



(43) International Publication Date
18 December 2014 (18.12.2014)

- (51) International Patent Classification:
F25D 23/02 (2006.01)
- (21) International Application Number:
PCT/US2014/041495
- (22) International Filing Date:
9 June 2014 (09.06.2014)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
61/833,160 10 June 2013 (10.06.2013) US
61/919,946 23 December 2013 (23.12.2013) US
- (71) Applicant: **THE COCA-COLA COMPANY** [US/US];
Patents, One Coca-Cola Plaza, NW, Atlanta, Georgia
30313 (US).
- (72) Inventor: **GODBOLE, Vinayak S.**; 152 Ardenlee Drive,
Peachtree City, Georgia 30269 (US).
- (74) Agents: **WARREN, Daniel J.** et al.; Sutherland Asbill &
Brennan LLP, 999 Peachtree Street, NE, Atlanta, Georgia
30309-3996 (US).
- (81) Designated States (*unless otherwise indicated, for every
kind of national protection available*): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,

BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,
DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR,
KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME,
MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,
OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,
SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM,
TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM,
ZW.

- (84) Designated States (*unless otherwise indicated, for every
kind of regional protection available*): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ,
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,
MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

Published:

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the
claims and to be republished in the event of receipt of
amendments (Rule 48.2(h))*

(54) Title: SYSTEMS AND METHODS FOR A VACUUM INSULATED PANEL

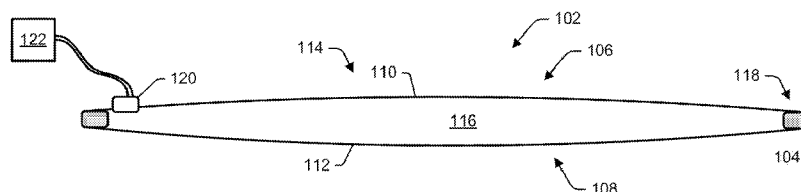


FIG. 2

(57) Abstract: A vacuum insulated panel is disclosed herein. According to an embodiment, the vacuum insulated panel may include a frame having a first side and a second side. The vacuum insulated panel also may include a first convex sheet positioned about the first side of the frame and a second convex sheet positioned about the second side of the frame. Moreover, the vacuum insulated panel may include a cavity formed between the first convex sheet and the second convex sheet. Further, the vacuum insulated panel may include a vacuum formed within the cavity. The vacuum may be configured to at least partially flatten the first convex sheet and the second convex sheet into a substantially parallel planar configuration.



SYSTEMS AND METHODS FOR A VACUUM INSULATED PANEL

CROSS-REFERENCE TO RELATED APPLICATIONS

5 [0001] The disclosure claims priority to and the benefit of U.S. Provisional Application No. 61/833,160, filed June 10, 2013, which is hereby incorporated by reference in its entirety. The disclosure also claims priority to and the benefit of U.S. Provisional Application No. 61/919,946, filed December 23, 2013, which is hereby incorporated by reference in its entirety.

10

FIELD

[0002] The disclosure generally relates to a vacuum insulated panel and more particularly relates to a vacuum insulated panel including one or more convex sheets configured to be flattened when a vacuum is applied thereto.

15

BACKGROUND

[0003] Glass door cooler assemblies enable retailers to present a large number of products on sale while at the same time maintaining a consistent temperature of the products contained therein. The glass door of the cooler assemblies may typically be constructed with an air gap situated between two parallel glass sheets. In order to increase the thermal efficiency of the glass door, additional glass sheets may be added to provide additional air gaps. Other additions may be made to the glass door to increase the thermal efficiency thereof. However, these additions to the glass door may increase the weight and/or expense of the glass door.

25

SUMMARY

[0004] Some or all of the above needs and/or problems may be addressed by certain embodiments of the vacuum insulated panel disclosed herein. According to an embodiment, the vacuum insulated panel may include a frame having a first side and a second side. The vacuum insulated panel also may include a first convex sheet

30

positioned about the first side of the frame and a second convex sheet positioned about the second side of the frame. Moreover, the vacuum insulated panel may include a cavity formed between the first convex sheet and the second convex sheet. Further, the vacuum insulated panel may include a vacuum formed within the cavity. The vacuum may be configured to at least partially flatten the first convex sheet and the second convex sheet into a substantially parallel planar configuration.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] The detailed description is set forth with reference to the accompanying drawings, which are not necessarily drawn to scale. The use of the same reference numerals may indicate similar or identical items. Various embodiments may utilize elements and/or components other than those illustrated in the drawings, and some elements and/or components may not be present in various embodiments. Throughout this disclosure, depending on the context, singular and plural terminology may be used interchangeably.

[0006] FIG. 1 schematically depicts a perspective view of a cooler assembly in accordance with one or more embodiments of the disclosure.

[0007] FIG. 2 schematically depicts a cross sectional view of a vacuum insulated panel in accordance with one or more embodiments of the disclosure.

[0008] FIG. 3 schematically depicts a cross sectional view of a vacuum insulated panel in accordance with one or more embodiments of the disclosure.

[0009] FIG. 4 schematically depicts a cross sectional view of a spacer in accordance with one or more embodiments of the disclosure.

[0010] FIG. 5 schematically depicts a cross sectional view of a spacer in accordance with one or more embodiments of the disclosure.

[0011] FIG. 6 schematically depicts a cross sectional view of a spacer in accordance with one or more embodiments of the disclosure.

[0012] FIG. 7 schematically depicts a sectional perspective view of a spacer assembly in accordance with one or more embodiments of the disclosure.

