INSULATED SHIPPING CONTAINER AND METHOD

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ABSTRACT

An improved shock-absorbing, disposable, insulated shipping container including an insulated body having a cavity for holding contents to be shipped in the container. The container also includes an especially configured dual-function structure, which is shock-absorbing and provides for air circulation about the contents of the container. A fan package provides for fan-forced circulation of air within the container over the contents and a temperature control mass, so that the contents are maintained at a desired uniform temperature during shipment.
INSULATED SHIPPING CONTAINER AND METHOD

CROSS REFERENCE TO RELATED APPLICATION


BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates generally to shipping containers, and more particularly relates to an improved insulated shipping container and method. The improved insulated shipping container has particular utility for shipping fragile or high value contents, which may be destroyed or damaged either because fragile bottles of the contents can be broken by dropping or jarring the container during shipping, or which may be rendered unusable by temperature variations (either too high or too low a temperature) experienced during shipping. The improved insulated shipping container is configured and constructed to provide both shock absorption, and to provide temperature regulation for the contents of the container by promoting natural or fan-forced convection currents within the container in order to maintain a temperature controlled condition which may be neither freezing or too warm, and which is maintained for an extended period of time without significant temperature stratification during transport by common carrier. Most preferably, the insulated shipping container according to this invention is disposable, and is used for only one shipping of a high-value contents, although the invention is not so limited.

[0004] 2. Related Technology

[0005] Traditionally, disposable containers for shipping temperature sensitive products have generally included conventional cardboard shipping containers having an insulating material therein. The insulating material may be simple loose-fill Styrofoam “peanuts,” for example, in which a chunk of dry ice is placed along with the material to be shipped. Another variety of conventional insulated shipping container utilized panels or containers made of an insulating material, such as expanded polystyrene (EPS). EPS is a relatively inexpensive insulating material, and it may be easily formed into a desired shape, has acceptable thermal insulating properties for many shipping needs, and may be encapsulated or faced with protective materials, such as plastic film or metal foil, or plastic film/metal foil laminates.

[0006] Containers including EPS are often provided in a modular form. That is, individual panels of EPS insulation, possibly wrapped in foil or the like, are preformed using conventional methods, typically with beveled or rabbed edges. The panels are then inserted into a conventional cardboard box type of shipping container, one panel against each wall, to create an insulated cavity within the container. In this arrangement, the beveled or rabbed edges of adjacent panels form seams at the corners of the container. A product is placed in the cavity and a plug, such as a thick polyether or polyester foam pad, is placed into the top of the cavity and over the top of the product before the container is closed and prepared for shipping. In many cases, a coolant, such as packaged ice, gel packs, or loose dry ice, is placed around the product in the cavity to refrigerate the product during shipping.

[0007] Alternatively, an insulated body may be injection molded from expanded polystyrene, forming a cavity therein and having an open top to access the cavity. A product is placed in the cavity, typically along with coolant, and a cover is placed over the open end, such as the foam plug described above or a cover also formed from EPS.

[0008] For shipping particularly sensitive products, such as certain medical or pharmaceutical products, expanded rigid polyurethane containers are often used, as expanded polyurethane has thermal properties generally superior to EPS. Typically, a cardboard container is provided having a box liner therein, defining a desired insulation space between the liner and the container. Polyurethane foam is injected into the insulation space, substantially filling the space and generally adhering to the container and the liner. The interior of the box liner provides a cavity into which a product and coolant may be placed. A foam plug may be placed over the product, or a lid may be formed from expanded polyurethane, typically having a flat or possibly an inverted top-flat shape.

[0009] For large size durable (i.e., expensive and not disposable) shipping containers, it is known to provide a dedicated refrigeration device (i.e., a mechanical refrigeration set using a refrigerant such as Freon, with a power supply, and a compressor, with heat exchangers, fans, and controls). However, such durable powered refrigerated containers are both large and expensive. They also require that the empty containers be shipped back (usually empty) to the place of origin for reuse. This return shipping adds significantly to the cost of using such large durable refrigerated containers. Such containers are also expensive initially, and require skilled service after every use to prepare them for their next use. They are subject to damage during shipping, and sometimes are stolen simply because of their intrinsic value. Thus, such larger durable refrigerated shipping containers have a very large initial cost, require service of the refrigeration package and its power supply after every use, have a high first cost, and a significant cost of use, incur large shipping costs (in part because of the empty return shipping), and are suitable only for shipments of large size.

[0010] For shipments of smaller size, containers using dry ice or frozen gel packs are commonly employed. With such conventional shipping containers, the fact that the product and coolant are typically placed together within a cavity in the container, may have several adverse effects. When shipping certain products, it may be desired to refrigerate but not freeze the product. Placing a coolant, such as loose blocks of dry ice, into the cavity against the product may inadvertently freeze and damage all or a portion of the product. Even if held away from the product, the coolant may shift in the cavity during shipping, especially as it melts and shrinks in size, inadvertently contacting the product. In addition, with gel packs, if they become perforated then melted coolant may leak from the pack, possibly creating a mess within the cavity or even contaminating the product being shipped.

[0011] Finally, polyurethane containers of the type using two cardboard boxes nested together with polyurethane
injectected into the space between these boxes (i.e., a composite container) may also create a disposal problem. When polyurethane is injected into such a container, it generally adheres substantially and strongly to the walls of both the inner and the outer cardboard box. Thus, the cardboard and insulation components of the container cannot be easily separated, and many have to be disposed of together, usually into a landfill, preventing recycling of the container. Some countries, states, and other jurisdictions have prohibited local disposal of such composite containers, requiring that the containers be shipped back to their place of origin for disposal or re-use.

[0012] Further, when temperature sensitive materials are shipped in winter time, there is a need to prevent low ambient temperatures from freezing the product being shipped.

[0013] Accordingly, there is a need for an improved shipping container to both cushion contents and prevent shocks and jarring from damaging the shipped contents, and to maintain temperature sensitive materials in a temperature controlled condition which is not freezing or too warm during transport and over an extended period of time.

SUMMARY OF THE INVENTION

[0014] The present invention is directed generally to an improved insulated shipping container and method. Particularly, the improved insulated shipping container provides for controlled energy absorption, so that shocks and jarring experienced during shipping (such as aboard a truck operated by a common carrier) do not damage fragile contents of the container. Further, the improved insulated shipping container provides for a temperature regulated condition, which is not frozen or too warm, for an extended period of time. That is, the improved container may be used to ship refrigerated contents during all seasons. Alternatively, the container may also be used in cold weather conditions to prevent an item being shipped from being frozen by low ambient temperatures. In the latter situation, gel packs with are warmed prior to shipping of the container are used, and the features of the container are employed to maintain a temperature controlled environment within the shipping container during shipment.

