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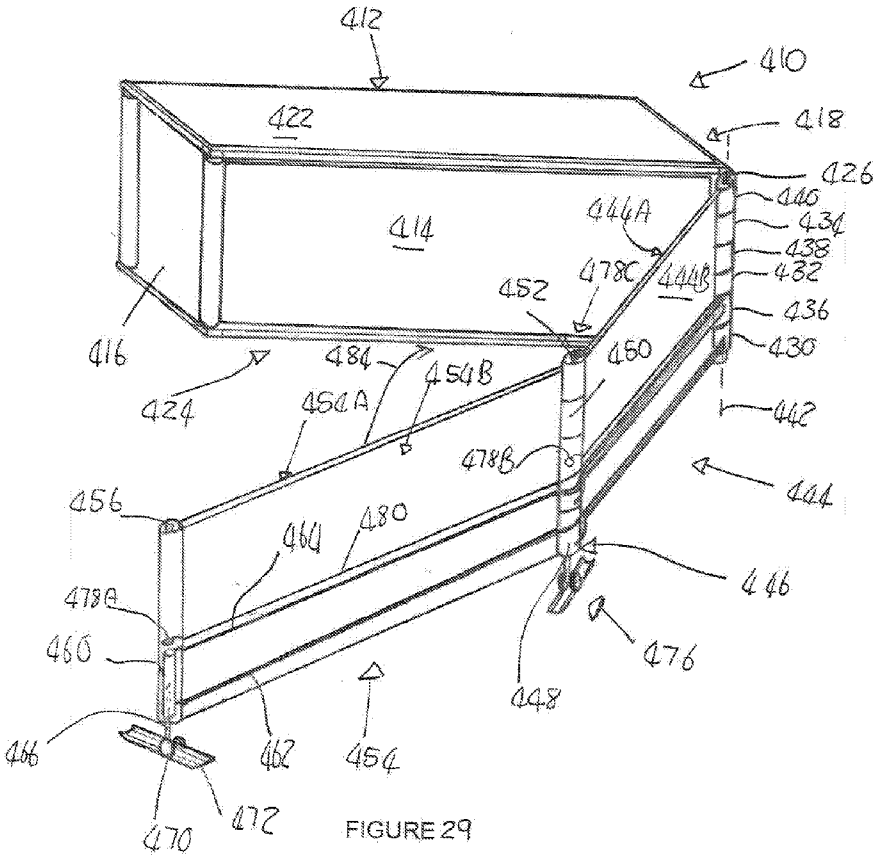

FIGURE 29

[Continued on next page]

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(57) Abstract: A containment assembly which includes a container, a plurality of linked wall sections which, in a storage mode, are arrangeable side by side and substantially parallel to one another at least partly inside the container and which are movable to an operative mode in which the wall sections are pivotally interconnected to one another and are in ground-engaging positions to form at least part of a boundary of an enclosure.

CONTAINMENT ASSEMBLY

BACKGROUND OF THE INVENTION

[0001] This invention relates to a containment assembly which can be stored and transported in a compact mode and which, at an installation site, can be erected in a number of ways to provide an enclosure, a shelter or the like. The mode of use in this respect is not restricted.

SUMMARY OF THE INVENTION

[0002] The invention provides a containment assembly which includes a plurality of linked wall sections which are arrangeable, side by side one another, in a storage mode and which are arrangeable in an extended configuration in an operative mode.

[0003] Each wall section may be of any appropriate size and shape. In one example of the invention each wall section is elongate and rectangular. Adjacent wall sections may be interconnected, e.g. in a pivotal manner, at abutting ends. A succeeding pair of wall sections may be similarly interconnected.

[0004] The wall sections may be movable to an extended configuration to enclose an area or to form a boundary. Preferably the wall sections are interconnected by means of a hinge system e.g. a two point hinge system which allows maximum relative swivel action.

[0005] It is possible to move the wall sections to a desired configuration manually or by using powered hinge systems e.g. through the aid of a hydraulic, mechanical, electrical or other actuator. It is possible to make use of a computer-controlled system to cause the wall sections to move, with the aid of a suitable actuator or actuators, and to take up a desired configuration.

[0006] To facilitate movement of the wall sections one or more skids, wheels or the like may be positioned at a lower side of each respective wall section in a ground-engaging position.

[0007] At least one wall section may have a cover which, in use, can be extended laterally. The cover may be movable to a ground-engaging position or may be supported at an elevated position to provide shelter from above.

[0008] It is also possible for a wall section to include a panel which can be moved vertically i.e. to extend the effective height of a wall section. The extent of vertical movement may be adjustable. Similarly a panel or cover could, if desired, be positioned at an inclined angle relative to the vertical. A plurality of the covers or panels may be telescopically configured to increase coverage over the ground or the like.

[0009] In broad terms, a reference to a "container", means any appropriate container, including a conventional shipping container, or a structure, which may be box-like, on a vehicle, or which may be formed integrally with a vehicle and, merely by way of non-liming examples, includes structure on a vehicle such as the body of a bus, the body of a truck, a structure mounted to a load area of a vehicle, a structure on a trailer such as a horsebox, or a structure which is mounted, optionally detachably, to a trailer or vehicle which is custom-designed for the purpose.

[0010] In a specific form of construction a corner of a container, e.g. a conventional shipping container, includes a hinge mechanism and at least one panel is attached to the hinge mechanism for angular movement between an inoperative position at which the panel is accommodated by the container for storage and transport purposes, and an operative position at which the panel forms part of a boundary of an enclosure.

[0011] (In this specification "wall section" and "panel" are used interchangeably).

[0012] A second panel may be attached to the aforementioned panel in a similar way i.e. through the use of an appropriate hinge mechanism.

[0013] An opposing corner of the container may include a similar hinge mechanism and one or more panels may be secured directly or indirectly thereto.

[0014] If the containment assembly includes four panels then these may be positioned to form part of an enclosure which, in outline, is that of a pentagon with a fifth side being constituted by the container.

