Abstract: A packaging system includes an outer tray and an inner tray. The outer tray has a base panel. The inner tray is configured to be placed over the base panel with a first side of the inner tray facing the base panel and a second side of the inner tray facing away from the base panel. The inner tray is arranged to form a temperature pack compartment and an object compartment. The temperature pack compartment is between the outer tray and the inner tray on the first side of the inner tray and the temperature pack compartment is configured to accommodate a temperature pack. The object compartment is on the second side of the inner tray and the object compartment configured to accommodate an object placed within the packaging system.

Fig. 3E
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Packaging for Objects and Temperature Packs

Specification

Background

[0001] The present disclosure is in the technical field of product packaging. More particularly, the present disclosure is directed to thermal and/or retention product packaging.

[0002] Protective packaging structures may be used to help protect a product during transport, for example, from physical shock, dust, and other contaminants. For example, a product may be enclosed in a box with additional packing materials (e.g., crumpled paper, air-filled plastic cushions, molded foam) to restrain the product movement inside the box and to cushion the product.

[0003] One type of packaging system is known as "retention packaging." In typical retention packaging, a product is retained between a sheet and a rigid backing frame, which is sometimes the frame to which the sheet is attached. Another type of packaging system is known as suspension packaging. In typical suspension packaging, the packaged product is suspended between two sheets each attached to opposing frames sized to fit within a corresponding box. Examples of retention and suspension packaging are described in more detail in U.S. Pat. Nos. 4,852,743; 4,923,065; 5,071,009; 5,287,968; 5,388,701; 5,678,695; 5,893,462; 6,010,006; 6,148,590; 6,148,591; 6,289,655; 6,302,274; and 6,311,844, and in U.S. Patent Application No. 14/782208, each of which is incorporated herein in its entirety by reference.

[0004] Protective packaging structures may also be used to provide thermal characteristics for the objects packaged therein during transport. For example, some
product packaging is made out of closed-cell extruded polystyrene foam or other foams that provide thermal insulation for objects transported therein. This thermal insulation hinders the transfer of heat into or out of the product packaging. The thermal insulation may also provide protection from physical damage, such as physical shock, in addition to the thermal insulation.

SUMMARY

[0005] This summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This summary is not intended to identify key features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter.

[0006] In one embodiment, a packaging system includes an outer tray and an inner tray. The outer tray has a base panel. The inner tray is configured to be placed over the base panel with a first side of the inner tray facing the base panel and a second side of the inner tray facing away from the base panel. The inner tray is arranged to form a temperature pack compartment between the outer tray and the inner tray on the first side of the inner tray. The inner tray is also arranged to form an object compartment on the second side of the inner tray. The temperature pack compartment is configured to accommodate a temperature pack. The object compartment is configured to accommodate an object placed within the packaging system.

[0007] In one example, the outer tray comprising a plurality of walls extending from the base panel. In another example, the inner tray is arranged to be located in the volume bounded by the base panel and the plurality of walls when the inner tray is placed over the base panel. In another example, the outer tray and the inner tray are formed from a cellulosic-based material. In another example, the cellulosic-based material includes corrugated cardboard. In another example, the temperature pack compartment is located between the base panel and the object compartment when the inner tray is placed over the base panel.
In another example, the object compartment is one of a plurality of object compartments formed by the inner tray. In another example, the temperature pack compartment is located in a divider formed by the inner tray between two object compartments of the plurality of compartments. In another example, the divider comprises a vent configured to permit air flow between the first side of the inner tray and the second side of the inner tray. In another example, the plurality of object compartments are configured to accommodate a plurality of objects.

In another example, the packaging system further comprises a retention assembly comprising a sheet panel coupled to a sheet, where the retention assembly is arranged to permit placement of the outer tray and the inner tray between the sheet panel and the sheet when the inner tray is placed over the base panel. In another example, the retention assembly further comprises first and second tension flaps foldably connected to the sheet panel at, respectively, first and second fold lines between the sheet panel and the first and second tension flaps. In another example, the first and second fold lines are located on opposing sides of the sheet panel. In another example, the sheet is connected to the first and second tension flaps. In another example, the sheet covers the second side of the inner tray and the object compartment when the outer tray and the inner tray are placed on a first side of the sheet panel between the sheet panel and the sheet and when the first and second tension flaps are folded to a second side of the sheet panel. In another example, the object is visible through the sheet such that the object is visible in the object compartment when the sheet covers the object compartment. In another example, the retention assembly further comprises first and second support flaps foldably connected to the sheet panel at, respectively, third and fourth fold lines between the sheet panel and the first and second support flaps. In another example, the first and second support flaps are configured to be rotated about the third and fourth fold lines, respectively, away from the second side of the sheet panel toward the outer tray and the inner tray.
[0010] In another embodiment, a method of packaging an object includes placing an inner tray over an outer tray. The outer tray has a base panel. A first side of the inner tray faces the base panel and a second side of the inner tray faces away from the base panel. The inner tray is arranged to form a temperature pack compartment between the outer tray and the inner tray on the first side of the inner tray and an object compartment on the second side of the inner tray. The method further includes placing a temperature pack in the temperature pack compartment and placing an object in the object compartment.