DETAILED DESCRIPTION

[0013] A vacuum insulated panel may include a frame configured to support two opposing sheets. For example, two glass sheets of relatively the same size and the same shape may be spaced apart from each other by the frame. The frame and the opposing glass sheets may collectively form an air tight cavity within the interstitial space between the opposing glass sheets. In order to increase the thermal properties of the vacuum insulated glass panel, a vacuum may be created between the opposing glass sheets. The vacuum between the opposing glass sheets, however, may tend to draw the opposing glass sheets inward towards each other in a biconcave manner. In order to prevent the opposing glass sheets from collapsing in on the cavity and/or touching, one or more spacers may be positioned between the opposing glass sheets within the cavity. The spacers, however, may create pathways for heat to travel between the opposing glass sheets, thereby reducing the overall thermal efficiency of the vacuum insulated glass panel. Further, the spacers may increase the cost and weight of the vacuum insulated panel.

[0014] A vacuum insulated panel is disclosed herein. In some instances, the vacuum insulated panel may form the door of a cooler assembly, such as a beverage cooler in a retail setting or the like. Other types of coolers and/or items may be used herein, including perishable items, products, promotional items, or the like. Any item where a temperature controlled setting is desirable may be stored within the cooler. Moreover, the vacuum insulated panel may form other portions of the cooler assembly, such as a side panel, a rear panel, a top panel, and/or a bottom panel, etc. The vacuum insulated panel may also be used with other types of assemblies such as, but not limited to, windows, patio doors, and the like. The vacuum insulated panel may be configured to provide a heat transfer barrier and/or obstruction between two or more spaces. For example, the vacuum insulated panel may be configured to prevent and/or substantially reduce the heat transfer between the interior of the beverage cooler and the surrounding environment.

[0015] In certain embodiments, the vacuum insulated panel may include one or more convex sheets configured to be flattened into a parallel planar configuration when a vacuum is applied thereto. The vacuum insulated panel may provide a number of technical advantages. For example, the vacuum insulated panel may be assembled without the use of spacers (or with a reduced number of spacers) disposed between the convex sheets. The absence or reduction in the use of spacers may eliminate and/or reduce the number of pathways for heat to travel between the convex sheets. By eliminating and/or reducing the number pathways for heat to travel between the convex sheets, the overall thermal efficiency of the vacuum insulated panel may be increased.

Other technical advantages may become apparent throughout the disclosure.

[0016] According to an embodiment, the vacuum insulated panel may include a frame having a first side and a second side. The vacuum insulated panel also may include a first convex sheet positioned about the first side of the frame and a second convex sheet positioned about the second side of the frame. In this manner, the first convex sheet may oppose the second convex sheet. The frame may be any suitable material and/or configuration for the attachment of the first convex sheet and the second convex sheet thereto. The first convex sheet and the second convex sheet may be spaced apart from each other by the frame. In some instances, the first convex sheet and the second convex sheet may be substantially the same size and the same shape. In certain embodiments, the frame, the first convex sheet, and the second convex sheet may initially form a generally biconvex silhouette when assembled. In other instances, the vacuum insulated panel may include a single convex sheet. For example, one of the sheets may be convex and the other sheet may be planar, thereby initially forming a generally plano-convex silhouette when assembled.

[0017] In certain embodiments, the vacuum insulated panel may include a cavity formed between the first convex sheet and the second convex sheet. In some instances, the frame, the first convex sheet, and the second convex sheet may collectively form a hermetic seal about the cavity. For example, the frame, the first convex sheet, and the second convex sheet may be interconnected by one or more seals, joints, or combinations

thereof so as to create an air tight cavity therebetween. In this manner, the vacuum insulated panel may include a vacuum formed within the air tight cavity. The vacuum may be configured to at least partially flatten the first convex sheet and the second convex sheet into a substantially parallel planar configuration.

5 **[0018]** In certain embodiments, the first convex sheet and the second convex sheet may be pre-formed. That is, the first convex sheet and the second convex sheet may include a predetermined or prefabricated arch or curve. In this manner, the first convex sheet and the second convex sheet may initially include a generally arcuate shape before the vacuum is applied thereto. The curvature of the first convex sheet and the second
10 convex sheet may vary depending on a number of parameters. By way of example, the parameters for determining the curvature of the first convex sheet and the second convex sheet may include the strength of the material used to construct the sheets and/or frame, the overall size of the vacuum insulated panel, the size of the cavity, the strength of the vacuum, and/or the strength of the seals and/or joints formed between the frame and
15 sheets, etc. Any number of parameters may be taken into account to determine the curvature of the first convex sheet and the second convex sheet.

[0019] In some instances, the first convex sheet may be a glass sheet, a plastic sheet, a polymer sheet (e.g. polycarbonate), or a combination thereof. Similarly, the second convex sheet may be a glass sheet, a plastic sheet, a polymer sheet (e.g. polycarbonate),
20 or a combination thereof. For example, as noted above, the vacuum insulated panel may form the door of a cooler, such as a beverage cooler in a retail setting. In this manner, the vacuum insulated panel may be at least partially transparent so that a customer can see the contents of the cooler when the door is closed. Other types of materials or combinations of materials may also be used.

25 **[0020]** In certain embodiments, the vacuum insulated panel may include at least one access port. In some instances, the access port may be associated with the frame, the first convex sheet, the second convex sheet, or a combination thereof. The access port may be configured to provide access to the cavity. For example, a pump or the like may be in communication with the access port so as to create the vacuum within the cavity. Once

the vacuum has been created within the cavity, the pump may be removed from the access port and the access port may be temporarily or permanently sealed closed.