[0015] Each hinge structure preferably is made from steel and each panel is preferably made from a material which is significantly lighter than steel e.g. aluminium. A steel pin may be attached to a respective corner of the container so that there is adequate strength in this arrangement to support an extended panel. However a panel, when displaced from the container, may exhibit significant flexibility and in order to provide support for the panel while it is being moved to an operative position various techniques may be employed. Preferably the panel is supported by a ground-engaging component. This may take the form of a skid, one or more wheels, or the like. The ground-engaging component may be fixed to a lower end of an actuable mechanism which is extended from the panel into ground-engaging contact. Hydraulic means may be provided for this purpose.

[0016] The panel may include one or more level sensors used during deployment of the containment assembly to ensure that the panel extends horizontally from the container and vertically relative to the ground.

[0017] A bracing structure may be provided to restrict flexing of the panel while it is being moved between a storage mode position and an operative mode.

[0018] Hydraulic lines to and from the aforementioned hydraulic actuator may be positioned on or inside the panel which may have a hollow wall structure.

[0019] Due to the size of the container and the panels it is likely that lower ends of the panels will not always directly contact the ground. Two problems can arise. Firstly the panels, which are pivotally interconnected by hinge systems, e.g. of the kind described, are heavy and elongate and exert a substantial moment about the relative points of attachment. It is important to keep the panels horizontal and supported. Height adjusting mechanisms may be used for this purpose. For example a piston and cylinder assembly or ram or other extensible/retractable device can be used in an appropriate way. In a preferred form of the invention a height adjusting mechanism is vertically aligned with the axis of a hinge system which interconnects adjacent vertical edges of adjacent panels together. The height adjusting mechanism is used to adjust the height of the hinge system and thereby the height of the panels and simultaneously

support the panels. Secondly, closure members may be used to obscure gaps between a lower edge of a panel and an opposing ground surface. The closure members may be attached in a hinged manner to a lower region of a panel. Preferably, in this respect, each panel includes a first closure which is on one side of the panel and a second closure on an opposing side of the panel. This type of construction is advantageous particularly if the resulting structure is to be used, for example, as part of a reservoir. In this event a liner is placed inside the enclosure. One closure, at a base of the panel, extends to the ground and provides support for the liner. A second closure, on an opposing side of the panel, digs into the ground and braces the arrangement when the liner is filled e.g. with a liquid such as water.

[0020] The deployment of the panels may be facilitated by means of manually actuated pulley and trolley jack devices, mechanically or hydraulically actuated drive and steering mechanisms or, in a more sophisticated embodiment, through the use of a software-enabled hydraulic drive and steer system. These devices may act on hinge systems which interconnect adjacent panels.

[0021] An interior surface bounded by the panels (the ground and inner surfaces of the panels) may be covered with a liner. In this way the deployed assembly is transformed into a reservoir for liquids, fresh water storage, fisheries, waste storage or the like.

[0022] The panels may be reinforced to withstand attacks e.g. bullets, shrapnel and the like. This assists in providing a secure installation not only for personnel but for water storage or other goods or material.

[0023] The panels may be interconnected by means of partitioning to provide smaller rooms or enclosures inside boundary panels. Reticulation for communication and electrical services may be provided within or on the panels.

[0024] The invention thus extends to a mobile containment assembly which can be erected rapidly and which is capable of housing a large number of personnel. Camouflage may be provided e.g. by means of covers, paint or the like, to cause the containment system to "blend" into a surrounding area.

[0025] In the embodiment in which the panels are folded from a container or similar enclosure, at least part of the container or enclosure may be used as a control centre, to house electrical equipment, to house personnel, to act as a hospital theatre, for food storage or kitchen purposes, or the like. Thus the containment assembly may be used to provide a mobile shelter for rapid deployment, e.g. in disaster areas, to provide shelter for humans or animals, for water storage, for clinic purposes and so on.

[0026] The containment assembly can be used for confining animals for rehabilitation or safety or other purposes.

[0027] If ground enclosed by the panels and the container is covered, above, with a transparent material e.g. a plastic material then a volume inside the boundary panels and container can be used in a greenhouse-type structure. The panels may also be transparent.

[0028] A panel, or a container in which the panel is normally stored, may have mounted to it one or more rollers from which flexible sheet material can be deployed to form a ground-covering liner, an overhead roof structure or the like. Movement of the roller can be assisted by means of pulleys which may be manually or power-driven. To assist in moving a liner over the ground air may be forced into a space between the ground and a lower surface of the liner – this lifts the liner and substantially reduces friction effects.

[0029] In a particular situation in which a liquid is contained in a reservoir constructed from the containment assembly, cables or similar bracing structures may be employed to assist the panels in withstanding force produced on inner surfaces of the panels by liquid pressure. The highest forces are at lower regions of the panels and, for this reason, the cables are strategically located at least in these regions to give a maximum restraining force.

[0030] In one particular application the containment assembly includes at least one elongate upwardly extending support, a locating member which is slidably engaged with the support, flexible sheet material attached to the member and surrounding the support, the flexible sheet material including a periphery which is retained at a

predetermined position, and at least one fan which pressurises air on a lower side of the sheet material thereby to cause the sheet material to move upwardly in a manner which is at least partly guided by the locating member which is movable along the elongate support.

[0031] The elongate support may be held in a desired orientation, e.g. substantially vertical, by means of suitable stays. These may be wires, cables or the like.

[0032] The locating member may include a sleeve through which the elongate support extends, preferably with a reasonable sealing action between the sleeve and the support. The sleeve may include a formation which may be in the form of a disc which provides a means for the sheet material to be attached to the sleeve.

[0033] The elongate support may have a lower end which is engaged with the ground preferably through a ball-type joint or the like which permits the elongate support to be inclined at least to a limited extent relative to the vertical.

[0034] The elongate support may be hollow i.e. tubular and may include one or more inlets or outlets for air to enter or leave an interior of the support.

[0035] At least one catch on the elongate support may automatically be engageable with the locating member. The catch may permit the locating member to move along the support in a first direction beyond a predetermined position and then restrain the locating member from moving beyond the predetermined position in the return direction. The catch may be releasable from a remote location.

