

BOX-IN-A-BOX SHIPPER**CROSS REFERENCE TO RELATED APPLICATION**

[0001] This application claims the benefit of U.S. Provisional Patent Application No.
5 63/159,859, filed March 11, 2021, which is incorporated by reference herein in its entirety.

TECHNICAL FIELD

[0002] This specification relates to a system, an apparatus and/or a method for fixating
and/or stabilizing a payload within the shipping container to protect the payload when the
10 shipping container moves during transport and/or storage.

BACKGROUND

[0003] In the health, medical, pharmaceutical and/or life science industry, the safe storage
of the payload in a temperature-controlled and watertight environment is an important aspect
15 of the industry. Typically, when a payload is shipped, the shipper packs the payload into an
enclosure, which is non-reusable, such as a cardboard box and may pack shipping material, such
as a polystyrene foam container and/or dry ice, around the payload to maintain the temperature.
The shipper may place or scoop dry ice pellets or blocks into an inner packaging made of an
insulating material, such as the polystyrene foam, and around the payload to maintain the
20 temperature of the payload. The shipper may place the inner packaging within an outer
enclosure, such as a sturdy cardboard box, and partially seal the outer enclosure. Due to this
configuration, the payload floats within the shipping material and when the shipping container
is jostled, reoriented and/or otherwise moved, the payload may move or shift during
transport, which may cause instability of the payload during transport.

25 [0004] Accordingly, there is a need for a system, apparatus and/or method for a shipping
container that stabilizes the payload within the shipping container to protect the payload.

SUMMARY

[0005] In general, one aspect of the subject matter described in this specification is embodied in a shipping container. The shipping container includes an outer enclosure having a cavity. The shipping container includes an inner enclosure positioned within the cavity of the outer enclosure. The inner enclosure has multiple panels and multiple phase-change material inserts that are received within the multiple panels. The multiple panels define a payload area that is configured to hold a payload.

[0006] These and other embodiment may optionally include a base and a lid. The lid may be removable to access the inner enclosure when the inner enclosure is within the cavity of the outer enclosure. Each panel of the multiple panels may have an angled edge that forms a channel. The channel may be configured to slidably receive a phase-change material insert.

[0007] The multiple panels may include a top panel, multiple side panels and a bottom panel. The bottom panel may be opposite the top panel. Edges of the multiple side panels may interface with edges of the top panel and edges of the bottom panel. The multiple side panels may be positioned between the top panel and the bottom panel. The multiple panels and the multiple phase change material inserts may be removable.

[0008] The outer enclosure may be made from an insulative, nonmetallic material that may be designed to withstand shocks and vibrations at cryogenic temperatures. The insulative, nonmetallic material may be a polycarbonate or other polymer. The multiple panels may be positioned along or adjacent to an inner surface of walls of the outer enclosure and may be made from a nonmetallic material.

[0009] In another aspect, the subject matter is embodied in a shipping container. The shipping container includes an outer enclosure having a cavity. The shipping container includes an inner enclosure positioned within the cavity of the outer enclosure. The inner enclosure has a top tray, a bottom tray and a nested enclosure positioned in between the top tray and a bottom tray. The nested enclosure has a payload area that is configured to receive a payload.

[0010] In another aspect, the subject matter is embodied in a shipping container. The shipping container has an outer enclosure having a cavity. The shipping container includes an inner enclosure positioned within the cavity of the outer enclosure. The inner enclosure has multiple concave walls that define a payload area that is configured to receive a container.

[0011] In another aspect, the subject matter is embodied in a shipping container. The shipping container includes an outer enclosure having a cavity. The shipping container

includes an inner enclosure positioned within the cavity of the outer enclosure. The inner enclosure includes multiple brackets. The multiple brackets define a receiving area configured to receive a payload.

5 **[0012]** In another aspect, the subject matter is embodied in a shipping container. The shipping container includes an outer enclosure. The outer enclosure has a cavity. The shipping container includes an inner enclosure positioned within the cavity of the outer enclosure. The inner enclosure has a top covering and a base. The shipping container includes multiple pillars. The multiple pillars are positioned on and upright along the base of the inner enclosure. The multiple pillars define a payload area to receive a payload.

10 **[0013]** A method is also disclosed. The method may be for maintaining a payload area of a shipping container within a predetermined temperature range during shipping of a payload in the shipping container. The method may include various aspects. For instance, the method may include providing an outer enclosure having side walls and a base defining a cavity in the outer enclosure. An inner enclosure may be inserted into the cavity of the outer enclosure and may
15 define a payload area inside the inner enclosure. A phase change material may also be inserted into the shipping container. A payload may be placed into the payload area of the inner enclosure and a lid may be attached on a top of the outer enclosure to cover the cavity of the outer enclosure containing the inner enclosure. The payload area may be cooled by the phase change material to maintain the payload area within the predetermined temperature range.