[0015] One aspect of the present invention provides a shock absorbing insulated shipping container for transporting a fragile product or contents comprising: an insulated body having a cavity defining an opening; the insulated body providing both thermal insulation to the contents of the container, isolating the contents from ambient conditions outside the container, a energy absorbing structure defining a controlled crush structure extending about the contents and isolating the contents from shocks and jarring experienced by the container during shipping, and an air circulation space or channels extending about the contents of the cavity. More particularly, the present invention provides an improved shock absorbing insulated shipping container, said container comprising: a chambered foam polymer insulated body, said body including a base portion defining a chamber therein and an opening from said chamber, and a lid portion spanning and closing said opening; said container also including dual-function structure disposed within said chamber for receiving contents to be shipped in said container, and a temperature-control mass, said dual-function structure on the one hand providing a shock-absorbing structure spacing the contents away from inside surfaces of said chamber so as to maintain a surrounding cushion space of controlled crushability, and on the other hand, also providing an air circulation space surrounding the contents, whereby air currents are allowed to circulate about said contents and said temperature-control mass.

[0016] According to another aspect, the present invention provides a method of isolating contents to be shipped both from shock and from ambient temperatures. This method includes steps of providing a chambered foam polymer insulating body, and configuring said body to include a base portion defining a chamber therein and an opening from said chamber, and a lid portion spanning and closing said opening. Included in the chamber of the body is a dual-function structure for receiving contents to be shipped in said container, and a temperature-control mass. Configuring said dual-function structure to the one hand provide a shock-absorbing structure spacing the contents away from inside surfaces of said chamber so as to maintain a surrounding cushion space of controlled crushability, and to the other hand also provide an air circulation space surrounding the contents, whereby air currents are allowed to circulate about said contents and said temperature-control mass.

[0017] Other objects and features of the present invention will become apparent from consideration of the following description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

[0018] FIG. 1 provides an external perspective view of an insulated shipping container embodying the present invention;

[0019] FIG. 2 is a side elevation view of the container seen in FIG. 1, taken at the line 2-2, and looking in the direction of the arrows, and shows contents within a cavity of the shipping container;

[0020] FIG. 2A is a side elevation view like FIG. 2, showing the insulated shipping container with no contents in the cavity for clarity of illustration of certain features and structures of the insulated shipping container;

[0021] FIG. 2B provides a plan view of the container seen in FIG. 2A, and is taken at the line 2B-2B of that Figure;

[0022] FIG. 3 is a fragmentary perspective view of the lower portion of the container seen in FIGS. 1-2B, partially in cross section, with some elements of the container omitted, and with the two walls and a portion of the container closest to the viewer broken away for clarity of illustration;

[0023] FIG. 4 provides a fragmentary elevation view, partially in cross section, of a portion of the insulated container seen in FIGS. 1-3, and is taken at line 4-4 of FIG. 2B;

[0024] FIG. 5 is a side elevation view of an alternative embodiment of insulated shipping container, and is similar to the view seen in FIG. 2, except that the embodiment of this Figure includes a power-driven forced-convection fan device;

[0025] FIG. 5A provides a side elevation view of the alternative embodiment of insulated shipping container seen
in FIG. 5, but is shown without contents in the cavity of the container for clarity of illustration;

[0026] FIG. 6 provides an enlarged fragmentary view, partly in cross section, of the alternative embodiment of insulated shipping container seen in FIGS. 5 and 5A;

[0027] FIG. 7 is a fragmentary side elevation view, similar to FIGS. 5 and 5A, but showing yet another alternative embodiment of a shipping container according to this invention including a power-driven, forced-convection fan device;

[0028] FIG. 8 provides a generalized diagrammatic or schematic illustration of a power and control circuit for a forced-convection fan device such as is included in the embodiments of FIGS. 5-7;

[0029] FIGS. 9, 10, and 11 each provide an illustration of a respective control element which may be included in the control circuit of FIG. 8, in order to effect controlled fan-forced convection for an insulated shipping container according to this invention;

[0030] FIGS. 12 and 13 each provide side elevation views, partially in cross section, of yet another alternative embodiment of insulated shipping container, including fan-forced convection, with FIG. 12 illustrating contents in the cavity of the container, while FIG. 13 illustrates the container with its cavity empty of contents for shipping;

[0031] FIG. 14 provides a plan view of the container seen in FIG. 12, with the container lid removed to provide a view into the cavity of the container;

[0032] FIG. 15 provides a fragmentary elevational perspective view of the container seen in FIGS. 12-14;

[0033] FIG. 16 is an exploded perspective view of components of the insulated container seen in FIGS. 14-15;

[0034] FIG. 17 provides an elevation view of an insulated shipping container embodying the present invention;

[0035] FIG. 18 is an elevation view of the container seen in FIG. 17, but is shown without contents in the cavity of the container for clarity of illustration;

[0036] FIG. 19 provides a fragmentary perspective view of the lower portion of the container seen in FIGS. 17 and 18, partially in cross section, with some elements of the container omitted, and with the two walls and a portion of the container closest to the viewer broken away for clarity of illustration;

[0037] FIG. 20 is a plan view of the container seen in FIGS. 17-19;

[0038] FIG. 21 provides an elevation view of an insulated shipping container with its lid removed (similar to FIG. 14), and illustrates another alternative embodiment of insulated shipping container embodying this present invention; and

[0039] FIG. 22 is an elevation view of the container seen in FIG. 21, and includes additional elements of the container.

[0040] FIGS. 23 and 24 provide respective plan views in perspective of still another alternative embodiment of an insulated shipping container according to this invention; and

[0041] FIG. 25 is a fragmentary elevation view of the container seen in FIGS. 23 and 24, but with contents illustrated within the container.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0042] Turning now to the drawings, considering FIGS. 1-4 in conjunction, and giving attention first of all to FIG. 1, this Figure shows a shock absorbing, insulated shipping container 10 in accordance with the present invention. The container 10 generally includes a rectangular prismatic body 12, which is formed principally of insulative and shape-retaining, but somewhat yieldable, foamed polymer. Preferably, the body 12 is formed of foamed polyurethane polymer, although the invention is not so limited. That is, the insulated and chambered container may be formed of other materials and may employ other insulation methods or structures. The body 12 includes a base or main portion 14, and a lid portion 16. The base portion 14 in this embodiment includes planar wall portions 14a/b/c/d, and a planar floor portion 14e. As is best seen in FIGS. 2, 2A, and 3, the body 12 is chambered, and defines an interior chamber or cavity 18. The base portion 14 defines an opening 20 to the cavity 18, and a lip 22 surrounding this opening 20. Outwardly of the lip 22, the base portion 14 defines a circumferential rabbet 24. Considering FIGS. 2 and 2A, it is seen that the lid portion 16 includes a wall portion 26 spanning the opening 20, and a circumferential flange 28 received into rabbet 24 and about the lip 22.