[0036] The flexible sheet material may be waterproof.

[0037] The flexible sheet material may be provided at least in two layers with an upper layer, in use, being in the nature of a roof and a lower layer acting as a ceiling in respect of an area or volume below the sheet material.

[0038] The periphery of the sheet material may be fixed to the ground or to panels or wall-like elements on the ground which form an enclosure around the elongate support.

[0039] In another application of particular importance the containment assembly is used in the construction of a reservoir and flexible sheet material is located in a stored configuration in or on the container, and a mechanism in or on the container is used to deploy the sheet material from the stored configuration to an open, operative configuration. In the operative configuration the sheet material may extend from the container.

[0040] The mechanism may take on any appropriate form and, preferably, comprises a roller, spool or the like around which the sheet material is coiled e.g. in a folded form.

[0041] The mechanism may be positioned inside the container but preferably is located on an upper side thereof. A cover, shroud or the like may be provided to shield the mechanism and the sheet material when it is in a stored configuration.

[0042] The mechanism allows the sheet material to be drawn from the stored configuration by means of at least one elongate flexible member such as a rope, a chain, a cable, or the like. The flexible member may be attached directly to one or more locations on the flexible sheet material.

[0043] The flexible sheet material may be designed to be used as a liner for a reservoir. A central portion of the liner may be ground-engageable. The liner may have edges or peripheral portions which are elevated and which, in use, constitute part of a wall of a reservoir.

[0044] The container may form at least part of a wall which extends vertically and against which a portion of the sheet material is backed. The container may be elongate and include an elongate side which forms said part of the wall.

[0045] Roof material may be provided which, in use, will overlie at least part of an area enclosed by the wall. Suitable supports for supporting roof material may be stored in the container. Without being restrictive this type of support may include one or more elongate members, each in the nature of a tent pole which elevates the roof material,

particularly if it is sheeting, to a suitable height above the ground level. Cables and similar devices may be used to provide additional support for the roof material.

[0046] One or more panels may be engaged with the housing and preferably overlie said side of the housing when the panels are in a stored mode. The panels may be movable to respective operative positions at which they extend away from the housing and are orientated substantially vertically, but resting on the ground.

[0047] The invention also provides a reservoir formed from a containment assembly (as described) which includes a container with a side which extends generally vertically, the side having opposed first and second ends, at least a first ground-engaging panel which is orientated generally vertically and which has an end which abuts and which is secured to the first end of the side, at least a second ground-engaging panel which extends generally vertically and which has an end which abuts and which is secured to the second end of the side, and flexible sheet material with a ground-engaging portion which covers at least ground between the first and second panels and which has a wall portion which bears against, and which is supported by, surfaces of the first and second panels and of said side of the container.

[0048] The side and the panels may be configured so that in plan they form an enclosure. Depending on the number of panels the enclosure may have three, four, five or more sides. If use is made of a second containment assembly then the number of sides of the enclosure can be increased.

[0049] A number of the containment assemblies may be configured in any suitable array. Multiple or abutting sides (walls) may be secured together in any appropriate way to increase the size of the overall structure and to impart stability to the configuration.

[0050] In one preferred form of the invention a containment assembly includes a container which houses four sides (panels or wall elements). These sides may be configured so that in use, when viewed in plan, an enclosure of a desired outline is formed. If multiple containment assemblies are used then the shape of the resulting enclosure or reservoir, viewed in plan, may be chosen from a variety of options.

[0051] A cover over the enclosure may be provided by additional sheet material which is supported at an elevated position over the ground-engaging portion of the aforementioned sheet material.

[0052] The invention also provides a method of erecting a reservoir which includes the steps of positioning a containment assembly of the aforementioned kind at a selected site, erecting a number of panels which, together with a side of the container, form a boundary of an enclosure, deploying sheet material which is held in a stored configuration on or in the container, and using the sheet material to cover a surface which is bounded, at least partly, by the panels and the container, and to cover opposing surfaces of the panels and the side thereby to form a wall of the reservoir.

[0053] It is possible to use one containment assembly on its own and, more particularly, to use wall elements or panels positioned on one side of the container only. It is evident that a similar set of panels or wall elements can be used on an opposing side of the container.

[0054] If two or more containment assemblies are used in combination then, effectively, the number of wall elements or panels is doubled.

[0055] By varying the number of wall elements which are employed, either by selecting a reduced number of the available wall elements from one containment assembly or by using more than one containment assembly the wall sections can be manipulated, in the operative mode, to form respective sides of the boundary which can take up with the shape of a square, a rectangle, a pentagon, a triangle, decagon (a ten-sided structure) or the like.

[0056] The wall sections or panels have substantial dimensions particularly when use is made of a conventional shipping container to form part of the containment assembly of the invention. It is important therefore to be able to support the wall elements in the operative modes. Although the wall elements are linked to one another it is normally not possible for the wall elements to be supported wholly by the container from which they extend. Some additional type of support is required. To this end a height adjusting mechanism or mechanisms are employed which take account of the

nature of the terrain at a deployment site. These mechanisms are used to ensure that each panel is kept true horizontal at a selected height. ... generally lower edges of the panels (say) are kept true horizontal with lower attachment points of the panels to the container. Although the height adjustment mechanisms may be of a diverse nature it is preferred that these are hydraulically, electrically or manually actuated. In a preferred embodiment a hinge structure is used to interconnect adjacent vertical edges of adjacent panels to each other. The hinge structure includes a hollow hinge pin and hinged leaves, pivotally engaged with the pin are fixed to adjacent panels. A height adjusting mechanism is preferably located wholly or partly inside a hollow interior of a hinge pin. If the height adjusting mechanism is a hydraulically activated piston and cylinder assembly then this provides a convenient and effective height adjusting and support arrangement.

