws a vacuum in trough **405** along the open edge bag **10**, and then heat-seals the bag using heatable clamps **22**, as described above. Such apparatus is sold by Sears Roebuck and Co., of Chicago, Ill., USA, as Kenmore Seal-n-Save, Tilia Food Saver Vac 800, and others. Apparatus **400** is used to seal the bags of the present invention.

[0013] 3. Objects and Advantages

[0014] Accordingly, one object and advantage of the present invention is to provide an improved vacuum-sealable bag. Other objects and advantages are to provide an inexpensive, simple bag which can be sealed using existing apparatus, which is easy to use, which is at least equal in performance to prior-art bags for vacuum sealing, and which does not require the use of an embossed interior surface.

[0015] Additional objects and advantages will become apparent from a consideration of the drawings and ensuing description.

SUMMARY

[0016] In accordance with the present invention, a method and apparatus are provided which comprise an inexpensive, heat-sealable bag with a flat (not embossed) interior surface, and a simple, plastic airway strip. Airway channels are incorporated in the strip which permit complete evacuation of the bag prior to sealing. The result is an easy-to-use, low-cost alternative to prior-art vacuum sealing bags.

DRAWINGS—FIGURES

[0017] **FIG. 1** shows a prior-art bag and the essential components of a heat-sealing apparatus.

[0018] **FIG. 2** shows the embossed inner surface of the bag of **FIG. 1**.

[0019] **FIG. 3** is a cross-sectional view of the bag of **FIG. 1**.

[0020] **FIG. 4** is a perspective view of a prior-art sealing apparatus.

[0021] **FIG. 5** is a perspective view of the apparatus of **FIG. 4** in the open position.

[0022] **FIG. 6** is a perspective view of a bag according to the present invention.

[0023] **FIG. 7** shows an airway strip according to the present invention.

[0024] **FIG. 8** is a plan-view photomicrograph of an airway strip mesh.

[0025] **FIG. 9** is an end-view photomicrograph of the mesh of **FIG. 8**.

[0026] **FIG. 10** shows a bag, airway strip, and contents in position for evacuating and sealing.

[0027] **FIG. 11** is a cross-sectional view of the airway strip and bag edge prior to sealing.

[0028] **FIGS. 12 and 13** show alternative airway strips.

REFERENCE NUMERALS

[0029] **10** Prior-art Bag

[0030] **12** Prior-art Nozzle

[0031] **14** Prior-art Clamp

[0032] **22** Prior-art Heat clamp

[0033] **16** Prior-art Inner layer

[0034] **18** Prior-art Outer layer

[0035] **20** Prior-art Airway channel

[0036] **400** Heat seal apparatus

[0037] **405** Trough

[0038] **600** Bag

[0039] **602** Edge of bag

[0040] **605** Inner layer

[0041] **610** Outer layer

[0042] **700** Airway strip

[0043] **705** Fibers

[0044] **800** Mesh cell

[0045] **805** Knot

[0046] **900** Hole

[0047] **1000** Contents

[0048] **1200** Airway member

[0049] **1205** Channels

[0050] **1300** Airway member

[0051] **1305** Grooves

DETAILED DESCRIPTION—PREFERRED EMBODIMENT—FIGS. **6-9**

[0052] **FIG. 6** shows an open vacuum-sealable container or bag **600** according to the preferred embodiment of the present invention. Bag **600** can be of any reasonable size from a few centimeters across and lengthwise to a meter or more. The limits of these dimensions are determined by the limitations of the sealing apparatus.

[0053] Bag **600** comprises inner and outer layers **605** and **610**, respectively. Inner layer **605** is a food-safe, sealable material such as low-density polyethylene. The material comprising layer **605** is generally air or gas-permeable. It is preferably 25-50 microns (0.001-0.002 in) thick. Layer **605** preferably has a plasticity (i.e., a fusing, softening, or melting) temperature of 130 deg. C.

[0054] Outer layer **610** is a gas-impermeable layer such as nylon, approximately 12 microns (0.0005 in) thick. Layer **610** prevents air from reaching gas-permeable inner layer **605**, thereby ensuring the integrity of the vacuum within bag **600** after sealing, as described below. Layer **610** has a plasticity temperature of 200 deg. C. Layers **605** and **610** are permanently bonded together with no air pockets between them. Such bag materials, called "3-mil High Barrier Nylon/EVOH/Poly Pouches" are available from Doug Care Equipment, Inc., of Edgerton, Wis., USA, and others.