[0043] Disposed within the cavity 18 are the contents (generally referenced with the numeral 30) to be shipped in the container 10. In this case, the contents 30 includes plural relatively small boxes 32 (individually labeled 32a/32b/32c, etc.), each of which may contain, for example, a liquid material carried in a glass bottle or vial, although the invention is not so limited. By way of example only, the liquid contents of the boxes 32 may include human growth hormone, or a vaccine. Thus, it is to be understood that the contents of shipping container 10 may have a high value.

[0044] Considering the contents and arrangement of the cavity 18, it is seen that a cushion space or substantially void volume, generally referenced with the numeral 34 surrounds the contents 30. Below the contents 30 (as well as on the vertical side of the contents "toward" and away from the viewer of FIG. 2), the void volume 34 is maintained by a pair of channel shaped members 36. These channel members 36 are both channel shaped in cross section, as well as being U-shaped overall. Toward the left and right sides of the contents 30 (as viewed in FIG. 2) the void space or cushion 34 is maintained by channel members 36a. The channel members 36a are channel shaped in cross section, but are straight overall. Each of the channel members 36, 36a is a "dual function" structure (as will be further explained), and each is preferably formed of corrugated paper board (i.e., corrugated cardboard), although the invention is not so limited. As is seen in the various drawing Figures, the corrugations of the corrugated cardboard channel members 36, 36a preferably run parallel to the length dimension of these channel members. So, at the exposed ends 36b of these channel members 36, 36a (best seen in FIGS. 2 and 2B), the serpentine corrugations are visible. Moreover, it is noted that also toward both the left-hand and right-hand sides of the contents 30 (as seen in FIG. 2), the respective channel
members 36a are carried by the respective walls of the base portion 14 and that each may define plural spaced apart holes or openings 36c along the sides there. These channel members 36a maintain the cushion space 34 respectively to the right and left side of the contents as seen in FIG. 2. Similarly, above the contents 30 (as is also best seen in FIG. 2), the cushion space 34 is maintained by a layer of packing material 38, which is preferably cellular foam polymer, and which further preferably may define plural vertically extending holes or passages 38a.

[0045] Above the top end edges 36b of the channel members 36, and supported thereby, is a partition member or tray member 40, which similarly may define plural vertically extending holes or passages 40a therein, which preferably align with or communicate with the passages 38a. Finally, it is to be noted that disposed upon the tray member 40, is a temperature control or refrigerant mass 42. This temperature control or refrigerant mass 42 may include a block of dry ice, for example. Or, the temperature-control, or refrigerant mass 42 may include a refrigerated (or warmed) gel pack, for example. Alternatively, the mass 42 may include a quantity of chunked or cubed dry ice. Water ice may also be employed as temperature control mass 42, and is preferably contained within a plastic bag.

[0046] Considering now FIGS. 2A, 2B, and 3 in conjunction, it is seen that the base portion 14 of body 12 in order to carry or receive the channel members 36, 36a, and tray 40 defines a shallow ledge 44 circumscribing the cavity 18, and plural vertically extending and laterally spaced apart grooves 46 and 48 each extending from this ledge downwardly to the floor 18a (i.e., the top surface of wall 14a within cavity 18). The grooves 46 are defined in walls 14a and 14c (only wall 14c being seen in FIG. 3), while the grooves 48 are defined in walls 14b and 14d (only the wall 14b being seen in FIG. 3). It is seen best in FIG. 3 that the grooves 46 extend not only vertically along the walls 14a and 14c, but also continue across the floor 18a (wall 14c) to communicate with the respective grooves 46 in the opposite wall. Into these grooves 46 and 48, respective end portions of the two opposite walls of the channel members 36 and 36a are slidably and retainingly received. That is, the width dimensions of the grooves 48, 46 are selected to provide a snug sliding and retaining fit therein of the corrugated cardboard from which the channels 36, 36a are formed.

[0047] As is best seen in FIGS. 2A, 2B, and 3, the channel members 36 are continuous vertically along opposite walls 14a and 14c (and across the floor 18a) while the channel members 36a extend only along the vertical walls 14b and 14d. As is seen in FIGS. 2A, 2B, and 3, these channels 36a preferentially define a plurality of spaced apart lateral perforations or holes 36b, which communicate through the opposite sides of the channel members adjacent to the respective walls. In this way, the channel members 36 and 36a provide for substantially unimpeded air circulation about the contents 30. As is seen best in FIG. 4, the channel members 36 are preferably continuous vertically along the side walls 14c and 14a (only wall 14c being seen in FIG. 4), and define a "living" hinge feature or section 50. Accordingly, when the channel members 36 are disposed as seen in the drawing Figures, they also form an open corner passage 52, also providing for additional air flow area between the inside and outside of each channel member 36.

[0048] Further viewing FIGS. 2, 2A, and 2B, it is seen that each channel member 36, 36a includes a central portion 54 upon which the contents 30 may make contact, and a pair of laterally spaced apart leg portions (each indicated with the numeral 56). The legs 56 are sufficiently longer than the depth of the grooves 46 and 48, that the central portion 54 is spaced from the respective walls 14, leaving an air passage 58. Considereing now the drawing FIGS. 2A-2B in conjunction with one another, it will be apparent that entirely about the contents 30, the insulated shipping container 10 maintains a void space or cushion volume 34 in which substantially unimpeded convection currents may circulate in order to maintain thermal equilibrium between the contents 30 and the refrigerated (or warmed) mass 42. In this way, the contents 30 are maintained at a substantially uniform temperature throughout, so that hot or cold spots are avoided because of ambient warmth (or cold) conducting through the walls 14 or lid 16. This is especially the case because colder air from the refrigerated mass 42 will settle toward the bottom of cavity 18, while warmer air will tend to circulate by natural convection toward the top of cavity 18, where it will come into contact with the mass 42 and be cooled. So to, warmth conducting through the walls 14 toward the contents 30 will be intercepted by convection currents before reaching the contents 30 because the void volume about these contents prevents contact of the contents 30 directly with the walls 14.

[0049] Further to the above, it is appreciated that if, in addition to providing air circulation space and channels about the contents 30, the channels 36, 36a provide a spacing structure of controlled crushability (energy absorption), spacing the contents 30 from the walls 14. That is, each channel 36, 36a includes a pair of spaced apart legs 56 providing the air passage 58. In the event that the container 10 is subjected to a shock or jarring of sufficient force and violence, some of the energy of the shock will be absorbed by the expanded foam polymer material from which the walls 14 or lid 16 is made. However, for fragile contents 30, the polymer foam from which the container 10 (i.e., body 12 and lid 16) is formed may nevertheless allow too much energy to be transmitted to the contents. So, the crushability of the channel members 36, 36a can be selected by variation of a combination of factors, including the thickness of the cardboard from which these channel members 36, 36a are made, the weight of paper used for the face sheets of that cardboard, the weight of paper used for the corrugations of the cardboard, the length of the legs 56, and the width of the central portion 54. Also, the number and size of the perforations 36c can be varied. These perforations may be omitted, or may be large or small, as is needed to accomplish a desired degree of crushability for the channel members 36 and 36a. Similarly, the channel members 36 and 36a may be individually tailored to the requirements necessary to safeguard the contents 30, as the contents 30 may have a differing weight in a particular direction, as well as possibly having a greater or lesser strength in a particular direction. The result is that a structure defining an air circulation space (i.e., for convection currents), with this structure also providing a controlled crush space and energy absorption, is provided about the contents 30 within the cavity 18.