[0011] In one example, the method further comprises placing the inner tray and the outer tray on a first side of a sheet panel between the sheet panel and a sheet of a retention assembly. In another example, the sheet is connected to first and second tension flaps, and the first and second tension flaps are foldably connected to the sheet panel at, respectively, first and second fold lines between the sheet panel and the first and second tension flaps. In another example, the method further comprises folding the first and second tension flaps toward the second side of the base panel to cause the sheet to cover the second side of the inner tray and the object compartment. In another example, the method further comprises after folding the first and second tension flaps toward the second side of the base panel, placing, in a container, the retention assembly with the sheet covering the second side of the inner tray and the object compartment visible through an opening of the container. In another example, the method further comprises placing a frame in the container between the sheet and the opening of the container. In another example, the method further comprises the frame includes an aperture so that the sheet is visible through the opening of the container and the aperture of the frame.

BRIEF DESCRIPTION OF THE DRAWING

[0012] The foregoing aspects and many of the attendant advantages of the disclosed subject matter will become more readily appreciated as the same become better understood by reference to the following detailed description, when taken in conjunction with the accompanying drawings, wherein:
Figs. 1A and 1B depict embodiments of an outer tray and an inner tray, respectively, in unfolded states, in accordance with the embodiments described herein;

Figs. 2A and 2B depict, respectively, the outer tray shown in Fig. 1A in a folded state and the inner tray shown in Fig. 1B in a folded state, in accordance with the embodiments described herein;

Figs. 3A to 3H depict instances of an embodiment of a method using the outer tray shown in Fig. 2A and the inner tray shown in Fig. 2B to package objects and a temperature pack, in accordance with the embodiments described herein;

Figs. 4A and 4B depict other embodiments of an outer tray and an inner tray, respectively, in unfolded states, in accordance with the embodiments described herein;

Figs. 5A and 5B depict, respectively, the outer tray shown in Fig. 4A in a folded state and the inner tray shown in Fig. 4B in a folded state, in accordance with the embodiments described herein;

Figs. 6A to 6C depict instances of an embodiment of using the outer tray and the inner tray depicted in Figs. 5A and 5B to package objects and a temperature pack, in accordance with the embodiments described herein.

DETAILED DESCRIPTION

The present disclosure describes embodiments of packaging systems that are used to package objects and temperature packs. Some objects that are placed in and/or shipped in containers, such as cardboard boxes, benefit from being in environments that have a cooler temperature than typical ambient temperatures. Such objects may include objects that have a shorter shelf life in higher temperature,
such as agricultural produce, flowers, or other organic materials, objects that melt in higher temperatures, such as chocolates, other candies, candles, makeup, and the like, objects that may change characteristics in high temperatures, such as beverages, or any other types of objects. Other objects benefit from being in environments that have a higher temperature than typical ambient temperatures.

[0020] Embodiments of packaging systems described herein includes inner and outer trays that interact to that the inner tray forms both a temperature pack compartment between the outer tray and the inner tray on a first side of the inner tray and an object compartment on a second side of the inner tray. The inner tray provides at least a partial barrier between the temperature pack compartment and the object compartment. This barrier can prevent direct contact between an object in the object compartment and a temperature pack, such as a cold pack or a hot pack, in the temperature pack compartment. Preventing direct contact between the object and the temperature pack can deter over-cooling or over-heating of the object that may occur from direct contact. In the case of a cold pack, preventing direct contact between the object and the temperature pack can also deter transfer of any condensation that forms on the cold pack to the object. Other benefits can be realized by the inner tray forming at least a partial barrier between the temperature pack compartment and the object compartment.

[0021] Depicted in Figs. 1A and 1B are embodiments of an outer tray 110 and an inner tray 120, respectively, in unfolded states. In some embodiments, the outer tray 110 and/or the inner tray 120 are formed from a rigid material or a substantially-rigid material, such as cellulosic-based materials (e.g., cardboard, corrugated cardboard, paperboard), plastic, and compressed foam. In one example, the outer tray 110 and/or the inner tray 120 may comprise corrugated cardboard, such as any of single-wall B-flute, C-flute, and/or E-flute corrugated cardboard, B/C double-wall corrugated cardboard, E/B double-wall corrugated cardboard, or any combination thereof. In some embodiments, the outer tray 110 and/or the inner tray 120 has a predetermined average thickness. In some examples, the average thickness of the
outer tray 110 and/or the inner tray 120, for example, at most about, and/or at least about, any of the following thicknesses: 0.03, 0.06, 0.12, 0.18, 0.25, 0.3, 0.4, and 0.5 inches.

[0022] As depicted in Fig. 1A, the outer tray 110 has a base panel 112. In some embodiments, the base panel 112 itself is free from weakened portions, such as fold lines. In the depicted embodiment, the outer tray 110 has walls 114 foldably coupled to the sides of the base panel 112. The base panel 112 is bounded by fold lines 116 about which the walls 114 can be rotated with respect to the base panel 112. A “fold line,” as used herein, represents a line along which a panel, frame, or other material has been creased, crimped, embossed, perforated, scored, or otherwise weakened so as to enhance the foldability of the panel, frame, or other material along the fold line. In the depicted embodiment, each of the walls 114 includes additional fold lines, cuts, cuts, tabs, and the like, that permit the walls 114 to be folded and secured such that the walls 114 extend from the base panel 112.