[0055] **FIG. 7** shows an airway strip **700** according to the preferred embodiment of the present invention. In use, strip **700** is inserted into bag **600** (**FIG. 6**), as described below, to enable bag **600** to be evacuated and sealed. Strip **700** is a woven, flexible mesh made of a food-grade plastic material such as nylon, polyethylene, or polypropylene. Hole densities between 37 and 99 per square cm (240 and 640 per sq. in) have been found to work well in this application. Mesh openings are nominally one mm (0.040 in) wide; however they can be somewhat larger or smaller. The individual fibers **705** of strip **700** are preferably 75 microns (0.003 in) in diameter, although they can be somewhat larger or smaller. One such mesh is style number 4000, available from Edley Associates, of Hicksville, N.Y., USA. Photomicrographs of this mesh are shown in **FIGS. 8 and 9**.

[0056] The length of strip **700** is comparable to the depth of bag **600**. The width of strip **700** is preferably approximately one-fourth of the width of bag **600**. The width of strip **700** is not critical; however it must be great enough to allow the reasonably rapid evacuation of bag **600**.

[0057] **FIGS. 8 and 9** show greatly magnified top and cross-sectional views, respectively, of strip **700**. Each side of mesh cell **800** (indicated by dashed lines) in strip **700** is bounded by two fibers **705** and four knots **805** (**FIG. 8**).

[0058] **FIG. 9** shows a cross-sectional view of mesh strip **700**. Although individual fibers **705** are only 75 microns (0.003 in) in diameter, the overall thickness of strip **700** is approximately 230 microns (0.009 in). This is due to the presence of knots **805**.

[0059] A similar, usable mesh made in polypropylene is style number XN6065, available from InterNet, Inc., of Minneapolis, Minn., USA. Although this mesh (not shown) is extruded, and therefore has no holes with axes in the plane of the mesh passing through knots, there is still adequate air flow space at cell walls between fiber junctions, as described above. Both meshes are commonly used in filtration applications.

Operation—Preferred Embodiment—FIGS. **10-11**

[0060] Bag **600** can be more easily evacuated and sealed using strip **700** and the sealing and evacuation apparatus of **FIG. 5** without the need for any embossed surfaces. **FIG. 10** shows a plan view of bag **600** prepared for vacuum sealing. Contents **1000** (e.g., food, an oxidizable machine part, etc.) are inserted into bag **600** as shown. Then strip **700** is partially inserted so that it extends from the outer edge **602** of bag **600** inwardly into the vicinity of contents **1000** as shown.

[0061] **FIG. 11** (not to scale) shows a cross/sectional view of the open mouth of bag **600** prior to sealing. Strip **700** is sandwiched between inner layers **605** of bag **600**. In this configuration, holes **900** in knots **805** of strip **700** provide an air path through knots **805**, and therefore between individual cells **800** of strip **700** (**FIGS. 8 and 9**). Holes **900** are approximately the diameter of fibers **705**. In addition, the

regions between knots **805** on cells **800** contain only two straight fibers, twisted around one-another. The height (approximately 150 microns) of these two fibers **705** is less than the height of knots **805** (approximately 230 microns). Thus, prior to sealing, the walls of cells **800** also provide an air path through strip **700**, as layers **605** rest on opposite sides of knots **805**.

[**0062**] Edge **602** of bag **600** with strip **700** in place is now ready for insertion into sealing apparatus **400** (**FIG. 5**). Bag **600** is positioned with edge **602** over trough **405**. Apparatus **400** is then closed and clamping edges **14** hold bag **600** securely in place, without flattening the mesh of strip **700**. The vacuum pump (not shown) of apparatus **400** is then activated. Air exits bag **600** via the myriad pathways provided through holes **900** in knots **805**, and across the walls of cells **800**. A vacuum is thus formed in bag **800**, within and around object **1000**.

[**0063**] When the desired level of vacuum is reached, heated clamp **22** of apparatus **400** is activated. When inner surface **605** of bag **600** reaches its plasticity temperature, approximately 130 deg. C, the material comprising surface **605** melts. Under the force of clamps **14** the material comprising surface **605** flows in and among fibers **705** of strip **700**. Holes **900** in knots **805** are filled, as are the regions surrounding the walls of cells **800**. After sufficient material in inner surface **605** has flowed and fused to seal bag **600** and strip **700**, clamp **22** is deactivated. Bag **600** is now hermetically sealed.