[0021] These and other embodiments of the disclosure will be described in more detail through reference to the accompanying drawings in the detailed description that follows. This brief introduction, including section titles and corresponding summaries, is provided for the reader's convenience and is not intended to limit the scope of the claims, nor the proceeding sections. Furthermore, the techniques described above and below may be implemented in a number of ways and in a number of contexts. Several example implementations and contexts are provided with reference to the following figures, as described below in more detail. However, the following implementations and contexts are but a few of many.

[0022] FIGS. 1-3 schematically depict one or more example systems and methods for a vacuum insulated panel including one or more convex sheets configured to be flattened into a parallel planar configuration when a vacuum is applied thereto in accordance with one or more embodiments of the disclosure. Specifically, FIG. 1 schematically depicts an example embodiment of a cooler assembly 100 as may be used herein. In some instances, the cooler assembly 100 may be a beverage cooler located in a retail setting, such as a convenience store, a grocery store, or the like. Other types of cooler assemblies may also be used herein, including a table top cooler assembly, a walk-in cooler assembly, a free standing cooler assembly, an integral cooler assembly, a modular cooler assembly, or the like. Moreover, other types of items may be stored within the cooler assembly 100, including perishable items, products, promotional items, or the like. Any item where a temperature controlled setting is desirable may be stored within the cooler assembly 100. In addition, heating elements may be used herein. That is, the cooler assembly 100 may heat and/or cool items therein.

[0023] The cooler assembly 100 may include a vacuum insulated panel 102. In some instances, the vacuum insulated panel 102 may form a door for accessing the contents of the cooler assembly 100. In this manner, the vacuum insulated panel 102 may be configured to be opened and closed. For example, the vacuum insulated panel 102 may

be a hinged door or a sliding door, although other types and styles of doors may be used herein. In some instances, the vacuum insulated panel 102 may include a handle or the like. A customer may open the vacuum insulated panel 102 and remove the contents within the cooler assembly 100, after which the user may close the vacuum insulated panel 102. In some instances, the vacuum insulated panel 102 may form other portions of the cooler assembly 100, such as a side panel, a rear panel, a top panel, and/or a bottom panel, etc. The vacuum insulated panel 102 may be configured to provide a heat transfer barrier and/or obstruction between two or more spaces. For example, the vacuum insulated panel 102 may be configured to prevent and/or substantially reduce the heat transfer between the interior of the cooler assembly 100 and the surrounding environment.

[0024] FIG. 2 schematically depicts an example embodiment of the vacuum insulated panel 102 before a vacuum is applied thereto. The vacuum insulated panel 102 may include a frame 104 having a first side 106 and a second side 108. The vacuum insulated panel 102 also may include a first convex sheet 110 and a second convex sheet 112. In some instances, the frame 104 may be aluminum, plastic, sheet metal, a combination thereof, or the like. The frame 104 may be any suitable material. The first convex sheet 110 and the second convex sheet 112 may be a glass sheet, a plastic sheet, a polymer sheet (e.g. polycarbonate), a combination thereof, or the like. The first convex sheet 110 and the second convex sheet 112 may be any suitable material. As noted above, in some instances, the vacuum insulated panel 102 may form the door of the cooler assembly 100. In this manner, the vacuum insulated panel 102 may be at least partially transparent so that a customer can see the contents of the cooler assembly 100 when the door is closed.

[0025] In certain embodiments, the first convex sheet 110 may be positioned about the first side 106 of the frame 104, and the second convex sheet 112 may be positioned about the second side 108 of the frame 104. In this manner, the first convex sheet 110 may oppose (or face) the second convex sheet 112. The frame 104 may be any suitable material and/or configuration for the attachment of the first convex sheet 110 and the second convex sheet 112 thereto. In some instances, the frame 104 may extend about the

periphery of the first convex sheet 110 and the second convex sheet 112. The first convex sheet 110 and the second convex sheet 112 may be spaced apart from each other by the frame 104. In some instances, the first convex sheet 110 and the second convex 112 sheet may be substantially the same size and the same shape. The nature of the curvature of the first convex sheet 110 and the second convex 112 sheet may vary. In certain embodiments, the frame 104, the first convex sheet 110, and the second convex sheet 112 may initially form a generally biconvex silhouette 114 when assembled, as depicted in FIG. 2.

[0026] In certain embodiments, the vacuum insulated panel 102 may include a cavity 116 formed between the first convex sheet 110 and the second convex sheet 112. In some instances, the frame 104, the first convex sheet 110, and the second convex sheet 112 may collectively form a hermetic seal about the cavity 116. For example, the frame 104, the first convex sheet 110, and the second convex sheet 112 may be interconnected by one or more joints 118. The joints 118 may include seals or the like for creating an air tight seal about the cavity 116.

[0027] In certain embodiments, the first convex sheet 110 and the second convex sheet 112 may be pre-formed. That is, the first convex sheet 110 and the second convex sheet 112 may include a predetermined or prefabricated arch or curve. In this manner, as depicted in FIG. 2, the first convex sheet 110 and the second convex sheet 112 may initially include a generally arcuate shape before a vacuum is applied to the cavity 116. In some instances, the first convex sheet 110 and the second convex sheet 112 may include a flange or other rim or the like to enable attachment to the frame 104. In addition, or alternatively, the frame 104 may include a flange or other rim or the like to enable attachment thereto.