[0023] As depicted in Fig. 1B, the inner tray 120 has a false bottom panel 122. In some embodiments, the false bottom panel 122 itself is free from weakened portions, such as fold lines. In the depicted embodiment, the inner tray 120 has sides 124 foldably coupled to the false bottom panel 122. The false bottom panel 122 is bounded on two sides by fold lines 126 about which the sides 124 can be rotated with respect to the false bottom panel 122. Each of the walls 114 includes additional fold lines that permit the walls 114 to be folded to cause the inner tray 120 to be in a folded state. In the depicted embodiment, the inner tray 120 also has false bottom support panels 128 foldably coupled to the false bottom panel 122. The base panel 112 is bounded on two sides by fold lines 126 about which the sides 124 can be rotated with respect to the false bottom panel 122. The false bottom panel 122 is bounded on two sides by fold lines 130 about which the false bottom support panels 128 can be rotated with respect to the false bottom panel 122.
[0024] Depicted in Figs. 2A and 2B, respectively, are embodiments of the outer tray 110 and the inner tray 120 in folded states. As depicted in Fig. 2A, the outer tray 110 has been folded such that the walls 114 extend upward from the base panel 112. While the outer tray 110, in the depicted embodiment, includes walls 114 that extend from the base panel 112, the outer tray 110 may include the base panel 112 without any such walls in other embodiments. As depicted in Fig. 2B, the inner tray 120 has been folded such that portions of the sides 124 are higher or lower than the false bottom panel 122. The false bottom support panels 128 are also folded down from the false bottom panel 122. In the depicted embodiment, the lower ends of the false bottom support panels 128 are aligned with the lowest portions of the sides 124. The inner tray 120 has a first side 132 and a second side 134, which are the lower and upper sides of the inner tray 120 as depicted in Fig. 2B.

[0025] The outer tray 110 and the inner tray 120 can be used to package objects, such as for shipment or for presentation. An embodiment of using the outer tray 110 and the inner tray 120 to package objects is depicted in a series of instances shown in Figs. 3A to 3H. Each of those instances is discussed below.

[0026] In the instance shown in Fig. 3A, the inner tray 120 is placed over the base panel 112 of the outer tray 110 to form a packaging system 100. The first side 132 of the inner tray 120 is facing the base panel 112 and the second side 134 of the inner tray is facing away from the base panel 112. In the depicted example, the outer tray 110 has walls 114 that extend upward from the base panel 112. The inner tray 120 is arranged to be located in the volume bounded by the base panel 112 and the walls 114 when the inner tray 120 is placed over the base panel 112.

[0027] With the inner tray 120 placed over the base panel 112 of the outer tray 110, as shown in Fig. 3A, the inner tray 120 forms a temperature pack compartment 142 between the outer tray 110 and the inner tray 120 on the first side 132 of the inner tray 120. As described in greater detail below, the temperature pack compartment 142 is configured to accommodate a temperature pack, such as a cold pack or a hot
pack. The inner tray 120 also forms object compartments 144 on the second side 134 of the inner tray 120. In the depicted embodiment, the object compartments 144 include three object compartments; however, in other embodiments, the inner tray 120 can form any number of one or more object compartments. The object compartments 144 are configured to accommodate one or more objects placed within the packaging system 100.

[0028] In the depicted embodiment, the temperature pack compartment 142 is located between the base panel 112 and the middle one of the object compartments 144. The false bottom panel 122 divides the temperature pack compartment 142 from the middle one of the object compartments 144. In the positioning of the inner tray 120 with respect to outer tray 110 shown in Fig. 3A, the false bottom panel 122 appears to be the bottom of the packaging system 100 when viewed from the top. However, the false bottom panel 122 is really a "false bottom" because the temperature pack compartment 142 is formed under the false bottom panel 122. Although not visible in Fig. 3A, the false bottom support panels 128 help provide structural stability for the false bottom panel 122 by extending down from the false bottom panel 122 to the base panel 112 along the sides of the temperature pack compartment 142.

[0029] In the instance shown in Fig. 3B, a temperature pack 150 is placed in the temperature pack compartment 142. In some embodiments, the temperature pack 150 is a cold pack that contains a material having a lower temperature than the ambient temperature in which the packaging system 100 is located. In some examples, the cold pack includes ice (e.g., bock ice, cube ice, or slurry ice), solid carbon dioxide, a cold gel pack, a phase-change material, chemicals that produce an endothermic reaction, any other material capable of being at a temperature below ambient temperature, or any combination thereof. In some embodiments, the temperature pack 150 is a hot pack that contains a material having a higher temperature than the ambient temperature in which the packaging system 100 is located. In some examples, the hot pack includes a hot gel pack, a phase-change
material, chemicals that produce an exothermic reaction, any other material capable
of being at a temperature above ambient temperature, or any combination thereof.
In some embodiments, the temperature pack 150 occupies the entire temperature
pack compartment 142, substantially all of the temperature pack compartment 142,
or a portion of the temperature pack compartment 142. The temperature pack 150
depicted in Fig. 3B shows a single pack, but the temperature pack 150 could include
any number of individual packs. As shown in the depicted embodiment, the inner
tray 120 forms a barrier between the temperature pack 150 and any objects placed
in the object compartments 144.

[0030] In the instance shown in Fig. 3C, objects 152 are placed in the object
compartments 144. As shown, any number of objects can be placed in the object
compartments 144. In some cases, at least one of the object compartments 144
contains more than one of the objects 152. In some embodiments, the dimensions
of one or more of the outer tray 110, the inner tray 120, or any portion thereof may
be selected based on a size of a desired object to be placed within the object
compartments 144.

[0031] Fig. 3D depicts an embodiment of the packaging system 100 placed within a
retention assembly 170. The retention assembly 170 includes a sheet panel 172.
The sheet panel 172 may be formed from a rigid material or a substantially-rigid
material, such as cellulosic-based materials (e.g., cardboard, corrugated cardboard,
paperboard), plastic, and compressed foam. In some embodiments, the sheet panel
172 itself is free from weakened portions, such as fold lines. In the depicted
embodiment, the retention assembly 170 has tension flaps 174 foldably coupled to
two sides of the sheet panel 172. The sheet panel 172 is bounded on two sides by
fold lines 176 about which the tension flaps 174 can be rotated with respect to the
sheet panel 172.