20 **[0014]** In various embodiments, the method includes one or more further aspect. For example, the phase change material may be inserted between the inner enclosure and the outer enclosure. The predetermined temperature range may be below 0 degrees Celsius. The predetermined temperature range may be below about 0 degrees Celsius. The predetermined temperature range may be between 25 degrees Celsius to -80 degrees Celsius. The
25 predetermined temperature range may be between about 25 degrees Celsius to about -80 degrees Celsius. The predetermined temperature range may be between -150 degrees Celsius to -190 degrees Celsius. The predetermined temperature range may be between about -150 degrees Celsius to about -190 degrees Celsius. The predetermined temperature range may be below about -150 degrees Celsius. The predetermined temperature range may be below -150
30 degrees Celsius. The inner enclosure may have a plurality of panels, the plurality of panels defining the payload area. The payload may be stabilized by the plurality of panels of the inner enclosure. Each panel of the plurality of panels may have an angled edge that forms a channel

and the method may include slidably inserting the phase-change material insert into the channel.

[0015] The method may be implemented with various configurations of inner enclosures. For example, the inner enclosure may have a top tray, a bottom tray and a nested enclosure positioned in between the top tray and a bottom tray, the nested enclosure defining the payload area, wherein the payload is stabilized by the nested enclosure of the inner enclosure. The inner enclosure may include a plurality of concave walls, the plurality of concave walls defining the payload area. The inner enclosure may have a plurality of brackets, the plurality of brackets defining the payload area configured to receive a payload. The inner enclosure may have a top covering and a base; and a plurality of pillars positioned on and upright along the base of the inner enclosure, the plurality of pillars defining the payload area to receive a payload.

[0016] As previously indicated, one aspect of the subject matter described in this specification is embodied in a shipping container. The shipping container may be have different configurations. For instance, the shipping container may have an outer enclosure having side walls and a base, wherein the side walls and the base defining a cavity in the outer enclosure. The shipping container may have a lid attachable to the sidewalls of the outer enclosure to cover the cavity in the outer enclosure. The shipping container may have an inner enclosure disposed inside the cavity and configured to provide a payload area for a payload within the inner enclosure.

[0017] The inner enclosure of the shipping container may be configured in various ways. For instance, the inner enclosure may include a plurality of panels, the plurality of panels defining the payload area. The inner enclosure may include a top tray, a bottom tray and a nested enclosure positioned in between the top tray and a bottom tray, the nested enclosure defining the payload area. The inner enclosure may include a plurality of concave walls, the plurality of concave walls defining the payload area. The inner enclosure may include a plurality of brackets, the plurality of brackets defining the payload area configured to receive the payload. The inner enclosure may include a base, a plurality of pillars positioned on and upright along the base of the inner enclosure, the plurality of pillars defining the payload area to receive a payload, and a top covering opposite the base, wherein the pillars extend between the top covering and the base.

BRIEF DESCRIPTION OF THE DRAWINGS

- [0018] Other systems, methods, features, and advantages of the present invention will be apparent to one skilled in the art upon examination of the following figures and detailed description. Component parts shown in the drawings are not necessarily to scale, and may be exaggerated to better illustrate the important features of the present invention.
- 5 [0019] FIG. 1A shows an example of a shipping container that has multiple panels and multiple phase-change material inserts according to an aspect of the invention.
- [0020] FIG. 1B shows a close-up perspective view of a panel and a phase-change material insert of the shipping container of FIG. 1A according to an aspect of the invention.
- 10 [0021] FIG. 2 shows an example of a shipping container that has a nested container according to an aspect of the invention.
- [0022] FIG. 3 shows an example of a shipping container that has a star-shaped inner enclosure according to an aspect of the invention.
- 15 [0023] FIG. 4 shows an example of a shipping container that has an inner enclosure with multiple brackets according to an aspect of the invention.
- [0024] FIG. 5 shows an example of a shipping container that has an inner enclosure with pillars according to an aspect of the invention.
- [0025] FIG. 6 shows a method for maintaining a payload area of a shipping container within a predetermined temperature range during shipping of a payload in the shipping container according to an aspect of the invention.
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DETAILED DESCRIPTION

[0026] Disclosed herein are systems, devices and/or methods for a shipping container (or “shipper”) that maintains the temperature within the payload area and stabilizes the payload within the payload area. The shipper may be designed to have an outer enclosure and an inner enclosure within the cavity of the outer enclosure to stabilize and protect the payload placed within the payload area of the inner enclosure. The outer and/or inner enclosures may be made from a metallic or nonmetallic material, such as from a hardened material, such as a polycarbonate, polyethylene or other polymer, which protects the payload in the payload from environmental factors, such as shock and vibrations. The material may be designed to withstand cryogenic temperatures so that the exposure to extremely cold temperatures does not make the material brittle and susceptible to shocks and vibrations that occur during storage and/or transport.