[0050] Turning now to FIGS. 2A, 2B, and 2C, a second embodiment of the insulated shipping container 10 in accordance with the present invention is shown. Because this second embodiment shares many features and structures in
common with the first embodiment described above, these features are indicated on FIGS. 5, 5A, and 6 with the same numeral used above, and increased by one-hundred (100). Viewing FIGS. 5, 5A, and 6 in conjunction, it is seen that a shock absorbing, insulated shipping container 110 in accordance with a second embodiment of the present invention is substantially the same as the first embodiment described above, with important differences to be described immediately below. An important difference of the container 110 is that the floor wall 114c is preferably thicker than was the case with container 10. This added thickness of floor wall 114c is needed to accommodate or provide space for a power-driven, forced-circulation fan package, generally referenced with the numeral 60. While the present embodiment includes the fan package 60 within cavity 118, the invention is not so limited. In other words, an insulated container according to this invention could employ a fan outside of but communicating with the cavity 118. This fan package 60 is received into a stepped recess 62 defined in the floor wall 114c of the insulated shipping container 110. Importantly, the stepped recess 62 includes a smaller diameter portion 62a, and a larger diameter portion 62b opening to the cavity 118. Thus, it is to be appreciated that the stepped recess 62 is most preferably circular or round in plan view, although the invention is not so limited.

[0051] Snugly received into the portion 62a of the recess 62 is a base portion 64 of the fan package 60. This base portion 64 may house batteries and controls (not detailed in FIGS. 5, 5A, and 6) for the fan package 60. Above the base portion 64, the fan package 60 may include a motor 66, and this motor 66 preferably drives a fan 68, which is illustrated in the Figures as being a shrouded fan so that the individual fan blades are not visible in these figures. Importantly, the fan 68 is disposed most preferably in the larger portion 62b of recess 62, so that an air flow space 70 (arrowed with flow arrows on FIG. 6) is provided about the fan 68. As a result, the fan 68 when operating is able to provide a discharge flow of air (arrows 72 on FIG. 6) discharging into the cavity 118. As is seen most clearly in FIG. 6, the fan 68 most preferably receives inflow from within the channels 136, and discharges air flow between these channels 136. When contents 130 are disposed in the cavity 118, the discharge air flow will flow about these contents in the air flow and cushion space 134 therewith, and at least some of this fan-forced circulation air flow will pass to and over the refrigerated mass 142.

[0052] In view of the above, it is seen that the insulated shipping container 110 will experience a vigorous fan-forced circulation air flow within the cavity 118 while the fan 68 is operating during shipping of the container 110. This fan-forced circulation air flow is especially important in the event that the container 110 is placed on its side or inverted. As will be easily understood from a consideration of the convection air flow within the first embodiment of insulated shipping container 10 described above, in the event that the refrigerated mass 42 or 142 is not at the top of the cavity 18/118 (i.e., because the container is on its side or is inverted), then some of the contents may become unduly warm because the cold air from the mass 42/142 circulates downwardly by natural convection. Also, experience has shown that even when an insulated container is in the desired orientation, temperature stratification can occur within the cavity of the container. That is, natural convection currents are not sufficient to prevent some of the contents of the container from experiencing a higher than desired temperature (i.e., in the case of contents that require cooling), while other of the contents may experience a temperature that is too low. However, with the insulated shipping container 110 including fan package 60, so long as this fan package is running, the cool air from refrigerated mass 42 will be circulated about the contents 130 regardless of the orientation of the container 110. The container 110 provides the same advantages of providing a dual-function structure both spacing the contents of the package 110 away from the inside surfaces of the walls 114 with a controlled crushability (i.e., so as to isolate the contents against shock), and also providing a surrounding air flow space, as was the case with the first embodiment described above.

[0053] Turning now to FIGS. 7-11 alternative embodiments of a fan package are illustrated. Because this fan package includes many features in common with the embodiment illustrated in FIGS. 5-6, the same reference numerals utilized above are used in FIGS. 7-11, with an added one-hundred, etc., added to distinguish between alternative embodiments. Viewing first FIG. 7, it is seen that a fan package 160 may include an extended discharge tube 74 extending upwardly between the channel members 136 so that air discharged from the fan is forced to flow upwardly within the cavity 118. Similarly, the size of the air flow passages 170 may be enlarged so as to provide an abundant air flow space for circulation of air within the cavity 118. FIG. 8 diagrammatically illustrates that the fan package 160 includes, and 60 for the fan package 60. Above the base portion 64, the fan package 60 may include a motor 66, and this motor 66 preferably drives a fan 68, which is illustrated in the Figures as being a shrouded fan so that the individual fan blades are not visible in these figures. Importantly, the fan 68 is disposed most preferably in the larger portion 62b of recess 62, so that an air flow space 70 (arrowed with flow arrows on FIG. 6) is provided about the fan 68. As a result, the fan 68 when operating is able to provide a discharge flow of air (arrows 72 on FIG. 6) discharging into the cavity 118. As is seen most clearly in FIG. 6, the fan 68 most preferably receives inflow from within the channels 136, and discharges air flow between these channels 136. When contents 130 are disposed in the cavity 118, the discharge air flow will flow about these contents in the air flow and cushion space 134 therewith, and at least some of this fan-forced circulation air flow will pass to and over the refrigerated mass 142.

[0054] Alternatively, FIGS. 10 and 11 illustrate that an effective temperature control may be effected by the use of a semi-conductor element (i.e., a zener diode 80, or a transistor 82) connected in series with the motor 166 as a control element 78. In each case, the element 80 or 82 acts as a voltage control for the motor 166, such that the motor 166 runs more slowly than it would if provided with full battery voltage when both the thermal mass and batteries are fresh (i.e., at a time when a lesser degree of air circulation is sufficient to maintain a desired temperature in the cavity 118), but also, so that power for the fan 160 lasts longer. A result is that the fan 160 will operate longer and will still be operating later in the use of the container 110 when the thermal mass is no longer fresh, is no longer so cold (or warm), and when a desired level of air circulation is desired.
within the cavity 118 in order to maintain the desired temperature uniformity in this cavity.