[0032] The retention assembly 170 also includes a sheet 178 that spans between the
tension flaps 174. The sheet 178 is attached to the tension flaps 174 at attachment
zones 180. The retention assembly 170 also has support flaps 182 foldably coupled to two sides of the sheet panel 172. The sheet panel 172 is bounded on two sides by fold lines 184 about which the support flaps 182 can be rotated with respect to the sheet panel 172.

[0033] In some cases, the sheet 178 is attached to the tension flaps 174 at the attachment zones 180 by adhering (e.g., with hot melt adhesive), gluing, heat welding, ultrasonic welding, stapling, tacking, fastening, clipping (see, e.g., U.S. Pat. No. 5,694,744 to Jones, which is incorporated herein in its entirety by reference), tab/slot engagement (see, e.g., U.S. Pat. No. 6,073,761 to Jones, which is incorporated herein in its entirety by reference), anchoring, retaining and/or securing (see, e.g., U.S. Patent No. 7,743,924 to McDonald et al., which is incorporated herein in its entirety by reference, and which discloses a sleeve having pockets or pouches for receiving a flap as shown in Figs. 24-25 and related discussion therein). The sheets of any embodiments described herein may be attached by one or more of any of the attachment ways described herein. Useful types of adhesives for attaching sheets to frames are known to those of skill in the art, and of course depend on the composition of the materials to be adhered. For example, a polyurethane-based sheet may be adhered with a polyurethane-based adhesive, such as a water-borne aliphatic polyurethane dispersion.

[0034] The sheet 178, and any of the sheets of the various embodiments described herein, may comprise any of the materials, compositions, and polymers set forth herein with respect to sheets, and may have any thickness, properties, treatments, additives, and other characteristics (e.g., flexibility, elasticity, optics, strength, elastic recovery, transparency, load tear resistance, puncture resistance) as set forth herein with respect to sheets.

[0035] In some embodiments, the sheet 178 has a composition and thickness providing acceptable performance properties (e.g., flexibility, elasticity, optics, strength) for the given packaging application of expected use. In some examples,
the sheet 178 has a thickness of at most any of the following: 10 mils, 6 mils, 5 mils, 4 mils, 3 mils, 2 mils, 1.5 mils, and 1 mil. (A "mil" is equal to 0.001 inch.) In some examples, the sheet 178 has a thickness of at least any of the following: 0.5 mils, 1 mil, 1.5 mils, 2 mils, and 3 mils.

[0036] In some embodiments, the sheet 178 has an elastic recovery in either or both of the transverse and longitudinal directions of at least any of the following values: 60%, 65%, 70%, 75%, 80%, and 85%, measured according to ASTM D5459 at 100% strain, 30 seconds relaxation time, and 60 second recovery time.

[0037] In some embodiments, the sheet 178 has a maximum load tear resistance in either or both of the transverse and longitudinal directions of at least any of the following values: 400, 450, 500, 550, and 600 grams force, measured according to ASTM D1004.

[0038] In some embodiments, the sheet 178 has a slow puncture maximum load of at least any of the following values: 4, 4.5, 5, 5.5, 6, 6.5, and 7 pounds force, measured according to ASTM F1306 using a crosshead speed of 5 inches per minute.

[0039] In some embodiments, the sheet 178 has a Young's modulus sufficient to withstand the expected handling and use conditions, yet may provide a "soft" feel that may be desirable for a packaging application. The sheet may have a Young's modulus of at least any of the following values: 2,000; 2,500; 3,000; 3,500; and 4,000 pounds/square inch. The sheet may have a Young's modulus of no more than about any of the following values: 8,000; 10,000; 15,000; 20,000; 30,000; and 40,000 pounds/square inch. The Young's modulus is measured in accordance with ASTM D882, measured at a temperature of 73°F.

[0040] In some embodiments, the sheet 178 is transparent so that a packaged article is visible through the sheet. As used herein, "transparent" means that the material
transmits incident light with negligible scattering and little absorption, enabling objects to be seen clearly through the material under typical unaided viewing conditions (i.e., the expected use conditions of the material). The transparency (i.e., clarity) of the retention sheet may be at least any of the following values: 65%, 70%, 75%, 80%, 85%, and 90%, measured in accordance with ASTM D1746.

[0041] In some embodiments, the sheet 178 has a heat-shrink attribute. In some examples, the sheet 178 has any of a free shrink in at least one direction (i.e., machine or transverse directions), in each of at least two directions (i.e., machine and transverse directions), measured at any of 160°F and 180°F of at least any of the following: 7%, 10%, 15%, 20%, 25%, 30%, 40%, 50%, 55%, 60%, and 65%. In other embodiments, the sheet 178 is non-heat shrinkable (i.e., has a total free shrink of less than 5% measured at 160°F). Unless otherwise indicated, each reference to free shrink in this application means a free shrink determined by measuring the percent dimensional change in a 10cmx10cm specimen when subjected to selected heat (i.e., at a certain temperature exposure) according to ASTM D2732.

[0042] In some embodiments, the sheet 178 includes one or more fabrics. For example, in some embodiments, the sheet 178 includes one or more of the following: wovens, knits, nonwovens, and openwork meshes (e.g., netting), spandex, including Lycra®, brand spandex, and elastic fabrics.