[0027] Other benefits and advantages may include the use of a phase-change material. The use of the phase-change material maintains the temperature within the payload area of the shipper, and consequently, the temperature of a payload positioned within the payload area. By using the phase-change material, the shipper may maintain and/or manage the temperature within the payload area. The temperature within the payload area may not be limited to a single temperature range, e.g., limited to the temperature of the dry ice when dry ice is used as the temperature control medium. Instead, the shipper may have the flexibility to maintain the temperature of the payload at various different temperature ranges, which may be set using phase-change material as the temperature control medium.

[0028] FIG. 1A shows an exploded view of the shipper 100. The shipper 100 maintains a temperature controlled environment for a payload within a payload area. The shipper 100 may include an outer enclosure 102 and an inner enclosure 104. The outer enclosure 102 may be shaped as a rectangular cube with a base 114, a lid 116 that may be removable and multiple sidewalls 118. Moreover, the outer enclosure 102 may be made from an insulative, metallic or a nonmetallic material, such as a polycarbonate or other polymer. The outer enclosure 102 may be designed withstand shocks and vibrations at cryogenic temperatures that occur during transport and/or storage.

[0029] The base 114, the lid 116 and/or the multiple sidewalls 118 may form or define a cavity 110 that receives the inner enclosure 104 within the cavity 110. The lid 116 may be removable to allow access to the inner enclosure 104. The lid 116 may couple to the multiple sidewalls 118 via one or more hinges, latches and/or connectors and/or may be sized and shaped

to fit to rest on the multiple sidewalls 118 to enclose and/or surround the cavity 110. This allows the lid 116 to be removable and/or to be moved between an open position and a closed position to provide access to the cavity 110 and the contents within the cavity 110.

5 [0030] The inner enclosure 104 and the payload may be placed within the cavity 110. The lid 116 may be placed on top of the inner enclosure 104 to prevent access to and seal or partially seal the inner enclosure 104 and/or the payload within the cavity 110. Thus, the outer enclosure 102 may protect the inner enclosure 104 and the payload that is placed within the cavity 110 from shocks and/or vibrations during storage and transport.

10 [0031] The shipper 100 includes the inner enclosure 104. The inner enclosure 104 may include multiple panels 106 and/or multiple phase change material (PCM) inserts 108. The multiple panels 106 and/or the PCM inserts 108 may be positioned along and/or adjacent to the inner surface of the base 114, the multiple sidewalls 118 and/or the lid 116 within the cavity 110. The multiple panels 106 and/or the PCM inserts 108 define a payload area 112 that may receive and enclose a payload that is placed within the payload area 112.

15 [0032] The multiple panels 106 may be made from a metallic or a non-metallic material, such as a polycarbonate or other insulative non-metallic material that may withstand cryogenic temperatures. The multiple panels 106 may include a bottom panel, multiple side panels, and a top panel that is opposite the bottom panel. Each of the multiple panels 106 may have one or more inward angled edges 120 that form a channel 122, which may slidably receive a
20 corresponding PCM insert 108, as shown in FIG. 1B for example. The edges of each of the multiple side panels may interface with edges of the top panel and edges of the bottom panel and may be positioned in between the top panel and the bottom panel to form the inner enclosure 104 and define the payload area 112.

[0033] The PCM insert 108 includes a phase-change material, which is a substance which
25 releases and/or absorbs sufficient energy at phase transition to provide useful heat and/or cooling. The phase-change material may transition between a solid and a liquid. Different phase-change materials may be designed to maintain the temperature within the payload area 112 at and/or within different temperature ranges and/or bands.

[0034] The corresponding PCM insert 108 may be slid into the channel 122 to integrate the
30 PCM insert 108 with the corresponding panel 106. For example, the edges of the PCM insert 108 may be slid into the channel 122 to position the PCM insert 108 within the channel 122 and to be secured to the panel 106. When the PCM inserts 108 are received within the multiple panels 106 and the multiple panels 106 and/or the PCM inserts 108 are inserted into the cavity

of the outer enclosure 102 to form the inner enclosure 104, a payload area 112 is defined, which may receive and enclose a payload. Each of the PCM inserts 108 and each of the multiple panels 106 may be shaped similarly, such as in a pyramidal frustum, to allow for interchangeability among the various components, and thus, allowing the multiple panels 106 and/or the PCM inserts 108 to be removable and interchangeable with each other.

5 [0035] In another aspect of the invention, FIG. 2 shows a shipper 200. The shipper 200 maintains a temperature controlled environment for a payload within a payload area. The shipper 200 includes an outer enclosure (not shown) and an inner enclosure 201. The inner enclosure 201 is positioned in the cavity of the outer enclosure and stores or surrounds a payload that is placed within.

10 [0036] The inner enclosure 201 has a top tray 202, a bottom tray 204 and a nested enclosure or container ("nested container") 206 within. The top tray 202 may be positioned opposite the bottom tray 204, and the nested container 206 may be positioned in between the top tray 202 and the bottom tray 204. The sides of the top tray 202 and the sides of the bottom tray 204 may interface and substantially contact with the sidewalls of the outer enclosure so that the top tray 202 and the bottom tray 204 do not move within the cavity of the outer enclosure when placed within the cavity of the outer enclosure. This fixates the inner enclosure 201 within the outer enclosure so that the inner enclosure 201 remains still within the outer enclosure during transport.