BRIEF DESCRIPTION OF THE DRAWINGS

[0057] The invention is further described by way of examples with reference to the accompanying drawings in which :

Figure 1 is a perspective view of a truck to which is coupled a containment assembly according to the invention,

Figure 2 shows the containment assembly of Figure 1 detached from the truck,

Figure 3 is a schematic plan view of the containment assembly of Figure 2 showing how panels are extended from a container which is part of the containment assembly,

Figure 4 shows in perspective an enclosure formed from two containment assemblies,

Figure 5 is a schematic cross-sectional view of a panel used to define part of the enclosure of Figure 4, in the process of erection,

Figure 6 is similar to Figure 5 showing the panel in cross-section once erected,

Figure 7 schematically shows an upper part of a container and depicts how sheet material can be deployed from the container,

Figures 8 to 12 illustrate in plan and on a reduced scale successive stages in the deployment of a liner from a container,

Figure 13 shows an upper end of a container once sheet material has been deployed from the container,

Figure 14 illustrates in perspective a reservoir constructed in accordance with the principles of the invention while a cover is being erected over the reservoir,

Figure 15, which is similar to Figure 14, shows the reservoir with the cover fully erected,

Figure 16 is a view from one side of a container used in a containment assembly according to the invention showing a possible arrangement of equipment inside the container,

Figure 17 is similar to Figure 16 but showing a different arrangement of equipment or components inside the container,

Figures 18 to 21 show different possible configurations of reservoirs (in plan) which can be made using two containment assemblies.

Figure 22 shows a wall section which has attached to it a foldable cover,

Figure 23 shows on a reduced scale the cover in Figure 22 at an operative position,

Figure 24 shows a wall section with a sliding panel or roof,

Figure 25 shows how the sliding panel in Figure 24 can be orientated to provide shelter,

Figure 26 shows an arrangement which includes four wall sections and two covers arranged in an inclined configuration,

Figure 27 illustrates the use of covers which have a telescopic configuration,

Figure 28 shows in plan and schematically another application of the containment assembly of the invention,

Figure 29 illustrates a containment assembly comprising a container with two panels which extend from a container,

Figure 30 illustrates a possible support arrangement which can be used with the panels shown in Figure 39,

Figures 31 and 32 illustrate how a lower edge of a panel is braced when the panel is used as part of a reservoir,

Figures 33 and 34 depict a possible floor structure which can be used with the containment assembly,

Figure 35 is a side view in section of a containment assembly according to another form of the invention in a collapsed condition,

Figure 36 shows the containment system in an erected state, and

Figure 37 illustrates on an enlarged scale an upper part of the containment system.

DESCRIPTION OF PREFERRED EMBODIMENT

[0058] Figure 1 of the accompanying drawings illustrates a mechanical horse 10 with a low-bed trailer 12 which carries a containment assembly 14, according to the invention. The containment assembly includes an upper shroud or enclosure 16 and four elongate and rectangular panels, collectively designated 18, secured to one side of the container.

[0059] The containment assembly includes a container 20 which is substantially the same as a conventional shipping container, and has elongate rectangular sides 22 and 24 respectively and relatively small rectangular ends 26 and 28 respectively. The container has four hydraulically extensible legs collectively designated 30. The legs are respectively positioned at extremities of the container 20. The legs are spaced sufficiently far apart so that the low-bed trailer 12 can be manoeuvred between each pair of extended legs at each end of the container. The legs are extensible by means of an energy source and pumps located inside the housing. This arrangement means that the container can be elevated into a ground-engaging position and the low-bed trailer can be driven away from the housing. Thereafter the container can be lowered to a position at which it rests on the ground. Conversely, when the container is to be removed from a particular site, the legs can be extended and the low-bed trailer can be manoeuvred so that it underlies the container 20. As the legs are retracted the container settles onto the low-bed trailer. This arrangement removes the need for a crane at an installation site to lift the container off a low-bed container and subsequently to place the container onto a low-bed trailer. The legs may also be used, as required, to level the container at a deployment site taking into account the slope of the ground around and at the container.

[0060] Figure 3 illustrates, in plan, the container 20 once it has been placed on the ground and the legs are retracted. As appropriate the legs may be adjusted in height to suit the requirements of the terrain at the deployment site. The side 22 forms part of an inner surface of a wall 34 of a reservoir. The side 22 is the side on which the panels 18 (Figure 1) are positioned. These panels are articulated or otherwise connected to each other in any appropriate way. Preferably use is made of a strong hinge mechanism,

which is vertically oriented, to interconnect adjacent edges of two adjacent panels together so that one panel can be pivoted about a vertical hinge axis relative to the other. As is described herein inter alia with particular reference to Figure 29 a height adjusting mechanism e.g. a hydraulic ram or the like which preferably is aligned with a vertical hinge axis is used to adjust the height of the hinge structure to take into account the terrain. The panels are thereby brought to a desired height in opposition so that they are true horizontal. The panels are also supported by the height adjusting mechanism. Once the container 20 is resting on the ground the panels 18 are moved from the stacked configuration shown in Figure 1 to a flared arrangement shown in Figure 3. For example panels 18A and 18B may be interconnected at a hinge joint 36 and the panel 18B may be connected to the side 22 at a hinge joint 38. The two panels are then jointly moved through an arc 40 relative to the side 22 and the panel 18A is then moved through a similar arc 42 relative to the panel 18B. A similar procedure in the reverse direction is implemented with the remaining panels 18C and 18D. In this arrangement there are four panels on one side. This is illustrative only and non-limiting. If, for example, there are two panels and one side these could be arranged in a triangular configuration. If there are three panels and one side these could be configured to form a square or rectangle. If multiple containers are used, each container being deployed generally in the manner shown in Figure 3, different polygonal structures result. The invention is thus not limited by the number of sides in a reservoir which can be erected using the principles of the invention.

[0061] Figure 4 illustrates a situation in which two containers designated 20A and 20B respectively are positioned opposing each other. Four panels are extended from each container. Extremities 46 and 48 of the extending sets of panels are connected to each other to form a ten-sided wall 34.