Turning now to FIGS. 12-16, still another alternative embodiment of a temperature controlled insulated and shock absorbing shipping container according to this invention is illustrated. Because the embodiment of FIGS. 12-16 has many features in common with the embodiments illustrated and described above, the same reference numerals (increased by two-hundred (200)) are utilized in FIGS. 12-16. Viewing FIGS. 12 and 13 an insulated, shock absorbing and temperature controlled shipping container 210 generally includes a rectangular prismatic body 212, which is formed principally of foam polymer. The body 212 includes a base or main portion 214, and a lid portion 216. The base portion 214 in this embodiment includes wall portions 214a/b/c/d (best seen in drawing FIG. 14), and a floor portion 214e. The body 212 is chambered, and defines an interior chamber or cavity 218.

Disposed within the cavity 218 are the contents, generally referenced with numeral 230, and individually as boxes 232 (seen in FIG. 12 but not in FIGS. 13, 15, or 16) to be shipped in the container 210. Along with the contents, the container 210 includes a shock-absorbing and air-channeling interlocking wall structure (best seen in FIGS. 15 and 16) indicated generally with the numeral 84.

Considering the contents and arrangement of structure within the cavity 218, it is seen that a cushion space or substantially void volume, generally referenced with the numeral 234 surrounds the contents 230. Below the contents 230, the void volume 234 is maintained by a plurality of protrusions 86, which may be configured, for example, as blocks, or ribs, or fins of the foam material of floor 214e, which protrusions 86 protrude upwardly into the cavity 218 all to substantially the same height, and so cooperatively provide an aggregate surface 86a (or aggregate support plane) upon which the wall structure 84 and the contents 230 rest. These blocks, ribs, or fins 86 provide an air channel space, and also have a selected cushion effect. That is, the number and size (i.e., in cross section) of the blocks or fins 86 of foam material is selected in view of the strength of the foam material in compression, so that these blocks or fins 86 have a determined crush or buckling strength. Toward the left, right, front and back sides of the contents 30 (again, as best viewed in FIG. 14) the void space or cushion 234 is maintained by protruding end portions 84a (best seen in FIG. 16) of the wall structure 84. Because this wall structure 84 is preferably formed of interlocking panels or pieces 84c of fiberboard or paper board (i.e., corrugated cardboard) it is well understood in view of the disclosure above how the crush or buckle strength of these protruding portions 84a can be selected to safeguard the contents 230 from shock.

Further to the above, the void space 234 also provides air circulation space surrounding the contents 230. Importantly, the wall structure 84 is arranged in such a way as to provide on the one hand, vertically extending wells 84b for receiving the contents 230, and on the other hand to provide in addition to the surrounding void space 234, a centrally located (i.e., among the contents 230, but not necessarily central of the cavity 218) “chimney” 84c, which provides for very open or effective air circulation in the cavity 218. In this case, the chimney 84c is of cruciform configuration, with a central passage indicated by the arrowed numeral in FIG. 15, as well as four side passages (or slots) 84d, also seen in FIG. 15. A result of the cruciform chimney configuration is that the contents 230 of the cavity 218 are surrounded by cooling air flow circulation, substantially preventing warmth from the ambient from reaching any part of the contents 230. Thus, in the event that the contents 230 is a high-value and very temperature sensitive product (such as a vaccine, or human growth hormone, for example), the temperature isolation and protection from ambient warmth provided by the container 210 to these contents is far better than conventional insulated shipping containers can provide.

Turning now to FIG. 16 in greater detail for an illustration of how the wall structure 84 is constructed of interlocking pieces 84c; it is also seen that a top panel 88 defines plural air circulation perforations 88a, and a centrally located larger perforation or hole 88b. Received into the hole 88b is a fan package 90 carrying a fan 262. The fan package is shown larger in size in FIG. 16 in order to make its details better visible to the viewer. In fact, the fan 262 of fan package 90 will only be about one inch or slightly larger in diameter, and the fan package itself will be about 3 inches in diameter. This fan package 90 fits into and is snugly retained in the hole 88b, and is disposed directly above the chimney 84c. Thus, as is best illustrated in FIGS. 12 and 13, the fan package 90 causes air within cavity 218 to be vigorously circulated (as is depicted by the air flow arrows on FIGS. 12 and 13). Atop of the panel or tray 88 and around the fan package 90 is disposed thermal masses 242 (or gel packs) so as to provide cooling or warming to the contents 230 in cavity 218.

Considering now to FIGS. 17-20, and recalling the description above about the protruding features 86 (i.e., blocks, ribs, or fins, for example), yet another embodiment of the present invention is depicted. Because this embodiment has many features which are the same or analogous in structure or function to those of earlier embodiments, these features are indicated on FIGS. 17-20 with the same numeral used above, and increased by one-hundred (100). As FIG. 17 illustrates, a shock absorbing, insulated shipping container 310 in accordance with the present invention includes a generally rectangular prismatic body 312. This body 312 is preferably formed principally of foam polymer (i.e., preferably of foamed polyurethane polymer). The body 312 includes a base or main portion 314, and a lid portion 316. The base portion 314 in this embodiment includes planar side wall portions 314a/b/c/d, and a planar floor wall portion 314e. As is best seen in FIGS. 18-20, the body 312 is chambered, and defines an interior chamber or cavity 318. The base portion 314 defines an opening 320 to the cavity 318, and a lip 322 surrounding this opening 320. Outwardly of the lip 322, the base portion 314 defines a circumferential rabbet 324. The lid portion 316 includes a wall portion 326 spanning the opening 320, and a circumferential flange 328 received into rabbet 324 and about the lip 322.

However, inspection of FIGS. 17-20 will show that in this embodiment the contents 330 (i.e., boxes 332, for example) rest upon and are spaced away from the interior wall surfaces of the container 310 almost entirely by cushioning structures (to be further described) which are integral with the container 310 itself. Turning to FIGS. 19 and 20, it is seen that the base portion 314 defines plural inwardly
protruding features 186, which may be configured, for example, as a plurality of spaced apart ribs, as is shown in these Figures. Alternatively, the features 186 may be configured as a plurality of blocks, fins, or even as pins or individual columns of foam material protruding from the inside surfaces of the walls 314a-c and into the cavity 318. These protrusions 386, regardless of their configuration (i.e., blocks, ribs, fins, etc.) are sized and spaced apart so as to on the one hand provide an air channel and cushion space 334, and on the other hand to also have a selected cushion effect. That is, the number and size (i.e., in cross section) of the blocks, ribs, fins, etc., 386 of foam material are selected in view of the strength of the foam material in compression, so that these protrusions 386 have a determined crush or buckling strength.

[0062] Above and resting upon a circumferential ledge 344 defined about cavity 318 is a top panel 388 (best seen in FIG. 17). This panel defines plural air circulation perforations 388a. On this panel or tray 388 is disposed a thermal mass 342 (or gel pack) so as to provide cooling or warming to the contents 330 in cavity 318. A panel 338 of foam packing material is interposed between the contents 330 and the tray 388, and defines plural air circulation holes 338a.