15 [0037] The top tray 202 and/or the bottom tray 204 may have one or more handles 208. The one or more handles 208 may be openings within the sidewalls of the top tray 202 and/or the bottom tray 204. The one or more handles 208 allow a user to grasp or insert their hands through the openings on the sidewalls of the top tray 202 and/or the bottom tray 204 to hold, lift, move or otherwise position the inner enclosure 202 within the cavity of the outer enclosure and/or to remove the inner enclosure 202 from the cavity of the outer enclosure. In some implementations, the top tray 202 and/or the bottom tray 204 may or may not be removable from the cavity of the outer enclosure. For example, the bottom tray 204 may be fixated within, integrally molded with or integrally formed with the outer enclosure and not be separable from the bottom or sides of the cavity of the outer enclosure.

20 [0038] The top tray 202 may have one or more openings 210 at the base of the top tray 202. The one or more opening 210 may be positioned in the center of the top tray 202 and may be sized and shaped similarly to the nested container 206. The one or more openings 210 allow a

container or a payload to be inserted into the payload area 212 of the nested container 206 without the need to remove the top tray 202.

5 **[0039]** The nested container 206 may be integrally formed with, fixated on or be removable from the bottom tray 204 and/or the top tray 202. The nested container 206 may be centrally positioned in between the top tray 202 and the bottom tray 204. The nested container 206 may have a perimeter that is less than that of the top tray 202 and/or the bottom tray 204 to allow for dry ice or other cooling material or substance to be placed between the nested container 206 and the sidewalls of the outer enclosure. That is, the nested container 206 may not contact or interface with the sidewalls of the outer enclosure.

10 **[0040]** The nested container 206 may be formed from multiple sidewalls 216 that define a payload area 212. The multiple sidewalls 216 may surround and/or enclose a payload that is placed or positioned within the payload area 212. The multiple sidewalls 216 may have one or more leaf springs 218 or portion thereof that is cutout from each of the sidewalls 216 and/or is coupled or otherwise fastened to each of the sidewalls 216 and angles, flexes or is bent inwards
15 to contact the walls of the payload that is placed, positioned or received within the payload area 212. The one or more leaf springs 218 may be compressible or flexible to absorb shocks or other movements of the payload that is positioned within while being rigid enough to secure or stabilize the payload within the sidewalls 216 of the nested container 206. The nested container 206 may be made from a metallic or nonmetallic material, such as a polycarbonate, to withstand
20 cryogenic temperatures.

[0041] The inner enclosure 201 may have one or more centering guides 214. The one or more centering guides 214 may be positioned on the inner surface of the top tray 202 and/or the bottom tray 204. The one or more centering guides 214 may be formed from a first wall and a second wall. The two walls may be integrally formed and the second wall may be
25 perpendicular to the first wall and may form a right angle where the second wall and the first wall are joined together, molded together or otherwise positioned adjacent to each other to form a corner. The one or more centering guides 214 may be positioned around the perimeter of the sidewalls 216 of the nested container 206 when the nested container 206 rests in between the top tray 202 and/or the bottom tray 204. One wall may be molded, fixated or positioned on the
30 top tray 202 and/or the bottom tray 204 with the other wall being positioned parallel to and adjacent to a portion of the nested container. The wall that is positioned parallel to and adjacent to the portion of the nested container may only contact the payload a small portion, approximately along less than 15% of the wall of the nested container. The one or more

centering guides 214 may only be along some of the walls of the nested container and not all of the walls of the nested container. The one or more centering guides 214 allow for the nested container 206 to be positioned centrally on the bottom tray 204 and underneath the one or more openings 210 of the top tray 202 so that dry ice or other substance may be placed around the nested container 206 to maintain the payload at the cryogenic temperature.

[0042] In another aspect of the invention, FIG. 3 shows a shipper 300 with a star-shaped inner enclosure 304. The shipper 300 maintains a temperature controlled environment for a payload within a payload area. The shipper 300 includes an outer enclosure 302 and an inner enclosure 304. The outer enclosure 302 may be made from one or more layers. The layers may include a layer of insulative foam and/or a layer of polycarbonate or other polymer or nonmetallic that may withstand cryogenic temperatures. The outer enclosure 302 may have multiple walls that define a cavity 303. The cavity 303 may be sized and shaped to receive the inner enclosure 304. For example, the cavity 303 may be defined by the multiple walls being formed in a rectangle, cubicle or other polygonal shape.