[0028] The curvature of the first convex sheet 110 and the second convex sheet 112 may vary depending on a number of parameters. By way of example, the parameters for determining the curvature of the first convex sheet 110 and the second convex sheet 112 may include the strength of the material used to construct the first convex sheet 110 and the second convex sheet 112 and/or the frame 104, the overall size of the vacuum

insulated panel 102, the size of the cavity 116, the strength of the vacuum applied to the cavity 116, and/or the strength of the joints 118 and seals formed between the frame 104 and the first convex sheet 110 and the second convex sheet 112, etc. Any number of parameters may be taken into account to determine the initial curvature of the first convex sheet 110 and the second convex sheet 112. Similarly, any number of parameters may be taken into account to determine the strength of the vacuum applied to the cavity 116.

[0029] In some instance, the curvature of the first convex sheet 110 and the second convex sheet 112 may be formed by flexing the sheets during the attachment of the sheets to the frame 104. That is, the sheets may be slightly wider than the frame 104 such that attachment of the sheets to the frame 104 induces the convex curvature of the first convex sheet 110 and/or the second convex sheet 112.

[0030] In certain embodiments, the vacuum insulated panel 102 may include at least one access port 120. In some instances, the access port 120 may be associated with the frame 104, the first convex sheet 110, the second convex sheet 112, or a combination thereof. The access port 120 may be configured to provide access to the cavity 116. In some instances, the access port 120 may be a valve, such as a one-way valve or the like. In some instances, a pump 122 or the like may be in communication with the access port 120.

[0031] FIG. 3 schematically depicts an example embodiment of the vacuum insulated panel 102 after a vacuum is applied thereto. The vacuum insulated panel 102 may include a vacuum formed within the air tight cavity 116. For example, the pump 122 may be in communication with the access port 120 so as to create the vacuum within the cavity 116. The vacuum may be configured to at least partially flatten the first convex sheet 110 and the second convex sheet 112 into a substantially parallel planar configuration. For example, the vacuum created within the cavity 116 may tend to draw the first convex sheet 110 and the second convex sheet 112 inward towards each other as indicated by arrows 124. That is, as air is drawn out of the cavity 116 by the pump 124, the first convex sheet 110 and the second convex sheet 112 may move inward towards

each other. Once the vacuum has been created within the cavity 116, the pump 122 may be removed from the access port 120, and the access port 120 may be temporarily or permanently sealed closed.

[0032] In some instances, the vacuum insulated panel 102 may be assembled without the use of spacers. In other instances, the number of spacers disposed between the first convex sheet 110 and the second convex sheet 112 may be substantially reduced. Any number of spacers may be used herein. For example, in an embodiment, a single spacer may be positioned about a center portion of the first convex sheet 110 and the second convex sheet 112. In other instances, additional spacers may be used or the spacers may be omitted. As noted above, the absence or reduction in the use of spacers may eliminate and/or reduce the number of pathways for heat to travel between the first convex sheet 110 and the second convex sheet 112. By eliminating and/or reducing the number pathways for heat to travel between the first convex sheet 110 and the second convex sheet 112, the overall thermal properties of the vacuum insulated panel 102 may be increased.

[0033] FIG. 4 schematically depicts a cross sectional view of a spacer 400 in accordance with one or more embodiments of the disclosure. In some instances, the spacer 400 may include a number of spacers. The spacer 400 may be positioned between a first sheet 402 and a second sheet 404. The first sheet 402 and the second sheet 404 may oppose (or face) each other so as to form a cavity 406 therebetween. The first sheet 402 and/or the second sheet 404 may initially be convex or substantially flat. The spacer 400 may be disposed within the cavity 406 formed between the two opposing sheets. The spacer 400 may be disposed at any location within the cavity 406. In some instances, the spacer 400 may include at least one rounded side 408 configured to minimize the contact point between the first sheet 402 and the spacer 400. For example, if a vacuum is applied to the cavity 406, the surface area in contact between the first sheet 402 and the rounded tip 408 of the spacer 400 may be less than that of a non-rounded spacer. The rounded configuration of the spacer 400 may provide a robust spacer while minimizing the contact are between the spacer 400 and the first sheet 402. In this manner, the pathway created

by the spacer 400 for heat to travel between the first sheet 402 and the second sheet 404 may be minimized.

[0034] FIG. 5 schematically depicts a cross sectional view of a spacer 500 in accordance with one or more embodiments of the disclosure. In some instances, the spacer 500 may include a number of spacers. The spacer 500 may be positioned between a first sheet 502 and a second sheet 504. The first sheet 502 and the second sheet 504 may oppose (or face) each other so as to form a cavity 506 therebetween. The first sheet 502 and/or the second sheet 504 may initially be convex or substantially flat. The spacer 500 may be disposed within the cavity 506 formed between the two opposing sheets. The spacer 500 may be disposed at any location within the cavity 506. In some instances, the spacer 500 may be rounded on both sides. For example, if a vacuum is applied to the cavity 506, the rounded surface area in contact between the first sheet 402 and the second sheet 504 may be less than that of a non-rounded spacer. The rounded configuration of the spacer 500 provides a robust spacer while minimizing contact between the spacer 500 and the first sheet 502 and the second sheet 504. In this manner, the pathway created by the spacer 400 for heat to travel between the first sheet 502 and the second sheet 504 may be minimized.

[0035] FIG. 6 schematically depicts a cross sectional view of a spacer 600 in accordance with one or more embodiments of the disclosure. In some instances, the spacer 600 may include a number of spacers. The spacer 600 may be positioned between a first sheet 602 and a second sheet 604. The first sheet 602 and the second sheet 604 may oppose (or face) each other so as to form a cavity 606 therebetween. The first sheet 602 and/or the second sheet 604 may initially be convex or substantially flat. The spacer 600 may be disposed within the cavity 606 formed between the two opposing sheets. The spacer 600 may be disposed at any location within the cavity 606. In some instances, the spacer 600 may include at least one rounded side 608 configured to minimize the contact point between the first sheet 602. In addition, the spacer 600 may include a gap 610 between the rounded side 608 of the spacer 600 and the first sheet 602. In certain embodiments, if a vacuum is applied to the cavity 606, the gap 610 between the rounded

side 608 of the spacer 600 and the first sheet 602 may be closed, and the rounded side 608 of the spacer 600 may contact the first sheet 602. In this manner, the first sheet 602 may tend to move in a direction away from the rounded side 608 of the spacer 600 so as to form the gap 610 therebetween if a vacuum is not applied to the cavity 606.