[0063] Attention now to FIGS. 21 and 22 in conjunction, and recalling the description above of FIGS. 17-20, still another embodiment of the present invention is depicted. Because this embodiment also has many features which are the same or analogous in structure or function to those of earlier embodiments, these features are indicated on FIGS. 21 and 22 with the same numeral used above, and increased by one-hundred (100). As FIG. 22 illustrates, a shock absorbing, insulated shipping container 410 in accordance with the present invention includes a generally rectangular prismatic body 412. This body 412 is preferably formed principally of foamed shape-retaining but somewhat resilient polymer. The body 412 includes a base or main portion 414, and a lid portion 416. The base portion 414 in this embodiment includes planar side wall portions 414a/b/c/d, and a planar floor wall portion 414e. As is best seen in FIG. 21, the body 412 is chambered, and defines an interior chamber or cavity 418. The base portion 414 defines an opening 420 to the cavity 418, and a lip 422 surrounding this opening 420. Outwardly of the lip 422, the base portion 414 defines a circumferential rabbit 424. The lid portion 416 includes a wall portion 426 spanning the opening 420, and a circumferential flange 428 received into rabbit 424 and about the lip 422.

[0064] However, inspection of FIGS. 21 and 22 will show that similarly to the embodiment of FIGS. 17-20, this embodiment defines plural inwardly protruding features 286, which in this embodiment are configured as a plurality of spaced apart blocks 286a on the floor wall 414e, and connecting vertically extending ribs 286b extending generally upwardly from the blocks 286a along the corners of the cavity 418. Within these ribs 286b and resting on the blocks 286a is an interlocking wall structure 184 similar to wall structure 84 (recalling FIG. 16), but not requiring or including the protruding end portions 84a of wall structure 84. In this case, the ribs 286b serve to space the wall structure 184 away from the inside surface of the side walls 414a-d, and provide a circumferential cushion space 434. This cushion space 434 is also maintained below the contents by the blocks 286a, upon which the wall structure 184 and contents 430 rest.

[0065] Above and resting upon a circumferential ledge 344 defined about cavity 418 by the ribs 286b is a top panel 488 (best seen in FIG. 22). This panel defines plural air circulation perforations 488a. On this panel or tray 488 is disposed a thermal mass 442 (or gel pack) so as to provide cooling or warming to the contents 430 in cavity 418. A panel of foam packing material (not seen in FIG. 21 or 22) may be interposed between the contents 430 and the tray 488, and define plural air circulation holes, if additional cushioning space is desired in the upward direction (i.e., relative to the contents 430). It is also seen in FIG. 22 that the tray or panel 488 defines a centrally located larger perforation or hole 488b. Received into the hole 488b is a fan package 490 carrying a fan 462. This fan package 490 is disposed directly above a chimney 184i defined by the wall structure 184. Thus, as is best illustrated in FIG. 22, the fan package 490 causes air within cavity 418 to be vigorously circulated (as is depicted by the air flow arrows on FIG. 22).

[0066] Finally, attention now to FIGS. 23-25 in conjunction with FIGS. 21-22 will illustrate another embodiment of the present invention. Because this embodiment also has many features which are the same or analogous in structure or function to those of earlier embodiments, these features are indicated on FIGS. 23-25 with the same numeral used above, and increased by one-hundred (100) over their prior usage. In general this embodiment of the invention provides an insulated shipping container which has both structure providing a surrounding cushion space, as well as air circulation channels or spaces, as well as providing a variable-volume feature. This variable-volume feature allows a container of a given size to be used to safely transport shipments of contents of a much smaller volume. As a result, a reduced number of different sizes and shapes of insulated shipping containers will suffice to ship many differing sizes and volumes of contents.

[0067] Turning first to FIG. 23, a shock absorbing, insulated shipping container 510 in accordance with the present invention includes a generally rectangular prismatic body 512. This body 512 is preferably formed principally of foamed shape-retaining but somewhat resilient polymer. The body 512 includes a base or main portion 514, and a lid portion 516 (seen in FIG. 25). The base portion 514 in this embodiment includes planar side wall portions 514a/b/c/d, and a planar floor wall portion 514e. As is best seen in FIGS. 23 and 24, the body 512 is chambered, and defines an interior chamber or cavity 518. The base portion 514 defines an opening 520 to the cavity 518, and a lip 522 surrounding this opening 520. Outwardly of the lip 522, the base portion 514 defines a circumferential rabbit 524.

[0068] Moreover, inspection of FIGS. 23 and 24 will show that similarly to the embodiment of FIGS. 17-22, this embodiment defines plural inwardly protruding features 486, which in this embodiment are configured as a plurality of spaced apart ribs 486a on the floor wall 514e, and connecting vertically extending ribs 486b extending generally upwardly along the side walls 514a-d. Attention to FIG. 23 will show that the ribs 486b are spaced apart in alternating pairs, with a closely spaced pair of ribs being more widely spaced from the next adjacent pair of closely spaced
ribs. Also, in one direction across the floor wall 514e, the ribs 486a are aligned with the space between a closely spaced pair of the ribs 486b. In fact, as FIG. 24 illustrates, the closely spaced pairs of ribs 486b are spaced such as to receive and retain a partition wall 90. The partition wall rests upon one of the ribs 486a extending across floor wall 414e, and effectively divides the cavity 518 into two portions 518a and 518b.

[0069] Thus, within one of the cavity portions 518a or 518b, dependent upon the size and number of contents items to be shipped in the container 510, an interlocking wall structure 584 similar to wall structure 84 (recalling FIG. 16, and FIGS. 17-20), and also not requiring or including the protruding end portions 84a of wall structure 84 (seen in FIG. 16), is received into one of the cavity portions. In this case also, the ribs 486b serve to space the wall structure 584 away from the inside surface of the side walls 514a-d, and provide a circumferential cushioning space 534. This cushion space 534 is maintained below the contents of the cavity 518 by the ribs 486a, upon which the wall structure 584 and contents 530 rest (viewing FIG. 25).

[0070] Above and resting upon a circumferential ledge 544 defined about cavity 518 by the ribs 586b is a top panel 588 (seen in FIG. 25). This panel defines plural air circulation perforations 588a. On this panel or tray 588 is disposed a thermal mass 542 (or gel pack) so as to provide cooling or warming to the contents 530 in cavity 518. A panel of foam packing material (not seen in FIG. 25) may be interposed between the contents 530 and the tray 588, and defines plural air circulation holes, if additional cushioning space is desired in the upward direction (i.e., relative to the contents 530). It is also seen in FIG. 25 that the tray or panel 588 defines a larger perforation or hole 588b. In this case, the hole 588b is disposed over the one of the cavity portions 518a or 518b, receiving the contents 530. Received into the hole 588b is a fan package 590 carrying a fan 562. This fan package 590 is disposed directly above and through the cavity 518, the contents 530 thereof. In FIG. 25, the fan package 590 causes air within cavity 518 to be vigorously circulated (as is depicted by the air flow arrows on FIG. 25).