[0043] The inner enclosure 304 may be positioned in the cavity 303 of the outer enclosure 302. The inner enclosure 304 may have multiple walls 310 or blades (hereinafter, "walls") and multiple vertices 308 where two adjacent walls are joined or meet. The walls 310 and/or the vertices 308 may be made from a metallic or nonmetallic material, such as a polycarbonate or the polymer shape. The multiple walls 310 are in between two or more vertices 308 of the multiple vertices 308. In some implementations, the inner enclosure 304 includes four vertices and four walls that are concave shaped forming a star-shape and contact the payload 306 at the inward-most curved portion 314.

[0044] The walls 310 of the inner enclosure 304 enclose or surround the payload 306 that is placed within. The walls 310 may be concaved shaped so that the payload 306 does not substantially contact the entire surface of each of the walls 310. Instead, the concaved shaped walls may contact the payload 306 only along the inward-most curved portion 314 of the concaved shaped wall. The inward-most curved portion 314 of the concaved shaped wall fixates, stabilizes and orients the payload 306 in the center of the inner enclosure 304.

[0045] The inner enclosure 304 may be positioned and oriented within the outer enclosure 302 such that the multiple vertices 308 are positioned in the corners of the outer enclosure 302 where two adjacent walls are joined or meet. This fixates and centers the inner enclosure 304 within the cavity 303 of the outer enclosure 302. And so, since the container 306 is positioned within and stabilized within the inner enclosure 304 and the inner enclosure 304 is fixated and

centered within the cavity 303, the payload 306 remains stabilized in the center of the cavity 303 of the outer enclosure 302. Moreover, since the inner enclosure 304 may be concave-shaped with its vertices in the corners of the outer enclosure 302, dry ice or other cooling material may be placed in the interstitial spaces 316 in between the inner enclosure 304 and the walls of the outer enclosure 302 and in between the inner enclosure 304 and the payload 306.

5 [0046] In another aspect of the invention, FIG. 4 shows a shipper 400 with one or more brackets 406 that together form an inner enclosure 404. The shipper 400 maintains a temperature controlled environment for a payload within a payload area. The shipper 400 includes an outer enclosure 402 and an inner enclosure 404. The outer enclosure 402 may be made from one or more layers. The layers may include a layer of insulative foam and/or a layer of polycarbonate or other polymer or nonmetallic that may withstand cryogenic temperatures. The outer enclosure 402 may have multiple walls 412 that define a cavity 403. The cavity 403 may be sized and shaped to receive the inner enclosure 404. For example, the cavity 403 may be defined by the multiple walls 412 being formed in a rectangle, cubicle or other polygonal shape.

15 [0047] The inner enclosure 404 may be positioned in the cavity 403 of the outer enclosure 402. The inner enclosure 404 may have multiple brackets 406. The multiple brackets 406 may be formed from multiple blades 408 and a wall 410 in between. For example, a bracket may be formed from a first blade that is angled inward from a corner of the cavity 403 of the outer enclosure 402, a second blade that is angled inward from a second corner of the cavity 403 of the enclosure 402 and a wall 410 that is coupled to, integrally formed with and/or in between the first blade and the second blade. The inner enclosure 404 may have two or more brackets 406 that are positioned opposite one another in the cavity 403 on opposite walls of the outer enclosure 402. In some implementations, the two or more brackets 406 may be positioned on each wall of the outer enclosure 402.

20 [0048] Each wall 410 may be concave-shaped and have a inward curved portion. Each blade 408 may have a proximal portion coupled to the wall 410, which is adjacent to the wall 412 of the outer enclosure 402, and a distal portion that is directed toward a center of the cavity 403 and contacts a payload that may be received within the inner enclosure 404. Dry ice or other material to maintain the cryogenic temperatures may be placed within the interstitial spaces 414 between the one or more blades 408, the one or more walls 410 of the one or more brackets 406 and/or the walls 412 of the outer enclosure 402.

[0049] The one or more brackets 406 may be compressible or flexible and may be made from a metallic or nonmetallic material, such as a polycarbonate or other polymer, which resists brittleness at cryogenic temperatures. The payload may exert a force against the one or more brackets 406 when the payload is placed in between the one or more brackets 406 within the inner enclosure 404. The one or more brackets 406 may bend slightly inward or exert an opposing force to maintain the position of the payload within the inner enclosure 404 to stabilize the payload within the payload area of the inner enclosure 404.

[0050] In another aspect of the invention, FIG. 5 shows a shipper 500 with one or more pillars 512. The shipper 500 maintains a temperature controlled environment for a payload within a payload area. The shipper 500 includes an outer enclosure 502 and an inner enclosure 504. The outer enclosure 502 and/or the inner enclosure 504 may be made from a metallic or nonmetallic material, such as a polycarbonate or other polymer that withstands cryogenic temperatures. The outer enclosure 502 may have multiple walls that define a cavity 503. The multiple walls may be positioned to form a rectangular cavity within to receive the inner enclosure 504 and the payload.