[**0064**] The depth of the sealed region in a direction perpendicular to edge **602** of bag **600** is approximately 1.59 mm (0.0625 in). This is greater than the dimension of a single cell **800** of strip **700**. Thus an airtight hermetic seal is formed across many cells **800**. Bag **600** is now evacuated and fully sealed and can be removed from apparatus **400**.

[**0065**] Since strip **700** provides an airway passage for evacuation, yet is also fusible and sealable, no embossed surface is required on the inside of bag **600**. Strip **700** is left in place in the sealed bag. It protrudes slightly (about 1 mm) from the sealed opening of bag **600**. The protruding edge can be trimmed if desired.

[**0066**] Bag **600** can be opened in the same manner as the prior-art bag of **FIG. 1**. I.e., it can be simply cut along any edge, or in any other suitable direction to permit access to its contents.

Description and Operation—Alternative Embodiment—FIGS. 12 and 13

[**0067**] A rigid or semi-rigid airway member can be used instead of flexible woven mesh strip **700**. One version of this member is shown in **FIGS. 12A, 12B**, and **13**.

[**0068**] A rigid or semi-rigid airway member **1200** (**FIGS. 12A and 12B**) preferably comprises a flat, heat-sealable finger or strip with channels **1205** incorporated into one or both flat surfaces. Thus the surface of member **1200** has lands and grooves or is crenellated, as shown in **FIG. 12B**. Channels **1205** are preferably about 0.5 mm (0.020 in) deep with respect to the surface of member **1200**. Airway member **1200** preferably is the same size as woven strip **700**, described above. I.e. it has sufficient width to permit rapid evacuation of air from bag **600**.

[**0069**] Member **1200** is inserted into the open end of bag **600** and reaches from edge **602** inward to object **1000**, similar to the placement of strip **700** in **FIGS. 6 and 10**.

[**0070**] During evacuation of bag **600**, edge **602** is placed in trough **405** of apparatus **400**, as described above. Clamps **14** and **22** securely grip the open end of bag **600** and member **1200**. During heat-sealing of bag **600**, inner surface **605** of bag **600** softens or melts and flows into channels **1205**. Member **1200** also softens during the heat-sealing operation, thus eliminating most of the structure of channels **1205** or grooves **1305**. This completes the sealing process. Bag **600** with now-flattened airway member **1200** is removed from apparatus **400** and stored and bag **600** is sealed with its air evacuated.

[**0071**] In the embodiment of **FIG. 13**, an alternative airway member **1300** with a zigzag cross-section is shown. Member **1300** has grooves or valleys **1305** that act and operate similarly to channels **1205** of **FIG. 12**.

CONCLUSION, RAMIFICATIONS, AND SCOPE

[**0072**] It is thus seen that the present system provides a novel method and apparatus for vacuum-sealing plastic bags. These bags can store any perishable item including food, precious objects, chemicals, electronic components and the like which must be kept in a vacuum environment.

[**0073**] Because plain, not-embossed bags are used, the cost of the bag is greatly reduced. The width and length of the airway member are determined by the requirements of the heat-sealing operation. Because of this, the airway member can be reasonably small, much smaller than the entire inner area of the embossed bag of the prior art.

[**0074**] Extruded meshes can be used instead of woven meshes. Since extruded meshes have no knots, as do woven meshes, there are no holes in knots for air passage. However, adequate air space still exists at individual cell walls, between junction points of the mesh fibers, to permit evacuation of a container.

[**0075**] Folded and extruded bags of any size can be used. Various thicknesses and compositions of bags and airways can be selected to accommodate individual requirements. For example, objects with sharp points such as a lobster will require a thicker, tougher bag than flat objects. Multi-layer bags can be used where required. Transparent, opaque, and pre-printed bags and airway inserts can be used.

[**0076**] Various sizes and shapes of woven meshes and rigid airway fingers and strips can be used. The principal requirement is that there is sufficient material in the inner surface of the bag to fill all airway passages in the airway member. Alternatively, the airway member can be melted and crushed during sealing. Instead of a flat rigid airway finger, the cross section can be square, round, curved, or lenticular.

[**0077**] Instead of inserting the airway into the bag at the time of use, pre-prepared, ready-to-use bags can be made. Such bags would have an inwardly-extending airway attached at a point near the bag entrance at the time of manufacture.

[**0078**] The container can be non-flexible with a fusible mouth. The strip can be rigid or flexible and can contain a plurality of separate, non-interconnected channels.