[0043] In some embodiments, the sheet 178 includes one or more polymers. In some examples, the sheet 178 includes one or more of any of the following polymers: thermoplastic polymers, polyolefins, polyethylene homopolymers (e.g., low density polyethylene), polyethylene copolymers (e.g., ethylene/alpha-olefin copolymers ("EAOs"), ethylene/unsaturated ester copolymers, and ethylene/(meth)acrylic acid), polypropylene homopolymers, polypropylene copolymers, polyvinyl chloride, various types of natural or synthetic rubber (e.g., styrene-butadiene rubber, polybutadiene, neoprene rubber, polyisoprene rubber, ethylene-propylene diene monomer (EPDM) rubber, polysiloxane, nitrile rubber, and
butyl rubber), and polyurethane (i.e., any one or more of polyurethane, polyether polyurethane, polyester polyurethane, and polycarbonate polyurethane, any of which may be aliphatic and/or aromatic). In some embodiments, the sheet 178 includes thermoplastic polyolefin elastomers (TPOs), which are two-component elastomer systems comprising an elastomer (such as EPDM) finely dispersed in a thermoplastic polyolefin (such as polypropylene or polyethylene). As used in this application, “copolymer” means a polymer derived from two or more types of monomers, and includes terpolymers, etc.

[0044] In some embodiments, the sheet 178 includes polyolefin (e.g., polyethylene), polyvinyl chloride, and/or polyurethane. In some examples, such embodiments of the sheet 178 have a thickness of from 2 to 4 mils. Such embodiments of the sheet 178 may be useful for lightweight applications. In some examples, the sheet 178 including polyurethane may provide desirable elastomeric, puncture resistance, temperature resistance, and tackiness characteristics.

[0045] In some embodiments, the sheet 178 includes effective amounts of one or more of tackifiers, antiblocking agents, and slip agents—or may be essentially free of any of these components. Tackifiers, antiblocking agents, and slip agents, and their effective amounts, are known to those of ordinary skill in the art.

[0046] In some embodiments, the sheet 178 is manufactured by thermoplastic film forming processes known in the art (e.g., tubular or blown-film extrusion, coextrusion, extrusion coating, flat or cast film extrusion). In some embodiments, a combination of these processes is also employed to manufacture the sheet 178.

[0047] In some embodiments, at least one side of the sheet 178 is corona and/or plasma treated to change the surface energy of the sheet 178. In one example, the change in surface energy increases the ability of the sheet 178 to adhere to a panel or frame.
Films that may be useful as sheets (e.g., sheet 178) are described in U.S. Pat. No. 6,913,147, issued Jul. 5, 2005, and entitled "Packaging Structure Having a Frame and Film," which is incorporated herein in its entirety by reference.

Referring back to Fig. 3D, the outer tray 110 and the inner tray 120 of the packaging system 100 are placed on the top side of the sheet panel 172 between the sheet panel 172 and the sheet 178. The packaging system 100 is located such that the sheet 178 covers the second side 134 of the inner tray 120 and the object compartments 144. As noted above, the sheet 178 may be transparent such that the objects 152 in the object compartments 144 are visible through the sheet 178.

In the instance shown in Fig. 3E, the tension flaps 174 have been folded about the fold lines 176 to the bottom side of the sheet panel 172 so that the tension flaps 174 are no longer visible in the depiction. Folding the tension flaps 174 in this manner causes the sheet 178 to cover the top side of the inner tray 120 and the object compartments 144. In some cases, the sheet 178 stretches as the tension flaps 174 are folded about the fold lines 176 to the bottom side of the sheet panel 172. As is depicted, the objects 152 can be visible through the sheet 178 (e.g., the sheet 178 is transparent) such that the objects 152 are visible in the object compartments 144 when the sheet 178 covers the object compartments 144. As is also shown in Fig. 3E, the support flaps 182 have been folded about the fold lines 184 away from the bottom side of the sheet panel 172 and toward the outer tray 110 and the inner tray 120.

The packaging system 100 and the retention assembly 170 may be taken from their positions, as depicted in Fig. 3E, and placed into a container. In the instance shown in Fig. 3F, the packaging system 100 and the retention assembly 170 have been placed within a container 190. The container 190 has an opening 192 that is bounded by flaps 194. In some embodiments, the packaging system is placed within the container 190 so that the object compartments 144 are visible through the opening 192. In some embodiments, the packaging system is placed
within the container 190 so that the support flaps 182 are substantially parallel to and in proximity with two sides of the container 190 and the ends of the support flaps 182 are configured to abut two other sides of the container 190.

[0052] Also depicted above the container 190 in Fig. 3F is a frame 196. In the depicted embodiment, the frame is configured to be placed in the container 190 above the inner tray 120. The frame 196 also includes an aperture 198. In some embodiments, the dimensions of the frame 196 are selected based on one or more of the dimensions of the container 190, the dimensions of the inner tray 120, the dimensions of the outer tray 110, the locations of the object compartments 144, or any combination thereof. In some cases, the dimensions of the frame 196 includes at least one of the height, width, or length of the frame 196, the size and location of the aperture 198, or any other dimension of the frame 196.

[0053] In the instance depicted in Fig. 3G, the frame 196 has been lowered into the container 190 between the sheet 178 and the opening 192 of the container 190. In the depicted embodiment, the aperture 198 is positioned so that the sheet 178 is visible through the opening 192 of the container 190 and the aperture 198 of the frame 196. In some embodiments, the height of the frame 196 occupies space in a void between the sheet 178 and the opening of the container 190. In the instance depicted in Fig. 3H, the flaps 194 have been closed over the opening 192. After the flaps 194 of the container are closed, the frame 196 restrains upward movement of the outer tray 110, the inner tray 120, and the retention assembly 170 toward the flaps 194.