[0062] Figure 5 shows a typical panel 18 from one side and in cross-section. The panel preferably carries a strut 50 in a hinged arrangement which can be pivoted downwardly, from the position shown in Figure 5, to a ground-engaging and bracing position shown in Figure 6. The strut is located on an outer side 18X which forms part of an outer side of the wall 34. On an inner side, close to a lower end 52 of the panel, a small flap 54 is positioned. When the panel is deployed the flap is pivoted downwardly

and away from the lower end of the panel into a ground-engaging position shown in Figure 6. The strut 50 braces the panel against forces 58 which are directed outwardly i.e. from an inner side 18Y towards the outer side 18X. The flaps 54, which may be made from rubber or smooth sheet metal, may be segmented along the length of the panel. An intention here is that the flaps can generally follow the contours of ground 60, on which the panel is located, which may not be generally level or flat, and thus the flaps can, to a substantial extent, close gaps which might otherwise exist between a lower end 52 of the panel and the opposing ground surface. Each panel, on its inner side 18Y, has no sharp edges or points. Also, an upper end 62 of the panel is smooth and rounded. This is to avoid damage to a liner which, as is explained hereinafter, is engaged with the panel.

[0063] Figure 7 shows, in cross-section an upper end 66 of a container 20. The container has a shroud 16 fitted to it. The shroud may be of any appropriate shape and, for example, may be generally trough-shaped or semi-cylindrical. A spool or roller 70 is rotatably fixed to suitable supports 72 (see Figure 13) and flexible sheet material 76 is coiled, in a folded form, on the roller. When the shroud 16 is lifted off the sheet material it is possible to attach a cable or similar elongate flexible member 80 to an end of the sheet material and, by using a winch or similar device, the flexible sheet material can be rotatably drawn from the roller 70.

[0064] Figures 8 to 12 show, in plan, successive stages in the deployment of the flexible sheet material 76. For ease of illustration the ten-sided wall 34 formed by the panels from the containers 20A and 20B is shown alongside the sheet material. It should be understood though that the sheet material would, for example, be drawn from a roller on top of the container 20A. This would be done by means of cables 80 which extend from the container 20A to the container 20B. The container 20B contains power-driven winches which can pull the cables across an area 84 enclosed by the wall 34.

[0065] Figure 8 shows the flexible sheet material 76 which has been folded into an elongate rectangular configuration. This is the form in which the sheet material is wound onto a roller and the initial form of the sheet material when it is drawn from the roller.

[0066] Figure 9 shows parts 76A and 76B being folded outwardly from a rectangular central portion 76C of the sheet material. This takes place while the sheet material is inside the area 84.

[0067] Figure 10 shows further unfolding with triangular parts 76D and 76E being flared outwardly. Figure 11 shows a further stage in this process.

[0068] Figure 12 shows the flexible sheet material 76 fully folded out to form a ten-sided, ground-engaging, liner portion which is located inside the confines of the ten-sided wall 34 and which rests on the ground 84. At a periphery of the ground-engaging portion, the liner extends upwardly and is positioned on an inner side of each of the panels 18 and on the opposing walls of the containers.

[0069] Figure 13 illustrates in perspective an upper end 66 of the container 20A from which the sheet material 76 has been removed. The roller 70 is substantially devoid of the sheet material although an edge 90 remains engaged with the roller. Peripheral portions 92 of the sheet material abut inner surfaces of the panels 18 and of the side 22 of the housing.

[0070] The sheet material is formed under factory conditions into a fluid-impervious liner. It is precisely dimensioned to fit inside the area enclosed by the walls 34 and to abut against the inner surfaces of the walls.

[0071] The material 76, as noted, forms a ground-engaging and wall-engaging liner. The material is stored, say, in or on the container 20A. The container 20B on the other hand carries further sheet material 100, generally of a lighter gauge and less robust than the ground-engaging material.

[0072] The cables (Figure 8) used to draw the sheet material from the container 20A can be repositioned at an elevated location to span the space between the containers. Additional cables 80A can further be positioned to extend transversely to the cables 80. When the sheet material 100 is removed from the container 20B initially it is in a folded configuration (Figure 14). Subsequently it is unfolded so that the material then acts as a cover over the whole area enclosed by the wall 34. Edges of the cover can be

attached, as required, to the ground or the wall. Any technique can be used for this purpose.

[0073] Figure 15 shows an enclosure e.g. a reservoir 106 constructed in accordance with the aforementioned principles. The reservoir consists of the wall 34 formed from the panels and the relevant sides of the containers 20A and 20B covered with the ground-engaging liner (not visible in Figure 15) and overlaid by the cover 100 which is supported as appropriate by various cables 80, 80A etc.

[0074] Figure 16 shows an outer side of a container 20. Optionally, a plurality of solar panels 120 can be positioned on the upper surface to collect energy for driving equipment associated with the container. Inside, the container contains a plurality of pumps 112 which are used to pump water into the reservoir, or from the reservoir, according to requirement. If the system is to operate under sub-zero conditions then water heaters 114 can be used to heat the water to a required temperature. The water level inside the reservoir is constantly monitored by means of a site glass 116 located inside the container. A motor 118 can be contained inside the container to drive the roller 70 to facilitate unwinding of the sheet material from the roller, or to help rewinding the sheet material onto the roller when it is to be recovered. Depending on the configuration and the equipment required it is possible, within the container, to locate a diesel generator and fuel to drive the pumps etc. Alternatively another container can be custom-designed for this purpose.

[0075] Figure 17 shows an alternative arrangement on an outer side of a container 20. In this instance a kitchen 120, an office 122 and a storage enclosure 124 are provided. This type of facility can considerably alleviate arduous conditions and working circumstances when the enclosure/reservoir is to be erected and operated in extreme environments e.g. sub-zero or arctic conditions.

[0076] It is to be understood that the configuration of an enclosure/reservoir, viewed in plan, is not restricted to the ten-sided shape shown, for example, in Figure 10.