[0051] The inner enclosure 504 may have a top covering 506 and a base 508. The base 508 may be fixated, integrally formed with, and/or otherwise positioned at the bottom of the outer enclosure 502. The walls of the base 508 may be adjacent to and/or in contact with the sidewalls of the outer enclosure 502 such that the base 508 does not move or change positions within the bottom of the outer enclosure 502. In some implementations, there is a gap in between the walls of the base 508 and the sidewalls of the outer enclosure 502 so that dry ice or other substance material may be placed in between. The base 508 may have a recess or cavity 510 within. The recess or cavity 510 may be filled with dry ice or other substance material to cool the payload that is received within the payload area 514 from underneath.

[0052] The top covering 506 of the inner enclosure 504 may be removable and may slide within the cavity 503 of the outer enclosure 502 to fit on top of the base 508 and surround, enclosure and/or define a payload area 514, which receives the payload when inserted within. The top covering 506 of the inner enclosure 504 may similarly have multiple walls that are sized and shaped similarly as the cavity 503 of the outer enclosure 502 so that the multiple walls of the top covering 506 are adjacent to the walls of the outer enclosure 502.

[0053] The shipper 500 may have one or more pillars 512. The one or more pillars 512 may be formed from a first wall and a second wall. The two walls may be made from a metallic or nonmetallic material, such as a polycarbonate or other polymer. The two walls may be

- integrally formed and the second wall may be perpendicular to the first wall and may form a right angle where the second wall and the first wall are joined together, molded together or otherwise positioned adjacent to each other to form a corner. The one or more pillars 512 may be positioned upright and parallel to the walls of the top covering 506 and around the perimeter of the cavity 510 of the base 508. The one or more pillars 512 may be fastened, molded or otherwise coupled to the base 508, and may define the payload area 514 that receives the payload when the payload is inserted into the inner enclosure 504. In some implementations, the one or more pillars 512 may be positioned on a lid (not shown) that is positioned on top of the top covering 506 and extend downwards toward the base 508.
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- 10 **[0054]** When the payload is inserted, the one or more pillars 512 may receive the one or more corners of the payload, such that the one or more pillars 512 only contact a portion of the wall of the payload, such as approximately less than 15% of each wall of the payload. The one or more pillars 512 stabilize the payload within the payload area 514 so that the payload does not jostle or otherwise move during transport of the shipper 500. There may be one or more
- 15 gaps or interstitial spaces between the payload within the payload area 514 and the walls of the inner enclosure 504 and/or the outer enclosure 502 to allow for dry ice or other substance material to be placed in between to maintain the cryogenic temperatures. Moreover, the dry ice or other substance material may be positioned within the cavity 510 and/or on top of the payload when positioned within the payload area 514.
- 20 **[0055]** With reference now to FIG. 6, a method 600 is provided. The method may be for maintaining a payload area of a shipping container within a predetermined temperature range during shipping of a payload in the shipping container. The method may include providing an outer enclosure (block 602). The outer enclosure may have side walls and a base defining a cavity in the outer enclosure. The method may include inserting an inner enclosure into the
- 25 cavity of the outer enclosure (block 604). In various instances the inner enclosure defines a payload area inside the inner enclosure. The method may include inserting a phase change material into the shipping container (block 606). The phase change material may be liquid nitrogen or another cryogen. The phase change material may be solid carbon dioxide (e.g., dry ice). The phase change material may be frozen water (e.g., ice), or any other material suitable
- 30 for maintaining the payload area of the shipping container within the predetermined temperature range.
- [0056]** The method may include placing a payload into the payload area of the inner enclosure (block 608) and attaching a lid on a top of the outer enclosure to cover the cavity of

the outer enclosure containing the inner enclosure (block 610). The method may include cooling the payload area by the phase change material to maintain the payload area within the predetermined temperature range (block 610).

[0057] In connection with the method, various aspects of the different embodiments may be incorporated. For example, the phase change material may be inserted between the inner enclosure and the outer enclosure. The predetermined temperature range may be below 0 degrees Celsius. The predetermined temperature range may be below about 0 degrees Celsius. The predetermined temperature range may be between 25 degrees Celsius to -80 degrees Celsius. The predetermined temperature range may be between about 25 degrees Celsius to about -80 degrees Celsius. The predetermined temperature range may be between -150 degrees Celsius to -190 degrees Celsius. The predetermined temperature range may be between about -150 degrees Celsius to about -190 degrees Celsius. The predetermined temperature range may be below about -150 degrees Celsius. The predetermined temperature range may be below -150 degrees Celsius. The inner enclosure may have a plurality of panels, the plurality of panels defining the payload area, wherein the payload is stabilized by the plurality of panels of the inner enclosure. Each panel of the plurality of panels may have an angled edge that forms a channel. The phase change material may be slidably inserted into the channel. The inner enclosure may have a top tray, a bottom tray and a nested enclosure positioned in between the top tray and a bottom tray, the nested enclosure defining the payload area, wherein the payload is stabilized by the nested enclosure of the inner enclosure. The inner enclosure may have a plurality of concave walls, the plurality of concave walls define the payload area. The inner enclosure may have a plurality of brackets, the plurality of brackets defining the payload area configured to receive a payload. The inner enclosure may have a top covering and a base; and a plurality of pillars positioned on and upright along the base of the inner enclosure, the plurality of pillars defining the payload area to receive a payload.