[0054] Depicted in Figs. 4A and 4B are embodiments of an outer tray 210 and an inner tray 220, respectively, in unfolded states. In some embodiments, the outer tray 210 and/or the inner tray 220 are formed from a rigid material or a substantially-rigid material, such as cellulosic-based materials (e.g., cardboard, corrugated cardboard, paperboard), plastic, and compressed foam. In one example, the outer tray 210 and/or the inner tray 220 may comprise corrugated cardboard, such as any of single-
wall B-flute, C-flute, and/or E-flute corrugated cardboard, B/C double-wall corrugated cardboard, E/B double-wall corrugated cardboard, or any combination thereof. In some embodiments, the outer tray 210 and/or the inner tray 220 has a predetermined average thickness. In some examples, the average thickness of the outer tray 210 and/or the inner tray 220, for example, at most about, and/or at least about, any of the following thicknesses: 0.03, 0.06, 0.12, 0.18, 0.25, 0.3, 0.4, and 0.5 inches.

[0055] As depicted in Fig. 4A, the outer tray 210 has a base panel 212. In some embodiments, the base panel 212 itself is free from weakened portions, such as fold lines. In the depicted embodiment, the outer tray 210 has walls 214 foldably coupled to the sides of the base panel 212. The base panel 212 is bounded by fold lines 216 about which the walls 214 can be rotated with respect to the base panel 212. In the depicted embodiment, each of the walls 214 includes additional fold lines, cuts, cuts, tabs, and the like, that permit the walls 214 to be folded and secured such that the walls 214 extend from the base panel 212.

[0056] As depicted in Fig. 4B, the inner tray 220 has bottom panels 222. In some embodiments, the bottom panels 222 themselves are free from weakened portions, such as fold lines. In the depicted embodiment, the inner tray 220 has divider sections 224 foldably coupled to the bottom panels 222. One of the bottom panels 222 is bounded on two sides by fold lines 226 about which the divider sections 224 can be rotated. The other two of the bottom panels 222 are bounded on one side by fold lines 226 about which the divider sections 224 can be rotated. Each of the divider sections 224 includes additional fold lines 226 that permit the divider sections 224 to be folded to cause the inner tray 220 to be in a folded state. A vent 228 is formed in one of the divider sections 224. In the depicted embodiment, the vent 228 spans between two of the fold lines 226.

[0057] Depicted in Figs. 5A and 5B are embodiments of the outer tray 210 and the inner tray 220, respectively, in folded states. As depicted in Fig. 5A, the outer tray
210 has been folded such that the walls 214 extend upward from the base panel 212. While the outer tray 210, in the depicted embodiment, includes walls 214 that extend from the base panel 212, the outer tray 210 may include the base panel 212 without any such walls in other embodiments. As depicted in Fig. 5B, the inner tray 220 has been folded such that the divider sections 224 are higher than the bottom panels 222. In the folded state of the inner tray 220, the vent 228 is located at the top of one of the divider sections 224. In addition, the divider sections 224 are arranged so that one of the divider sections 224 is wider than the other when the inner tray 220 is in the folded state. In the depicted embodiment, the vent 228 is located in the wider of the divider sections 224.

[0058] The outer tray 210 and the inner tray 220 can be used to package objects, such as for shipment or for presentation. An embodiment of using the outer tray 210 and the inner tray 220 to package objects is depicted in a series of instances shown in Figs. 6A to 6C. Each of those instances is discussed below.

[0059] In the instance shown in Fig. 6A, the inner tray 220 is placed over the base panel 212 of the outer tray 210 to form a packaging system 200. The first side 232 of the inner tray 220 is facing the base panel 212 and the second side 234 of the inner tray is facing away from the base panel 212. In the depicted example, the outer tray 210 has walls 214 that extend upward from the base panel 212. The inner tray 220 is arranged to be located in the volume bounded by the base panel 212 and the walls 214 when the inner tray 220 is placed over the base panel 212.

[0060] With the inner tray 220 placed over the base panel 212 of the outer tray 210, as shown in Fig. 6A, the inner tray 220 forms a temperature pack compartment 242 between the outer tray 210 and the inner tray 220 on the first side 232 of the inner tray 220. As described in greater detail below, the temperature pack compartment 242 is configured to accommodate a temperature pack. The inner tray 220 also forms object compartments 244 on the second side 234 of the inner tray 220. In the depicted embodiment, the object compartments 244 include three object
compartments; however, in other embodiments, the inner tray 220 can form any number of one or more object compartments. The object compartments 244 are configured to accommodate one or more objects placed within the packaging system 200.

[0061] In contrast to the temperature pack compartment 142 in packaging system 100, the temperature pack compartment 242 in packaging system 200 is located in one of the divider sections 224 in the depicted embodiment. More specifically, the temperature pack compartment 242 is located in the one of the divider sections 224 that also includes the vent 228. The vent is configured to permit airflow between the first side 232 of the inner tray 220 and the second side 234 of the inner tray 220. This allows cooler air in the temperature pack compartment 242 to more easily pass to the object compartments 244. The vent 228 also allows at least a portion of the temperature pack compartment 242 to be visible from the second side 234 of the inner tray 220.