[0077] Figure 18 shows schematically and in plan containers 20A and 20B each substantially of the aforementioned kind. Each container is associated with a respective

set of five panels 18A to 18E and 18V to 18Z. The containers are positioned more or less side by side. Thereafter the panels are opened into respective five-sided arrays which are side by side. Each set of panels encloses a liner which is deployed from the associated container in the manner which has been described. It might be easier in practice to erect two smaller enclosures or reservoirs than to erect a single large enclosure or reservoir. In the latter instance the handling of the liner, in particular, can be problematic.

[0078] Figure 19 shows a rectangular configuration achieved through the use of two containers, each with five panels. The configuration includes three sub-enclosures or reservoirs 140, 142 and 144 respectively. Again it is pointed out that the lining of a rectangular or square reservoir may be more readily effected than the lining of a five or ten-sided reservoir for, in particular, the fabrication of the liner can more easily be accomplished.

[0079] In the Figure 19 configuration the various panels 18A to 18E, and 18V to 18Z are shown in a different sequence than in Figure 18. This is readily achieved though by virtue of the fact that the panels are pivotally interconnected to one another.

[0080] Figure 20 shows an elongate L-shaped arrangement. The manner in which the enclosure or reservoir is configured, by interconnecting the panels from the two containers 20A and 20B, is readily apparent. A disadvantage of this shape however is that the liner also has an irregular shape. This disadvantage is not present in the configuration shown in Figure 21 where the panels are positioned to form an elongate rectangular enclosure 148.

[0081] The enclosure or reservoir can be recovered (repackaged) by going through a reverse process to what has been described in connection with its erection. The reservoir components, once recovered, can be transported with ease and utilised at a second site.

[0082] Figure 22 shows an arrangement wherein a wall section 212P is fitted with a relatively slender cover 238 which is attached at a hinge joint 240 to an upper end 242 of a wall section 212. During storage and transport phases the cover is normally flat

against a side 244 of the wall section. As shown in Figure 23 when the wall section is at a desired position the cover is elevated to a horizontal position (in this example) and is held in that position by means of stays or struts 250. This type of arrangement helps to provide shelter below the cover.

[0083] In Figure 24 a wall section 212P includes a panel 250 which is mounted for vertical movement, relative to the wall section, against a side 252 thereof. Suitable guides, not shown, are engaged with the wall section and with vertical edges 254 and 256 of the panel. These guides ensure that the panel will be elevated in a vertical orientation and thereafter will be stably supported. This helps to increase the effective height of a wall section. Stability is imparted to the arrangement by the interlocking arrangement of the wall section with adjacent wall sections 212Q and 212R etc.

[0084] Figure 25 shows that the panel 250 in Figure 24 can be configured to extend at an angle relative to the side 252 i.e. it is not maintained in a vertical orientation. Stability can be achieved by means of ties 260 which are placed under tension and which extend between the wall section and the panel.

[0085] Figure 26 shows an enclosure 270 formed from four wall sections 212A, 212B, 212C and 212D respectively. The section 212A is pivotally linked to the section 212B which in turn is pivotally linked to the section 212C which in turn is pivotally linked to the section 212D. In this way ends 272 and 274 of the wall sections 212A and 212D are brought into abutting relationship. These ends are then tied to each other by means of suitable ties 276 so that a firm rectangular or square configuration results. Respective panels 250A and 250D associated with the wall sections 212B and 212D are then elevated to provide shelter over at least a portion of the area enclosed by the wall sections.

[0086] Figure 27 shows an arrangement wherein a panel 250 is associated with a second panel 250X which in turn is associated with a third panel 250Y. The panel 250Y is telescopically retractable into the panel 250X which in turn is retractable into the panel 250. This arrangement enables an extended cover to be created, projecting from an associated wall section 212R. As an alternative to the panels being telescopically

interconnected they could, in fact, be pivotally interconnected. Thus the panel 250Y could fold onto the panel 250X as indicated by a curved arrow 280 and the two panels could then be folded onto the panel 250 as is indicated by a curved arrow 282. Adjacent panels are then linked by means of hinges along lines 284 and 286 respectively. Obviously with this type of arrangement it is necessary to ensure structural integrity. This can be done in different ways for example through the use of suitable supporting rods, cables or the like.

[0087] One particular embodiment of the present invention is illustrated in Figure 28 which shows a container 310 from which four articulated panels 314, 316, 318 and 320 are deployed to form part of a boundary enclosure which is generally in the form of a pentagon. The four panels form four sides of the pentagon and the container forms a fifth side of the pentagon.

[0088] Cables 322 stretch between opposing pairs of panels. At each end the cables have a respective branch structure 324 of shorter cables 326. Ends of the cables 326 in the branch structure are tethered to lower points on the respective panels.

[0089] In a subsequent operation, not shown, the ground 328 on which the containment structure is erected and which is bounded by the panels and the container, is covered with a liner. The liner also extends upwardly along inner vertical surfaces of the panels and over an opposing inner surface of the container. In this way a leak-proof reservoir is formed. Optionally, a cover in the form of a roof, is placed over the reservoir. The cover may be supported by cables or alternatively may have air-filled "bubbles" which allow the cover to float on a liquid which is introduced into the reservoir.

[0090] The liquid pressure is highest at ground level and, for this reason, the cables are tethered to the wall panels at this level. The forces which are exerted by liquid inside the reservoir are thus contained by means of the cables. It is pointed out in this respect that, generally, the wall panels are planar and cannot readily withstand the same forces as curved or arcuate panels.

[0091] Figure 29 illustrates a conventional shipping and transport container 410 which is modified to comply with the objectives of the present invention. The container

has opposing long sides 412 and 414, opposing short sides 416 and 418 respectively, a roof 422 and a floor 424. At each corner of the container a stout steel rod 426 is attached to adjacent container components in a secure manner. The rod, due to its nature, braces and strengthens the container particularly at the corner and is used as a pin for a hinge mechanism. Steel bushes 430, 432 and 434 are engaged with the pin in a rotatable manner. Intermediate bushes 436, 438 and 440 respectively are coupled to the pin and bear against respective steel bushes. A wall panel 444 which is secured to the bushes 436, 438 and 440 is then pivotally movable relative to a vertically extending axis 442 defined by the respective rod or pin 426.