5 [0036] FIG. 7 depicts a sectional perspective view of a spacer assembly 700 in accordance with one or more embodiments of the disclosure. The spacer assembly 700 may be positioned between a first sheet 702 and a second sheet 704. The first sheet 702 and the second sheet 704 may oppose (or face) each other so as to form a cavity 706 therebetween. The first sheet 702 and/or the second sheet 704 may initially be convex or
10 substantially flat. The spacer assembly 700 may be disposed within the cavity 706 formed between the two opposing sheets. In some instances, the spacer assembly 700 may be at least partially transparent. The spacer assembly 700 may be disposed at any location within the cavity 706. In some instances, a vacuum may be applied to the cavity 706.

15 [0037] In certain embodiments, the spacer assembly 700 may include a sheet of interconnected spacers. For example, the spacer assembly 700 may include a number of alternating and opposing pyramid-like structures 708. That is, some pyramid structures 708 may extend and narrow towards the first sheet 702, while other pyramid structures may extend and narrow towards the second sheet 704. In some instances, the pyramid
20 structures 708 may be frustums, such as square frustums or the like. In one embodiment, the sheet of pyramid structures 708 may resemble an egg carton. Each of the pyramid structures 708 may form contact points 710. The contact points 710 may contact the first sheet 702 or the second sheet 704 depending on the orientation of the pyramid structure 708. An angled wall 714 may connect adjacent contact points 710 to form the pyramid
25 structures 708. That is, the pyramid structures 708 may include a number of angled walls 714. In some instances, the angled wall 714 may include at least one hole 715. The at least one hole 715 may enable the passage of air between the alternating pyramid structures 708. For example, if a vacuum is applied to the cavity 706, the holes 715 may enable air to travel throughout the cavity 706.

[0038] In some instances, a top portion 716 of the pyramid structures 708 may be configured to minimize the contact area between the first sheet 702 or the second sheet 704. For example, the top portion 716 may include a recessed portion 718. In some instances, only the edge of the top portion 716 may contact the first sheet 702 or the second sheet 704 when a vacuum is applied to the cavity 706. In this manner, the pathway created by the spacer assembly 700 for heat to travel between the first sheet 702 and the second sheet 704 may be minimized.

[0039] The pyramid structures 708 may have any size, shape, or configuration. Any number of the pyramid structures 708 may be used herein. Other components and other configurations may be used herein. The spacer assembly 700 may combine the pyramid structures 708 with other types of spacers. The pyramid structures 708 may be positioned continuously or intermittently across the sheets.

[0040] Although specific embodiments of the disclosure have been described, numerous other modifications and alternative embodiments are within the scope of the disclosure. For example, any of the functionality described with respect to a particular device or component may be performed by another device or component. Further, while specific device characteristics have been described, embodiments of the disclosure may relate to numerous other device characteristics. Further, although embodiments have been described in language specific to structural features and/or methodological acts, it is to be understood that the disclosure is not necessarily limited to the specific features or acts described. Rather, the specific features and acts are disclosed as illustrative forms of implementing the embodiments. Conditional language, such as, among others, “can,” “could,” “might,” or “may,” unless specifically stated otherwise, or otherwise understood within the context as used, is generally intended to convey that certain embodiments could include, while other embodiments may not include, certain features, elements, and/or steps. Thus, such conditional language is not generally intended to imply that features, elements, and/or steps are in any way required for one or more embodiments.

CLAIMS

THAT WHICH IS CLAIMED IS:

1. A vacuum insulated door for a cooler assembly, comprising:
 - a frame comprising a first side and a second side;
 - a first pre-formed convex sheet positioned about the first side of the frame;
 - a second pre-formed convex sheet positioned about the second side of the frame;
 - a cavity formed between the first pre-formed convex sheet and the second pre-formed convex sheet; and
 - at least one access port to the cavity configured to maintain a vacuum within the cavity, wherein the first pre-formed convex sheet and the second pre-formed convex sheet are configured to at least partially flatten into a substantially parallel planar configuration with the vacuum in the cavity.
2. The vacuum insulated door of claim 1, wherein the frame, the first pre-formed convex sheet, and the second pre-formed convex sheet collectively form a hermetic seal about the cavity.
3. The vacuum insulated door of claim 1, wherein the at least one access port is coupled to at least one of the frame, the first pre-formed convex sheet, the second pre-formed convex sheet, or a combination thereof.
4. The vacuum insulated door of claim 3, further comprising a pump in communication with the at least one access port, wherein the pump is configured to create the vacuum within the cavity.
5. The vacuum insulated door of claim 1, further comprising at least one spacer disposed within the cavity between the first pre-formed convex sheet and the second pre-formed convex sheet.