[0062] In the instance shown in Fig. 6B, a temperature pack 250 is placed in the temperature pack compartment 242. In some embodiments, the temperature pack 250 is a cold pack that contains a material having a lower temperature than the ambient temperature in which the packaging system 200 is located. In some examples, the cold pack includes ice (e.g., bock ice, cube ice, or slurry ice), solid carbon dioxide, a cold gel pack, a phase-change material, chemicals that produce an endothermic reaction, any other material capable of being at a temperature below ambient temperature, or any combination thereof. In some embodiments, the temperature pack 250 is a hot pack that contains a material having a higher temperature than the ambient temperature in which the packaging system 200 is located. In some examples, the hot pack includes a hot gel pack, a phase-change material, chemicals that produce an exothermic reaction, any other material capable of being at a temperature above ambient temperature, or any combination thereof. In some embodiments, the temperature pack 250 occupies the entire temperature pack compartment 242, substantially all of the temperature pack compartment 242,
or a portion of the temperature pack compartment 242. The temperature pack 250 depicted in Fig. 6B shows a single pack, but the temperature pack 250 could include any number of individual packs. As shown in the depicted embodiment, the inner tray 220 forms a barrier between the temperature pack 250 and any objects placed in the object compartments 244.

[0063] In the instance shown in Fig. 6C, objects 252 are placed in the object compartments 244. As shown, any number of objects can be placed in the object compartments 244. In some cases, at least one of the object compartments 244 contains more than one of the objects 252. In some embodiments, the dimensions of one or more of the outer tray 210, the inner tray 220, or any portion thereof may be selected based on a size of a desired object to be placed within the object compartments 244.

[0064] As described above and depicted in Figs. 2D to 2H, the packaging system 100 can be placed in the retention assembly 170 between the sheet panel 172 and the sheet 178, the retention flaps 174 and the support flaps 182 of the retention assembly 170 can be folded, the packaging system 100 and the retention assembly 170 can be placed in the container 190, and the container 190 can be closed. A similar process can be performed with the packaging system 200. More specifically, from the instance shown in Fig. 6C, the packaging system 200 can be placed in a retention assembly between a sheet panel and a sheet, retention flaps and support flaps of the retention assembly can be folded, the packaging system 200 and the retention assembly can be placed in a container, and the container can be closed. Although these steps are not specifically depicted in the accompanying figures, such steps are within the scope of the present disclosure. Likewise, it is also within the scope of the present disclosure to use any other embodiments of inner and outer trays together where the inner tray forms both a temperature pack compartment between the outer tray and the inner tray on a first side of the inner tray and an object compartment on a second side of the inner tray.
In the embodiments described above, the packaging system 100 can be packaged in the retention assembly 170 and the packaging system 200 can be packaged in the retention assembly 270. In other embodiments, the packaging system 100 and the packaging system 200 can be packaged in other packaging material. In one embodiment, the packaging system 100 or the packaging system 200 is placed in heat-shrinkable film and then the heat-shrinkable film can be subjected to a heat-shrink process to shrink the heat-shrinkable film around the packaging system 100 or the packaging system 200. In another embodiment, the outer tray 110 of the packaging system 100 or the outer tray 210 of the packaging system 200 is made from a thermoform tray and the packaging system 100 or the packaging system 200 is packaged by sealing a film on top of the thermoform tray. In one embodiment, the packaging system 100 or the packaging system 200 is placed in a clamshell packaging container and the clamshell packaging container is closed over the packaging system 100 or the packaging system 200. The packaging system 100 and the packaging system 200 can be contained in any other type of packaging material to contain the temperature packs or objects placed therein.

In some cases, the packaging material around the packaging system 100 and/or the packaging system 200 can be fully or partially transparent. In those cases, the objects in the packaging system 100 and/or the packaging system 200 may be visible from outside the packaging material. Such a packaging material may be used to present the objects within the packaging system 100 and/or the packaging system 200, such as in the case of display in retail environments. In other cases, the packaging material around the packaging system 100 and/or the packaging system 200 can be fully or substantially opaque. In those cases, the objects in the packaging system 100 and/or the packaging system 200 may not be visible from outside the packaging material. Such a packaging material may be used to protect the objects within the packaging system 100 and/or the packaging system 200, such as in the case of shipping the objects.
For purposes of this disclosure, terminology such as "upper," "lower," "vertical," "horizontal," "inwardly," "outwardly," "inner," "outer," "front," "rear," and the like, should be construed as descriptive and not limiting the scope of the claimed subject matter. Further, the use of "including," "comprising," or "having" and variations thereof herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items. Unless limited otherwise, the terms "connected," "coupled," and "mounted" and variations thereof herein are used broadly and encompass direct and indirect connections, couplings, and mountings. Unless stated otherwise, the terms "substantially," "approximately," and the like are used to mean within 5% of a target value.

The principles, representative embodiments, and modes of operation of the present disclosure have been described in the foregoing description. However, aspects of the present disclosure which are intended to be protected are not to be construed as limited to the particular embodiments disclosed. Further, the embodiments described herein are to be regarded as illustrative rather than restrictive. It will be appreciated that variations and changes may be made by others, and equivalents employed, without departing from the spirit of the present disclosure. Accordingly, it is expressly intended that all such variations, changes, and equivalents fall within the spirit and scope of the present disclosure, as claimed.
CLAIMS

What is claimed is:

1. A packaging system, comprising:
   an outer tray having a base panel; and
   an inner tray configured to be placed over the base panel with a first side of
   the inner tray facing the base panel and a second side of the inner tray facing away
   from the base panel, wherein the inner tray is arranged to form:
      a temperature pack compartment between the outer tray and the inner
      tray on the first side of the inner tray, the temperature pack compartment configured
      to accommodate a temperature pack, and
      an object compartment on the second side of the inner tray, the object
      compartment configured to accommodate an object placed within the packaging
      system.

2. The packaging system of claim 1, wherein the outer tray comprising a plurality
   of walls extending from the base panel.

3. The packaging system of claim 2, wherein the inner tray is arranged to be
   located in the volume bounded by the base panel and the plurality of walls when the
   inner tray is placed over the base panel.