[0092] At an end 446 of the panel 444, remote from the pin 426, a second hinge mechanism 448 is provided. This is generally similar to what has been described although the various bushes 450 are made, for example, from aluminium and a supporting hinge pin 452 is not quite as robust as the rod or pin 426.

[0093] The hinge mechanism 448 permits a second panel 454 to be hingedly attached to the panel 444.

[0094] The pin 452 is hollow i.e. tubular. A similar tubular pin 456 is attached to an outer end of the panel 454.

[0095] A hydraulically actuable cylinder and piston arrangement 460 is mounted inside the tubular pin 456. A similar structure, not shown, is inside the tubular pin 456. Hydraulic lines 462 and 464 respectively extend to ports on the cylinders from a hydraulic source, not shown, inside the container. The lines 462 and 464 are preferably accommodated inside a hollow in each panel which is formed from two spaced sheets of material 454A, 454B, and 444A, 444B, respectively.

[0096] A piston rod 466 extends from the cylinder 460. A lower end of the rod has a pair of wheels 470 attached to it. Alternatively a lower end of the rod has a skid 472 attached to it.

[0097] A lower end of the hinge 448 has a similar structure 476 secured to it. This is not described in detail.

[0098] A number of level sensors 478A, 478B and 478C are attached to the panel and hinge mechanisms at respective locations and provide signals to a control device, not shown, housed inside the container via electrical conductors or wires 480.

[0099] Figure 29 shows two panels 444, 454 attached to a right hand corner of the container 410. Similar panels are, in practice, attached to a left hand corner of the container. These function in the same way as the panels 444 and 454. The panels on the left hand corner have been omitted from Figure 29 merely to simplify the illustration. The panels 444 and 454 are dimensioned so that they can be accommodated inside the container, adjacent the side 414 thereof, for transport and storage purposes. The panel 454 is pivoted about the hinge mechanism 448 in the direction of an arrow 484 so that it is in contact with or directly opposes the inner sheet 444A. The compound assembly of the two panels is then pivoted into the storage position adjacent the side 414.

[00100] At an installation site the two panels 444, 454 are initially pivoted jointly outwardly about the axis 442. The panels have substantial dimensions and a reasonable weight and to assist in this process the hydraulic cylinders 460 are actuated to bring the wheels 470 into ground-engaging contact. The wheels provide a means which supports the panels as they are moved to their desired positions. When there is sufficient space for the panel 454 to be moved away from the panel 444 it is pivoted outwardly i.e. in a direction opposite to the direction 484 and an extended panel structure results.

[00101] The cylinders 460 are controlled, as necessary, using the level sensors 478A, 478B and 478C to provide input signals and, in this way, the panels are correctly orientated i.e. extending horizontally and vertically once they are at an installation position.

[00102] The panels attached to the hinge mechanism at the opposing corner are opened in a similar manner and an outer end of these panels is then connected to the tubular pin 456. In plan the resulting structure has the shape of a pentagon with four sides being formed by respective panels and the fifth side being formed by the side 414.

[00103] Figure 30 illustrates a different type of support which can be used when the panels are to be pivoted relative to the container. A small trolley 490 which has spaced sets of wheels 492 and 494 has a locating formation 496 on an upper surface. When a piston rod 466 is extended a lower end 498 of the rod is engaged with the locating formation. Subsequently two stabilisers 400 and 402 which may be either rods or cables are connected between respective ends of the trolley and the panel (444 or 454 as the case may be). This arrangement is capable of taking the load of the panel or panels and additionally helps to restrict flexing of the panels as they are being moved.

[00104] One application of the structure described, is in the erection of a reservoir. In this instance the panels are deployed in the manner which has been described and an enclosure is formed. Subsequently the enclosure is lined with a liner 506 of a stout plastics material, see for example Figure 32. This shows the panel 440 with the liner 506 on an area of the ground 508 which is bounded by the panels. The liner closely abuts the inner surface 444A and extends over an upper end 510 of the panel.

[00105] At a lower end 512 of each panel two closures 514 and 516 respectively are used (see Figure 31). These closures serve two functions. Firstly the inner closure 516 which is pivotally attached to the panel 444 is movable to seal a gap 518 between the lower end 512 of the panel and the ground 508 and, in this way, the closure provides support for the liner as it moves from the ground to the panel.

[00106] Secondly the closure 514 which is positioned on an opposing side of the panel is moved downwardly so that a lower end 520 digs into the ground 508 and provides support for the panel. It is to be borne in mind in this respect that when water 522 is placed into the reservoir there is a substantial pressure exerted by the water and the pressure is at its highest at the lower end of the reservoir. Thus the closure 514 helps to brace the panel to take this load. Additionally however encircling cables 524 are located at spaced locations on an outer surface of the panels. These cables extend circumferentially around the panels and help to brace the panels when the reservoir is filled with water.

[00107] Figures 33 and 34 show a floor structure 530 which can be used to cover the area of the ground 508 which is enclosed by the panels. The floor structure includes a number of floor sheets 532 and 534 etc. which are attached at longitudinal edges 536 to each other by means of an appropriate hinge 540. At an installation site the floor panels are folded into ground-engaging contact (see Figure 34) to cover the ground. A number of these structures are used as appropriate to provide complete ground coverage.

[00108] Figures 35 and 36 illustrate from one side and in cross-section a containment assembly 610 according to another form of the invention in different stages of deployment. A plurality of panels or wall elements 612 are previously erected using any suitable technique to form an enclosure on the ground 614. A mast 618, which is tubular, is held in a vertical orientation by means of a number of stay wires 620. The mast is centrally positioned within the enclosure formed by the wall elements. The mast has an upper end 622 and terminates at a lower end 624 in a hemispherical formation 626. The formation 626 is positioned inside a large upwardly facing dish-shaped formation 630 which is at an upper end of a peg 632 which is embedded in the ground.

[00109] A catch 634 is fixed to the mast near an upper end. The catch is spring-loaded so that it is biased outwardly, away from the mast in the direction of an arrow 636. The catch has a downwardly facing inclined surface 638 and a transverse upper surface 640. A flexible lead 642, extends inside the mast from the catch to a lever 644 which is near ground level.