6. A vacuum insulated panel, comprising:
 - a frame comprising a first side and a second side;
 - a first convex sheet positioned about the first side of the frame;
 - a second convex sheet positioned about the second side of the frame;
 - a cavity formed between the first convex sheet and the second convex sheet; and
 - at least one access port to the cavity configured to maintain a vacuum within the cavity, wherein the first convex sheet and the second convex sheet are configured to at least partially flatten into a substantially parallel planar configuration with the vacuum in the cavity.
7. The vacuum insulated panel of claim 6, wherein the first convex sheet and the second convex sheet are pre-formed.
8. The vacuum insulated panel of claim 6, wherein the first convex sheet comprises at least one of a glass sheet, a plastic sheet, a polymer sheet, or a combination thereof.
9. The vacuum insulated panel of claim 6, wherein the second convex sheet comprises at least one of a glass sheet, a plastic sheet, a polymer sheet, or a combination thereof.
10. The vacuum insulated panel of claim 6, wherein the vacuum insulated panel comprises a door of a cooler assembly.
11. The vacuum insulated panel of claim 10, wherein the door is at least partially transparent.
12. The vacuum insulated panel of claim 6, wherein the frame, the first convex sheet, and the second convex sheet collectively form a hermetic seal about the cavity.

13. The vacuum insulated panel of claim 6, wherein the at least one access port is coupled to at least one of the frame, the first convex sheet, the second convex sheet, or a combination thereof.
14. The vacuum insulated panel of claim 13, further comprising a pump in communication with the at least one access port, wherein the pump is configured to create the vacuum within the cavity.
15. The vacuum insulated panel of claim 6, further comprising at least one spacer disposed within the cavity between the first convex sheet and the second convex sheet.
16. A method for assembling a vacuum insulated panel, the method comprising:
positioning a first pre-formed convex sheet about a first side of a frame;
positioning a second pre-formed convex sheet positioned about a second side of the frame, thereby forming a cavity between the first pre-formed convex sheet and the second pre-formed convex sheet; and
forming a vacuum within the cavity between the first pre-formed convex sheet and the second pre-formed convex sheet such that the first pre-formed convex sheet and the second pre-formed convex sheet at least partially flatten into a substantially parallel planar configuration.
17. The method of claim 16, further comprising forming a hermetic seal about the cavity.
18. The method of claim 16, further comprising providing at least one access port to the cavity with at least one of the frame, the first convex sheet, the second convex sheet, or a combination thereof.

19. The method of claim 18, wherein forming the vacuum within the cavity further comprises pumping air out of the cavity via the at least one access port.
20. The method claim 16, further comprising positioning at least one spacer within the cavity between the first pre-formed convex sheet and the second pre-formed convex sheet.
21. A vacuum insulated door for a cooler assembly, comprising:
a first sheet;
a second sheet positioned opposite the first sheet;
a cavity formed between the first sheet and the second sheet; and
at least one spacer disposed within the cavity, wherein the at least one spacer comprises at least one rounded side.
22. The vacuum insulated door of claim 21, further comprising a gap formed between the at least one rounded side of the spacer and at least one of the first sheet or the second sheet.
23. The vacuum insulated door of claim 21, further comprising a vacuum formed within the cavity.
24. The vacuum insulated door of claim 21, wherein the at least one rounded side comprises two rounded sides.
25. A vacuum insulated door for a cooler assembly, comprising:
a first sheet;
a second sheet positioned opposite the first sheet;
a cavity formed between the first sheet and the second sheet; and

at least one spacer disposed within the cavity, wherein the at least one spacer comprises a spacer assembly comprising one or more sheets of alternating pyramid structures, each pyramid structure comprising contact points with the first convex sheet and the second convex sheet.

26. The vacuum insulated panel of claim 25, wherein the contact points comprise a recessed portion.

27. The vacuum insulated panel of claim 25, wherein each pyramid structure comprise an angled wall between the contact points.