[0058] Exemplary embodiments of the methods/systems have been disclosed in an illustrative style. Accordingly, the terminology employed throughout should be read in a non-limiting manner. Although minor modifications to the teachings herein will occur to those well versed in the art, it shall be understood that what is intended to be circumscribed within the scope of the patent warranted hereon are all such embodiments that reasonably fall within the scope of the advancement to the art hereby contributed, and that that scope shall not be restricted, except in light of the appended claims and their equivalents.

CLAIMS

What is claimed is:

1. A shipping container, comprising:
an outer enclosure having a cavity; and
5 an inner enclosure positioned within the cavity of the outer enclosure and having a plurality of panels and a plurality of phase-change material inserts that are received within the plurality of panels, the plurality of panels defining a payload area that is configured to hold a payload.
- 10 2. The shipping container of claim 1, wherein the outer enclosure includes a base and a lid, wherein the lid is removable to access the inner enclosure when the inner enclosure is within the cavity of the outer enclosure.
3. The shipping container of claim 1, wherein each panel of the plurality of panels has an
15 angled edge that forms a channel, wherein the channel is configured to slidably receive a phase-change material insert of the plurality of phase-change material inserts.
4. The shipping container of claim 1, wherein the plurality of panels include a top panel, a plurality of side panels and a bottom panel that is opposite the top panel, wherein the top
20 panel is opposite the bottom panel and edges of the plurality of side panels interface with edges of the top panel and edges of the bottom panel, wherein the plurality of side panels are positioned between the top panel and the bottom panel.
5. The shipping container of claim 4, wherein each of the plurality of panels is removable
25 and each of the plurality of phase-change material inserts are removable.
6. The shipping container of claim 1, wherein the outer enclosure is made from an insulative, nonmetallic material that is designed to withstand shocks and vibrations at cryogenic temperatures.
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7. The shipping container of claim 6, wherein the insulative, nonmetallic material is a polycarbonate or other polymer.

8. The shipping container of claim 1, wherein the plurality of panels are positioned along or adjacent to an inner surface of walls of the outer enclosure and are made of a nonmetallic material.

5 9. A shipping container, comprising:
an outer enclosure having a cavity; and
an inner enclosure positioned within the cavity of the outer enclosure and having a top tray, a bottom tray and a nested enclosure positioned in between the top tray and a bottom tray, the nested enclosure having a payload area to receive a payload.

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10. The shipping container of claim 9, wherein the top tray has an opening to allow the container to be placed within the nested enclosure.

11. The shipping container of claim 9, wherein the nested enclosure has one or more leaf
15 springs that are angled inward and that are configured to contact and stabilize the payload within the nested enclosure.

12. The shipping container of claim 11, wherein the leaf springs, the top tray and the bottom tray are nonmetallic.

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13. The shipping container of claim 9, wherein the top tray or the bottom tray has one or more centering guides that receive the nested enclosure and centers the nested enclosure in a center of the top tray or the bottom tray.

25 14. The shipping container of claim 9, wherein the top tray and the bottom are shaped to fit within the shipping container and interface with each wall of a plurality of walls of the outer wall when inserted into the cavity of the outer enclosure.

15. The shipping container of claim 9, the top tray or the bottom tray has one or more
30 handles to allow a user to grasp or hold the top tray or the bottom tray.

16. The shipping container of claim 9, wherein the bottom tray is fixated within, integrally molded with or integrally formed with the outer enclosure and is not separable from the outer enclosure.
- 5 17. The shipping container of claim 9, wherein the nested enclosure is integrally formed with or fixated on the bottom tray or the top tray.
18. A shipping container, comprising:
an outer enclosure having a cavity; and
10 an inner enclosure positioned within the cavity of the outer enclosure and having a plurality of concave walls that define a payload area to receive a container.
19. The shipping container of claim 18, the inner enclosure has a plurality of vertices where two adjacent walls of the plurality of concave walls meet, wherein each vertex of the plurality
15 of vertices contacts a corner of cavity of the outer enclosure.
20. The shipping container of claim 19, wherein the inner enclosure is star-shaped with four vertices and four concave walls.
- 20 21. The shipping container of claim 18, wherein the inner enclosure is nonmetallic and is configured to contact the container at an inward-most curved portion of each concave walls of the plurality of concave walls when the container is placed within the payload area of the inner enclosure.
- 25 22. The shipping container of claim 18, wherein the outer enclosure has a layer of insulative material or a layer of polycarbonate to withstand cryogenic temperatures.
23. A shipping container, comprising:
an outer enclosure having a cavity; and
30 an inner enclosure positioned within the cavity of the outer enclosure and having a plurality of brackets, the plurality of brackets defining a receiving area configured to receive a container.