4. The packaging system of claim 1, wherein the outer tray and the inner tray are
   formed from a cellulosic-based material.

5. The packaging system of claim 4, wherein the cellulosic-based material
   includes corrugated cardboard.

6. The packaging system of claim 1, wherein the temperature pack compartment
   is located between the base panel and the object compartment when the inner tray is
   placed over the base panel.
7. The packaging system of claim 1, wherein the object compartment is one of a plurality of object compartments formed by the inner tray.

8. The packaging system of claim 7, wherein the temperature pack compartment is located in a divider formed by the inner tray between two object compartments of the plurality of compartments.

9. The packaging system of claim 8, wherein the divider comprises a vent configured to permit air flow between the first side of the inner tray and the second side of the inner tray.

10. The packaging system of claim 7, wherein the plurality of object compartments are configured to accommodate a plurality of objects.

11. The packaging system of claim 1, further comprising:
   a retention assembly comprising a sheet panel coupled to a sheet;
   wherein the retention assembly is arranged to permit placement of the outer tray and the inner tray between the sheet panel and the sheet when the inner tray is placed over the base panel.

12. The packaging system of claim 11, wherein the retention assembly further comprises first and second tension flaps foldably connected to the sheet panel at, respectively, first and second fold lines between the sheet panel and the first and second tension flaps.

13. The packaging system of claim 12, wherein the first and second fold lines are located on opposing sides of the sheet panel.

14. The packaging system of claim 13, wherein the sheet is connected to the first and second tension flaps.

15. The packaging system of claim 14, wherein, when the outer tray and the inner tray are placed on a first side of the sheet panel between the sheet panel and the
sheet and when the first and second tension flaps are folded to a second side of the sheet panel, the sheet covers the second side of the inner tray and the object compartment.

16. The packaging system of claim 15, wherein the object is visible through the sheet such that the object is visible in the object compartment when the sheet covers the object compartment.

17. The packaging system of claim 12, wherein the retention assembly further comprises first and second support flaps foldably connected to the sheet panel at, respectively, third and fourth fold lines between the sheet panel and the first and second support flaps.

18. The packaging system of claim 17, wherein the first and second support flaps are configured to be rotated about the third and fourth fold lines, respectively, away from the second side of the sheet panel toward the outer tray and the inner tray.

19. A method of packaging an object, comprising:
   placing an inner tray over an outer tray, wherein the outer tray has a base panel, and wherein a first side of the inner tray faces the base panel and a second side of the inner tray faces away from the base panel, and wherein the inner tray is arranged to form a temperature pack compartment between the outer tray and the inner tray on the first side of the inner tray and an object compartment on the second side of the inner tray;
   placing a temperature pack in the temperature pack compartment; and
   placing an object in the object compartment.

20. The method of claim 19, further comprising:
   placing the inner tray and the outer tray on a first side of a sheet panel between the sheet panel and a sheet of a retention assembly.

21. The method of claim 20, wherein the sheet is connected to first and second tension flaps, and wherein the first and second tension flaps are foldably connected
to the sheet panel at, respectively, first and second fold lines between the sheet panel and the first and second tension flaps.

22. The method of claim 21, further comprising:
   folding the first and second tension flaps toward the second side of the base panel to cause the sheet to cover the second side of the inner tray and the object compartment.

23. The method of claim 22, further comprising:
   after folding the first and second tension flaps toward the second side of the base panel, placing, in a container, the retention assembly with the sheet covering the second side of the inner tray and the object compartment visible through an opening of the container.

24. The method of claim 23, further comprising:
   placing a frame in the container between the sheet and the opening of the container.

25. The method of claim 24, wherein the frame includes an aperture so that the sheet is visible through the opening of the container and the aperture of the frame.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
INV. B65D81/38 F25D1/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B65D F25D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<th>Category</th>
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<th>Relevant to claim No.</th>
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<td>X</td>
<td>US 3 309 206 A (DANIELS PAUL J) 14 March 1967 (1967-03-14) figures 1-3</td>
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<td>CH 671 747 A5 (DIVIDELLA AG) 29 September 1989 (1989-09-29) figure 4</td>
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Further documents are listed in the continuation of Box C. X See patent family annex.

* Special categories of cited documents:
- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"A" document member of the same patent family

Date of the actual completion of the international search 15 May 2018

Date of mailing of the international search report 23/07/2018

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INTERNATIONAL SEARCH REPORT

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. □ Claims Nos.:
   because they relate to subject matter not required to be searched by this Authority, namely:
   
2. □ Claims Nos.:
   because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
   
3. □ Claims Nos.:
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

   see additional sheet

1. □ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. □ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. □ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. □ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
   1-10, 19

Remark on Protest

- The additional search fees were accompanied by the applicant’s protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant’s protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.
A packaging system, according to claim 1, comprising: an outer tray and an inner tray, wherein the inner tray is arranged to form: a temperature pack compartment between the outer tray and the inner tray, the temperature pack compartment configured to accommodate a temperature pack. The potential special technical feature of the first invention is the design of the inner tray with its compartments, this can solve the problem of avoiding unintentional contact of the packed objects in order to avoid breaking of fragile products such as glass e.g. bottles.

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A packaging system, according to claim 1, comprising: an outer tray and an inner tray, wherein the inner tray is arranged to form: a temperature pack compartment between the outer tray and the inner tray, the temperature pack compartment configured to accommodate a temperature pack. The potential special technical feature of the second invention is the retention system with a retention sheet and tension flaps. This can solve the problem of holding the packed objects securely on the second tray.

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