[0071] In view of the above, it is seen that the container 510 is able to receive, transport, cushion, and circulate temperature controlling air about contents that would not completely fill the cavity 518. By utilizing only a controlled and partitioned portion of the cavity 518, the contents 530 are maintained in a compact mass (best seen in FIG. 25), for which it is easier to control the temperature of this mass, and to cushion the contents 530 against shocks during transport.

[0072] While the invention is susceptible to various modifications, and alternative forms, specific examples thereof have been shown in the drawings and are herein described in detail. It should be understood, however, that the invention is not to be limited to the particular forms disclosed, but to the contrary, the invention is to cover all modifications, equivalents and alternatives falling within the spirit and scope of the appended claims.

1 claim:

1. An improved shock absorbing insulated shipping container, said container comprising:

said container also including dual-function structure disposed within said chamber for receiving contents to be shipped in said container, and a temperature-control mass, said dual-function structure on the one hand providing a shock-absorbing structure spacing the contents away from inside surfaces of said chamber so as to maintain a surrounding cushion space of controlled crushability, and on the other hand, also providing an air circulation space surrounding the contents, whereby air currents are allowed to circulate about said contents and said temperature-control mass.

2. The shipping container of claim 1, wherein said insulating body includes foamed polymer.

3. The shipping container of claim 1, further including an air circulation fan package communicating with said chamber.

4. The shipping container of claim 3 wherein said air circulation fan package is disposed within said chamber.

5. The shipping container of claim 3, wherein said air circulation fan package includes a battery, a motor, and a fan driven by said motor.

6. The shipping container of claim 3, further including a temperature responsive control device for effecting controlled fan-forced circulation of air within said chamber by operation of said fan in response to temperature within said chamber.

7. The shipping container of claim 6, wherein said temperature responsive control device includes a temperature responsive switch.

8. The shipping container of claim 3, further including a voltage control circuit element interposed in circuit with said battery and said motor and operating said motor at less than full battery voltage while said battery is fresh, while also extending the operating time for said motor, whereby, said voltage control element extends the operating interval for said motor.

9. The shipping container of claim 8, wherein said voltage control circuit element includes a zener diode.

10. The shipping container of claim 8, wherein said voltage control circuit element includes a transistor.

11. The shipping container of claim 1, wherein said dual-function structure disposed within said chamber for receiving contents to be shipped in said container, and a temperature-control mass, includes plural crushable channel members, each of said plural crushable channel members being respectively interposed between an inside surface of said chamber and said contents.

12. The shipping container of claim 11, wherein said crushable channel members include a pair of spaced apart legs extending from an inside surface of said chamber to a portion spanning between said pair of spaced apart legs, and said pair of spaced apart legs having a determined crushability.

13. The shipping container of claim 12, wherein said pair of spaced apart channel legs include features for modifying the crushability of said pair of spaced apart legs.

14. The shipping container of claim 13, wherein said features for modifying the crushability of said pair of legs are selected from the group consisting of: openings, holes, slots, and slits formed in said pair of spaced apart legs.
15. The shipping container of claim 11, wherein said base portion includes plural pairs of spaced apart grooves extending along an inside surface of said chamber; and said channel members each include a pair of spaced apart legs respectively received retainingly in said pairs of spaced apart grooves.

16. The shipping container of claim 15, wherein said base portion includes at least one pair of spaced apart grooves extending from adjacent said opening of said chamber along a side wall surface to a floor of said chamber, and along said floor to an opposite side wall, and along said opposite side wall to terminate adjacent said opening of said chamber, and said one pair of spaced apart grooves receiving a channel member which is U-shaped to extend along said one and said opposite side wall as well as across said floor of said chamber.

17. The shipping container of claim 15, wherein said base portion includes at least one pair of spaced apart grooves extending from adjacent said opening of said chamber along a side wall surface to terminate adjacent to a floor of said chamber, and said one pair of spaced apart grooves receiving a channel member which is substantially straight to extend along said side wall between said opening of said chamber and said floor.

18. The shipping container of claim 1, wherein a tray member is further received in said chamber and carries said thermal mass, said tray member defining air circulation openings communicating with said dual-function structure so as to allow air circulation about said thermal mass and about the contents to be shipped in said container.

19. The shipping container of claim 18, wherein said tray member carries said fan package, said fan package receiving air from said air circulation space of said dual-function structure to circulate this air over said thermal mass, and delivering fan-forced air circulation into said air circulation space.

20. The shipping container of claim 4, wherein said base portion defines a floor wall, and said floor wall defines a recess communicating with said chamber, said fan package being disposed in said recess to receive air from said air circulation space of said dual-function structure, and delivering fan-forced air into said air circulation space.

21. The shipping container of claim 1, wherein said dual-function structure includes plural interlocking wall members, said plural interlocking wall members defining at least one wall for receiving the contents to be shipped in said container, and said plural interlocking wall members further including protruding crushable end portions extending outwardly of said at least one wall and engaging inside surfaces of said chamber to both provide said cushion space and to also provide at least a part of said air circulation space.

22. The shipping container of claim 21, wherein said plural interlocking wall members cooperatively define plural wells for receiving the contents to be shipped in said container, and said plural interlocking wall members also defining a chimney passage among said wells and defining a portion of said air circulation space, whereby said air circulation space includes said cushion space surrounding the contents to be shipped in said container as well as said central chimney passage among the contents to be shipped in said container, so that the contents have air circulation space about these contents as well as among these contents.

23. The shipping container of claim 22, wherein said plural interlocking wall members define a chimney passage of cruciform configuration, so that a part of said cruciform passage is interposed between adjacent wells for receiving contents to be shipped in said container.

24. The shipping container of claim 22, wherein said chimney passage communicates directly with said fan of said fan package.

25. The shipping container of claim 2, wherein said dual-function structure includes plural integral spaced apart features protruding from an inside surface of said chamber; said protruding features being selected from the group including: columns, fins, ribs, and blocks, each formed integrally of the foamed polymer material of said container and having a determined crushability; and said spaced apart features providing a portion of said air circulation space therebetween.

26. The shipping container of claim 25, wherein said plural integral spaced apart features protruding from an inside surface of said chamber are selected to include pair of closely spaced apart ribs, and said pairs of closely spaced apart ribs extending along opposite side walls of said chamber, said pairs of closely spaced apart ribs receiving therebetween a partition member dividing said chamber into a first and a second portion, and an additional part of said dual-function structure as well as said contents to be shipped in said container being received into only one of said first and said second chamber portions, whereby said container has a variable-volume capacity within said chamber for receiving said additional part of said dual-function structure and said contents to be shipped in said container.