1/4

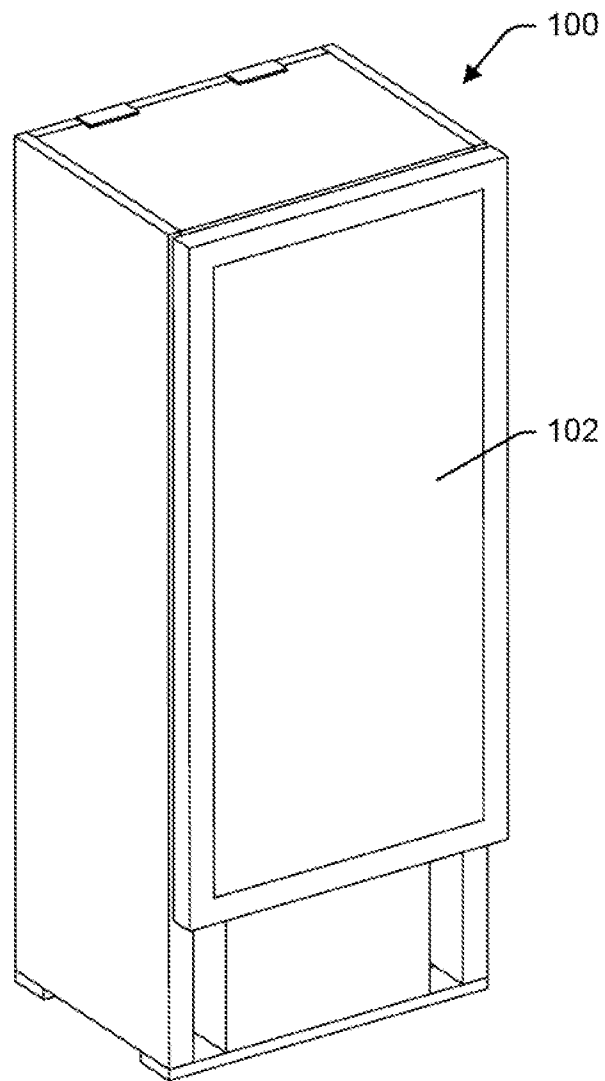


FIG. 1

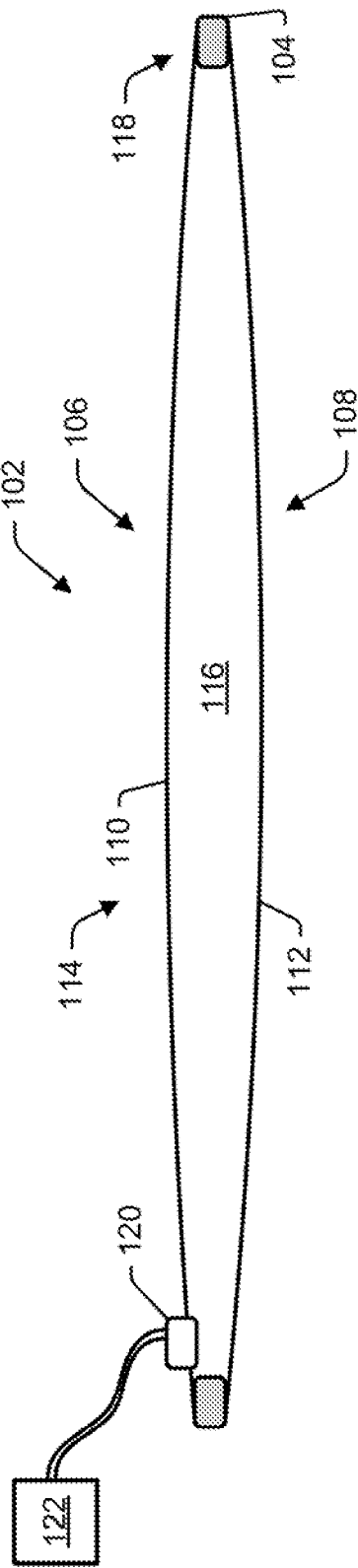


FIG. 2

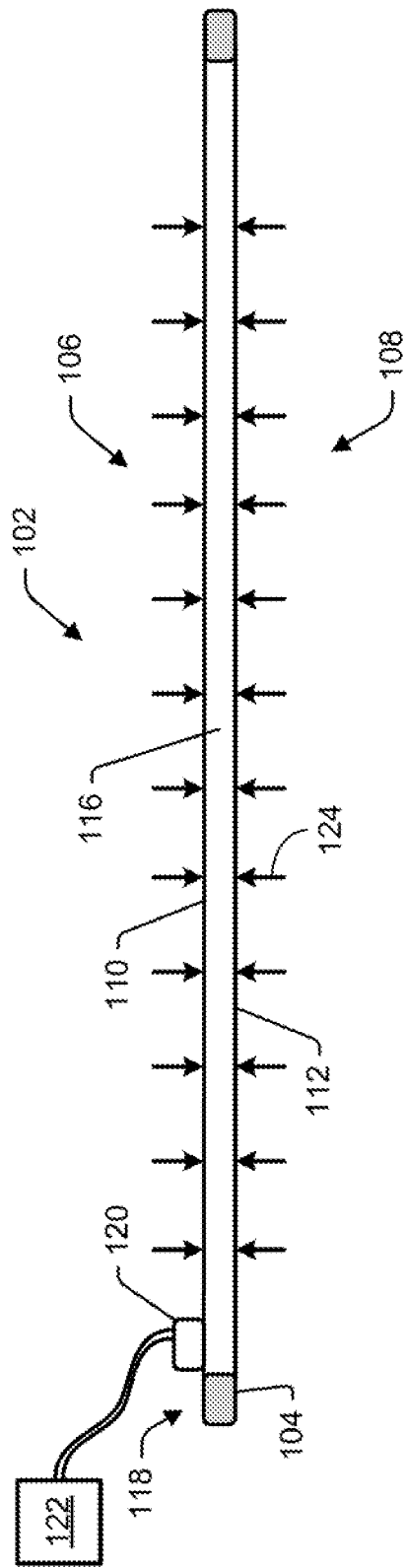


FIG. 3

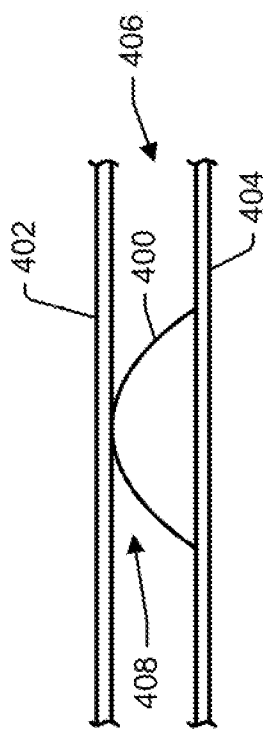


FIG. 4

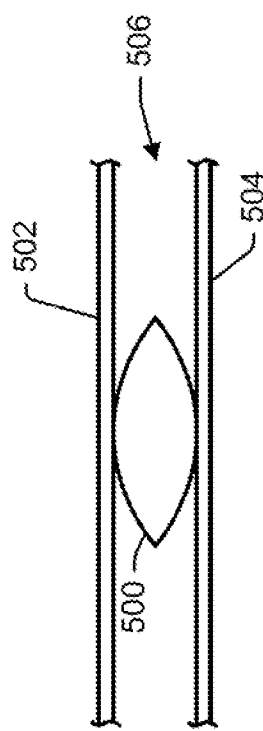


FIG. 5

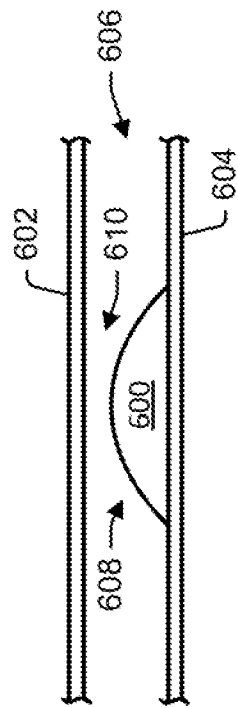


FIG. 6

4/4

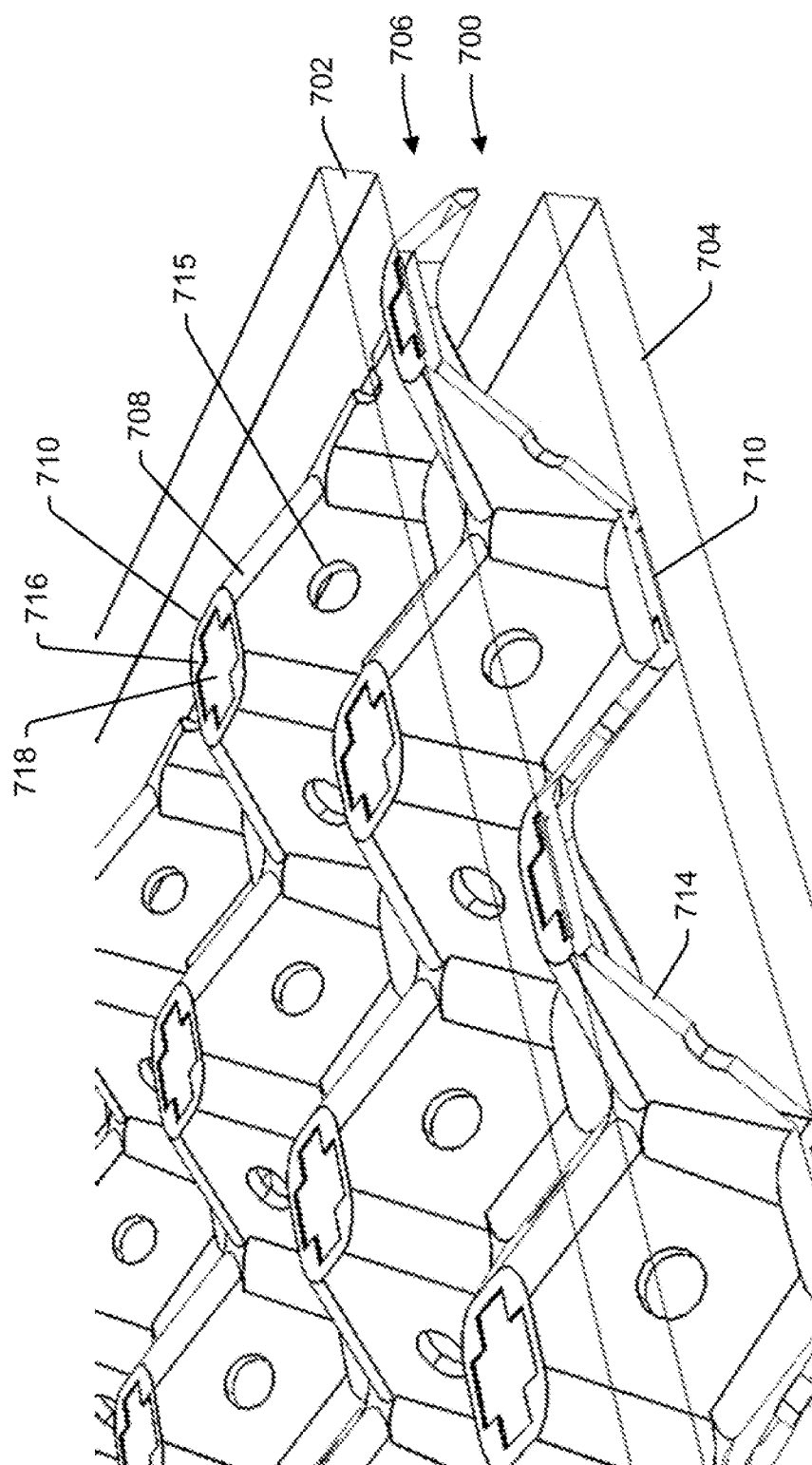


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2014/041495

A. CLASSIFICATION OF SUBJECT MATTER
 INV. F25D23/02
 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)
 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

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 2 409 314 Y (YANG YOUKAO [CN]) 6 December 2000 (2000-12-06) figure 2	1-20
X	----- CN 102 701 575 A (CHANGHONG DAI) 3 October 2012 (2012-10-03) figure 5 paragraphs [0058], [0064], [0073]	1-20
A	----- US 5 252 408 A (BRIDGES JOHN A [US] ET AL) 12 October 1993 (1993-10-12) figures 1-11 -----	1-20



Further documents are listed in the continuation of Box C.



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

"&" document member of the same patent family

Date of the actual completion of the international search

10 September 2014

Date of mailing of the international search report

27/11/2014

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
 NL - 2280 HV Rijswijk
 Tel. (+31-70) 340-2040,
 Fax: (+31-70) 340-3016

Authorized officer

Dezso, Gabor

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/041495

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.:

1-20

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.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2014/041495

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
CN 2409314	Y	06-12-2000	NONE	

CN 102701575	A	03-10-2012	NONE	

US 5252408	A	12-10-1993	NONE	

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-20

A vacuum insulated door and a vacuum insulated panel with convex sheets and a method for assembling a vacuum insulated panel

2. claims: 21-27

Vacuum insulated doors with various spacers