[**0079**] While the above description contains many specificities, these should not be considered limiting but merely exemplary. Many variations and ramifications are possible. For example, instead of a two-layer bag, bags with three or more plastic layers can be used. In some cases, a one-layer

bag may be suitable. Two or more airway members can be used to speed evacuation of the bag.

[0080] While the present system employs elements which are well known to those skilled in the art of heat-sealing packages, it combines these elements in a novel way which produces a new result not heretofore discovered.

[0081] Accordingly the scope of this invention should be determined, not by the embodiments illustrated, but by the appended claims and their legal equivalents.

I claim:

1. An insertable airway strip for providing an escape path for air so that when said strip is placed in the mouth or opening of a container having fusible material at said mouth, and said strip extends from an interior part of said container to outside said container, said container can be evacuated via said strip and hermetically sealed around said strip, comprising:

a strip of material,

said strip comprising a solid member that contains a plurality of airway paths therethrough so that when said fusible material at said mouth sandwiches said strip and is fused, said fusible material will seal said airway paths to prevent said strip from thereafter conveying any air therethrough

whereby said strip may be used to evacuate a vacuum-sealable container and thereafter be easily sealed in the mouth of said container without the need for a container with an embossed interior surface.

2. The insertable airway strip of claim 1 wherein said strip has a plurality of lands and grooves on its surface.

3. The insertable strip of claim 2 wherein said lands and grooves have a rectangular configuration.

4. The insertable strip of claim 2 wherein said lands and grooves have a zig-zag configuration.

5. The insertable airway strip of claim 1 wherein said strip comprises a fiber mesh that has a plurality of internal paths therethrough.

6. The insertable airway strip of claim 5 wherein said strip comprises a plurality of elongated fibers that contain a plurality of knots.

7. The insertable airway strip of claim 1, further including said container which has fusible material at its mouth, said strip being narrower than the width of said mouth.

8. The invention of claim 6 wherein said container comprises a plastic material having a plurality of layers, an inner one of said layers being air-impermeable and fusible.

9. A method of evacuating and sealing a container, comprising:

providing a container having a mouth portion with an opening with a fusible material at said opening,

providing an insertable airway strip for providing an escape path for air so that when said strip is placed in said opening of said container, and said strip extends from an interior part of said container to outside said container,

placing said strip of material in said opening of said container so that said strip extends from an interior part of said container to outside said container,

evacuating said container by inserting said mouth portion of said container in a vacuum and sealing apparatus and clamping a pair of edges of said apparatus around said mouth portion and evacuating said container via said strip,

heating said edges to seal said opening of said container and said strip so that it can no longer convey air,

whereby said vacuum-sealable container can be evacuated and thereafter be easily sealed without the need for a container with an embossed interior surface.

10. The method of claim 9 wherein said strip has a plurality of lands and grooves on its surface.

11. The method of claim 10 wherein said lands and grooves have a rectangular configuration.

12. The method of claim 10 wherein said lands and grooves have a zig-zag configuration.

13. The method of claim 9 wherein said strip comprises a fiber mesh that has a plurality of internal paths therethrough.

14. The method of claim 13 wherein said strip comprises a plurality of elongated fibers that contain a plurality of knots.

15. The method of claim 9 wherein said strip is narrower than the width of said mouth.

16. The method of claim 15 wherein said container comprises a plastic material having a plurality of layers, an inner one of said layers being air-impermeable and fusible.

17. A method of evacuating and sealing a container, comprising:

providing a container having a mouth portion with an opening with a fusible material at said opening,

providing an insertable airway strip for providing an escape path for air so that when said strip is placed in said opening of said container, and said strip extends from an interior part of said container to outside said container,

placing said strip of material in said opening of said container so that said strip extends from an interior part of said container to outside said container,

said strip being narrower than said mouth of said container,

said strip comprising a fiber mesh that has a plurality of internal paths therethrough,

evacuating said container by inserting said mouth portion of said container in a vacuum and sealing apparatus and clamping a pair of edges of said apparatus around said mouth portion and evacuating said container via said strip,

heating said edges to seal said opening of said container and said strip so that it can no longer convey air,

whereby said vacuum-sealable container can be evacuated and thereafter be easily sealed without the need for a container with an embossed interior surface.

18. The method of claim 17 wherein said strip comprises a plurality of elongated fibers that contain a plurality of knots.

19. The method of claim 17 wherein said container comprises a plastic material having a plurality of layers, an inner one of said layers being air-impermeable and fusible.

20. The method of claim 19 wherein an outer one of said layers is bonded to said inner one of said layers.

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