27. A method of isolating contents to be shipped in a container both from shock and from ambient temperatures, said method including steps of:

- providing a chambered insulating body;
- configuring said body to include a base portion defining a chamber therein and an opening from said chamber;
- providing a lid portion spanning and closing said opening;
- included in the chamber of the body a dual-function structure for receiving contents to be shipped in said container along with a temperature-control mass;
- configuring said dual-function structure to on the one hand provide a shock-absorbing structure spacing the contents away from inside surfaces of said chamber so as to maintain a surrounding cushion space of controlled crushability, and to on the other hand to also provide an air circulation space surrounding the contents;
- whereby air currents are allowed to circulate about said contents and said temperature-control mass.

28. The method of claim 27 further including the steps of:

- providing a fan communicating with said chamber, and utilizing said fan to effect fan-forced air circulation in said air circulation space surrounding the contents.

29. The method of claim 28 including steps of: providing said fan by providing a fan package including a battery providing electrical power, a motor receiving electrical power from said battery, and a fan driven by said motor.

30. The method of claim 29 further including the step of: effecting controlled fan-forced circulation of air within said chamber by operation of said fan in response to temperature within said chamber.
31. The method of claim 30 including the step of providing a temperature responsive control device in said fan package.

32. The method of claim 31 including the step of including a temperature responsive switch in said control device.

33. The method of claim 30 including the steps of including a voltage control circuit element interposed in circuit with said battery and said motor and operating said motor at less than full battery voltage while said battery is fresh, and utilizing said voltage control circuit element to extend the operating time for said motor, whereby, said voltage control element extends the operating interval for said motor before said battery is exhausted.

34. The method of claim 27 including step of disposing as a part of said dual-function structure within said chamber for receiving contents to be shipped in said container plural crushable channel members, and interposing each of said plural crushable channel members between an inside surface of said chamber and said contents.

35. The method of claim 34 including steps of providing for each of said crushable channel members a pair of spaced apart legs extending from an inside surface of said chamber to a portion spanning between said pair of spaced apart legs, and providing said pair of spaced apart legs with a determined crushability.

36. The method of claim 35 wherein said pair of spaced apart channel legs of said channel members are provided with a determined crushability by including features weakening the pair of spaced apart legs.

37. The method of claim 36 wherein the step of including features for weakening said pair of spaced apart legs includes forming features selected from the group consisting of: openings, holes, slots, and slits formed in said pair of spaced apart legs.

38. The method of claim 34 wherein said base portion is formed to include plural pairs of spaced apart grooves extending along an inside surface of said chamber, and said channel members each include a pair of spaced apart legs respectively received retainingly in said pairs of spaced apart grooves.

39. The method of claim 27 further including in said chamber of said container a tray member, and carrying said thermal mass on said tray member, and defining air circulation openings in said tray member communicating with said dual-function structure so as to allow air circulation about said thermal mass and about the contents to be shipped in said container.

40. The method of claim 39 further including the steps of carrying said fan package on said tray member, and providing for said fan package to receive air from said air circulation space of said dual-function structure and to circulate this air over said thermal mass and to deliver fan-forced air currents into said air circulation space.

41. The method of claim 29 further including steps of: configuring said base portion to defines a floor wall, and in said floor wall providing a recess communicating with said chamber;

disposing said fan package in said recess to receive air from said air circulation space of said dual-function structure; and

delivering fan-forced air into said air circulation space by operation of said fan package.

42. The method of claim 27 further including steps of: including in said dual-function structure plural interlocking wall members;

configuring said plural interlocking wall members to define at least one well for receiving the contents to be shipped in said container; and

providing for said plural interlocking wall members to further include protruding crushable end portions extending outwardly of said at least one well to engage respective inside surfaces of said chamber;

whereby said protruding crushable end portions both provide said cushion space and provide at least a part of said air circulation space.

43. The method of claim 42 further including steps of: providing for said plural interlocking wall members to cooperatively define plural wells for receiving the contents to be shipped in said container;

utilizing said plural interlocking wall members to also define a chimney passage among said wells; and

utilizing said chimney passage to define a portion of said air circulation space;

whereby said air circulation space includes said cushion space surrounding the contents to be shipped in said container as well as said chimney passage among the contents to be shipped in said container, so that the contents have air circulation space about these contents as well as among these contents.

44. The method of claim 43 including the steps of: utilizing said plural interlocking wall members to define said chimney passage; and

providing for said chimney passage to be part of a passage of cruciform configuration defined by said plural interlocking walls and separating said plural wells for receiving contents to be shipped in said container.

45. The method of claim 27 further including steps of: forming said insulating body to include foamed polymer;

providing for said dual-function structure to include plural integral spaced apart features of foamed polymer protruding from an inside surface of said chamber;

providing for said protruding features to be selected from the group including: columns, fins, ribs, and blocks;

forming said protruding features each integrally from the foamed polymer material of said container and having a determined crushability according to the strength of said polymer material; and

further providing for said protruding features to be sufficiently spaced apart such that they cooperatively define spaces therebetwen which define at least a portion of said air circulation space.

46. The method of claim 45 including steps of: selecting said plural integral spaced apart features to include a pair of closely spaced apart ribs, and

extending one pair of closely spaced apart ribs along opposite side walls of said chamber;
providing for said pairs of closely spaced apart ribs to receiving therebetween a partition member dividing said chamber into a first and a second portion;

whereby said container has a variable-volume capacity within said chamber for receiving said dual-function structure and said contents to be shipped in said container.

47. An improved disposable, shock-absorbing insulated shipping container, said container comprising:

a chambered foam polymer insulating body;

said body including a base portion including a floor wall and at least one side wall cooperatively bounding a chamber therein and an opening from said chamber;

said body including also a lid portion spanning and closing said opening;

disposed within said chamber, said container also including a dual-function structure for receiving contents to be shipped in said container, and a temperature-control mass;

said dual-function structure on the one hand providing a shock-absorbing structure spacing the contents away from inside surfaces of said chamber walls so as to maintain a surrounding cushion space of controlled crushability, and on the other hand, also providing an air circulation space surrounding the contents so that air currents are allowed to circulate about said contents and said temperature-control mass; and

an air circulation fan package disposed within said chamber.

48. The shipping container of claim 47, wherein said disposable air circulation fan package includes a battery, a motor, and a fan driven by said motor.

49. The shipping container of claim 47, further including a temperature responsive control device for effecting controlled fan-forced circulation of air within said chamber by operation of said fan in response to temperature within said chamber.

50. The shipping container of claim 47, further including a voltage control circuit element interposed in circuit with said battery and said motor and operating said motor at less than full battery voltage while said battery is fresh, while also extending the operating time for said motor, whereby, said voltage control element extends the operating interval for said motor before said battery is exhausted.

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