24. The shipping container of claim 23, wherein the plurality of brackets include a first bracket and a second bracket, wherein the first bracket has a first blade, a second blade and a concave wall positioned in between the first blade and the second blade.

5 25. The shipping container of claim 24, wherein the first blade is positioned within a corner of the cavity of the outer enclosure and protrudes inward toward a center of the cavity and the second blade is positioned within a second corner of the cavity that is opposite the first corner of the cavity of the outer enclosure and protrudes inward toward the center of the cavity of the outer enclosure.

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26. The shipping container of claim 24, wherein the first blade, the second blade and the concave wall is made from a nonmetallic material.

15 27. The shipping container of claim 24, wherein the first bracket is positioned adjacent to a first wall of the outer enclosure and the second bracket is positioned adjacent to a second wall of the outer enclosure that is opposite the first wall of the outer enclosure.

28. The shipping container of claim 23, wherein the outer enclosure is made from a one or more layers of insulative material or polycarbonate material.

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29. A shipping container, comprising:
an outer enclosure having a cavity;
an inner enclosure positioned within the cavity of the outer enclosure and having a top covering and a base; and
25 a plurality of pillars positioned on and upright along the base of the inner enclosure, the plurality of pillars defining a payload area to receive a payload.

30. The shipping container of claim 29, wherein the plurality of pillars include a first pillar and a second pillar that is opposite the first pillar, wherein the first pillar receives a first corner of the payload and the second pillar receives a second corner of the payload that is opposite the first corner of the payload.

31. The shipping container of claim 30, wherein the plurality of pillars contact a portion of a wall of the payload and stabilize the payload so that the payload does not move during transport.

5 32. The shipping container of claim 29, wherein the plurality of pillars are fastened, molded or otherwise coupled to the base.

33. The shipping container of claim 29, wherein the plurality of pillars are made from a nonmetallic material.

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34. A method for maintaining a payload area of a shipping container within a predetermined temperature range during shipping of a payload in the shipping container, the method comprising:

providing an outer enclosure having side walls and a base defining a cavity in the

15 outer enclosure;

inserting an inner enclosure into the cavity of the outer enclosure, wherein the inner enclosure defines a payload area inside the inner enclosure;

inserting a phase change material into the shipping container;

placing a payload into the payload area of the inner enclosure;

20 attaching a lid on a top of the outer enclosure to cover the cavity of the outer enclosure containing the inner enclosure; and

cooling the payload area by the phase change material to maintain the payload area within the predetermined temperature range.

25 35. The method of claim 34, wherein the phase change material is inserted between the inner enclosure and the outer enclosure.

36. The method according to claim 34, wherein the predetermined temperature range is between about 25 degrees Celsius to about -80 degrees Celsius.

30

37. The method according to claim 34, wherein the inner enclosure comprises a plurality of panels, the plurality of panels defining the payload area, wherein the payload is stabilized by the plurality of panels of the inner enclosure.

38. The method according to claim 37, wherein each panel of the plurality of panels has an angled edge that forms a channel, the method further comprising slidably inserting the phase-change material insert into the channel.

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39. The method according to claim 34, wherein the inner enclosure comprises a top tray, a bottom tray and a nested enclosure positioned in between the top tray and a bottom tray, the nested enclosure defining the payload area, wherein the payload is stabilized by the nested enclosure of the inner enclosure.

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40. The method according to claim 34, wherein the inner enclosure comprises a plurality of concave walls, the plurality of concave walls defining the payload area.

41. The method according to claim 34, wherein the inner enclosure comprises a plurality of brackets, the plurality of brackets defining the payload area configured to receive a payload.

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42. The method according to claim 34, wherein the inner enclosure having a top covering and a base; and a plurality of pillars positioned on and upright along the base of the inner enclosure, the plurality of pillars defining the payload area to receive a payload.

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43. A shipping container comprising:
an outer enclosure having side walls and a base, wherein the side walls and the base define a cavity in the outer enclosure; and
a lid attachable to the sidewalls of the outer enclosure to cover the cavity in the outer enclosure;
an inner enclosure disposed inside the cavity and configured to provide a payload area for a payload within the inner enclosure.

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44. The system according to claim 43, wherein the inner enclosure comprises a plurality of panels, the plurality of panels defining the payload area.

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45. The system according to claim 43, wherein the inner enclosure comprises a top tray, a bottom tray and a nested enclosure positioned in between the top tray and a bottom tray, the nested enclosure defining the payload area.

5 46. The system according to claim 43, wherein the inner enclosure comprises a plurality of concave walls, the plurality of concave walls defining the payload area.

47. The system according to claim 43, wherein the inner enclosure comprises a plurality of brackets, the plurality of brackets defining the payload area configured to receive the payload.

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48. The system according to claim 43, wherein the inner enclosure comprises:

a base;

a plurality of pillars positioned on and upright along the base of the inner enclosure, the plurality of pillars defining the payload area to receive a payload; and

15 a top covering opposite the base, wherein the pillars extend between the top covering and the base.