[00110] A locating member 650, see Figure 37, is slidably engaged with the mast 618. The locating member has a sleeve 652 which bears closely yet slidably against an outer surface of the mast and which thus acts to some extent as a seal. A disc 654 is attached to the sleeve. The disc includes a number of holes 656 or equivalent anchor formations, which are engaged with the stay wires 620.

[00111] Flexible sheet material 660 is fixed to the disc 654 and surrounds the mast – see Figure 35. The sheet material 660 has a periphery 662 which is attached more or less in a leak-proof manner to upper edges 664 of the wall elements. The sheet material comprises at least two layers of material namely, a relatively large area, upper

layer 666 and a smaller area, lower layer 668. The upper layer 666 is fixed to the disc. The lower layer 668 is fixed to a ring 670 which is below the locating member and which is connected to the locating member 650 by means of a cable 672. A suitable seal, not shown, which may in the form of an elongate bulbous member, made from a flexible material such as rubber, can be used at lower edges of the wall elements to seal an interface between the lower edges and the ground.

[00112] An air blower or fan 674 forms part of the containment system. The blower may be fixed to one of the wall elements, if required.

[00113] When the blower is actuated it introduces air under pressure into a volume below the sheet material 666. The air in this volume is contained to a substantial extent and thereby is pressurised, forcing the sheet material to move upwardly. Air can pass through the lower layer 668 but not through the upper layer 666 which thus rises with its movement being guided by the locating member 650. When the member 650 strikes the catch 634 it rides over the inclined surface 638. The catch is moved inwardly against the biasing action of the spring which is attached to it. The locating member, at an uppermost position, comes to rest on an outwardly projecting relatively flat surface 640 of the catch. The layer 666 is then suspended from the locating formation 650 substantially in the form of a tent and forms a roof over the area enclosed by the wall elements. The lower layer 668 is also elevated by means of the cable 672 to a position at which the lower layer acts as a ceiling over the enclosed area.

[00114] To the extent which may be necessary air can flow into an interior of the tubular mast or out of the mast through various apertures 674 which are formed through a wall of the mast.

[00115] Figure 37 illustrates a telescopic-type support 676 which can be attached to the disc 654 and which is engaged with a tubular sleeve inside the upper layer 666. This is one of a number of similar supports which can be used to support and stabilise the upper layer 666.

[00116] Figure 37 also illustrates a dome cover 680 which fits over an upper end of the mast for aesthetic and weather proofing purposes.

[00117] Once the flexible sheet material has been anchored to the catch the blower 674 is not required.

[00118] When the flexible sheet material is to be lowered the lever 644 is operated and the catch 634 is then drawn inwardly and disengages from the locating member 650. The sheet material 660 then settles downwardly under gravity action and air is expelled, as required, through the various apertures 674 upwardly through an interior of the mast to atmosphere.

[00119] It is possible for the wall elements to be eliminated and, in this event, the periphery 662 of the sheet material is anchored to the ground.

[00120] Referring again in particular to Figure 29 the piston and cylinder assembly shown at the junction of abutting vertical edges of adjacent panels, which are interconnected by means of a hinge mechanism can be employed, as required, in any embodiment of the containment system of the invention. As pointed out it is important for the panels/wall elements to be supported and to be aligned horizontally. The piston and cylinder structures shown in Figure 29 can be adapted as appropriate to fulfil a height adjusting and supporting function in any embodiment. Other mechanisms can however be employed for this purpose e.g. jacks which are manually or electrically or hydraulically actuated can be employed. Although it is preferred to mount this type of jack or height adjustable mechanism wholly or partly within the hollow section of a hinge pin, at a junction of adjacent panels this is not essential for other configurations are possible.

CLAIMS

1. A containment assembly which includes a container, a plurality of linked wall sections which, in a storage mode, are arrangeable side by side and substantially parallel to one another at least partly inside the container and which are movable to an operative mode in which the wall sections, still linked to one another, are in ground-engaging positions and form at least part of a boundary of an enclosure.

2. A containment assembly according to claim 1 wherein the wall sections are pivotally interconnected to one another.

3. A containment assembly according to claim 1 or 2 wherein, in the operative mode, the wall sections form respective sides of the boundary, which, in plan, has the shape of a square, rectangle, pentagon, part of a decagon and the container forms a fifth side of the boundary.

4. A containment assembly according to claim 1 to 3 which includes one or more level sensors used during deployment of the containment assembly to ensure that the wall sections extend substantially horizontally from the container and vertically relative to the ground and a bracing structure to restrict flexing of each wall section at least while it is being moved between the storage mode and the operative mode.

5. A containment assembly according to any one of claims 1 to 4 wherein adjacent vertical edges of adjacent wall sections are pivotally interconnected by means of a respective hinge system and a height adjusting mechanism acting on the hinge system, is operable to support the adjacent panel at a chosen height in horizontal orientations.

6. A containment assembly according to any one of claims 1 to 5 wherein the container is used to house equipment or personnel when the wall sections are in the operative mode.

7. A containment assembly according to any one of claims 1 to 6 which includes a roof structure over the enclosure and a liner covering the ground which is bounded by the enclosure.

8. A structure which includes a containment assembly according to claim 1, wherein the wall sections are in the operative mode, and which includes flexible sheet material which covers the ground bounded by the enclosure and which bears against, and which is supported by, surfaces of the wall sections and of the container.

9. A structure according to claim 8 which includes a plurality of bracing cables, engaged with the wall sections, to resist fluid pressure which is exerted on said surfaces of the wall sections.

10. A structure according to claim 8 or 9 which includes at least one upwardly extending support on the ground within the enclosure, and flexible sheet material attached to the support which covers and which is spaced from the ground.

11. Structure which includes a containment system according to claim 1 wherein the wall sections are in the operative mode and which includes at least one upwardly extending support on the ground within the enclosure and a flexible sheet material attached to the support which covers and which is spaced from the ground.

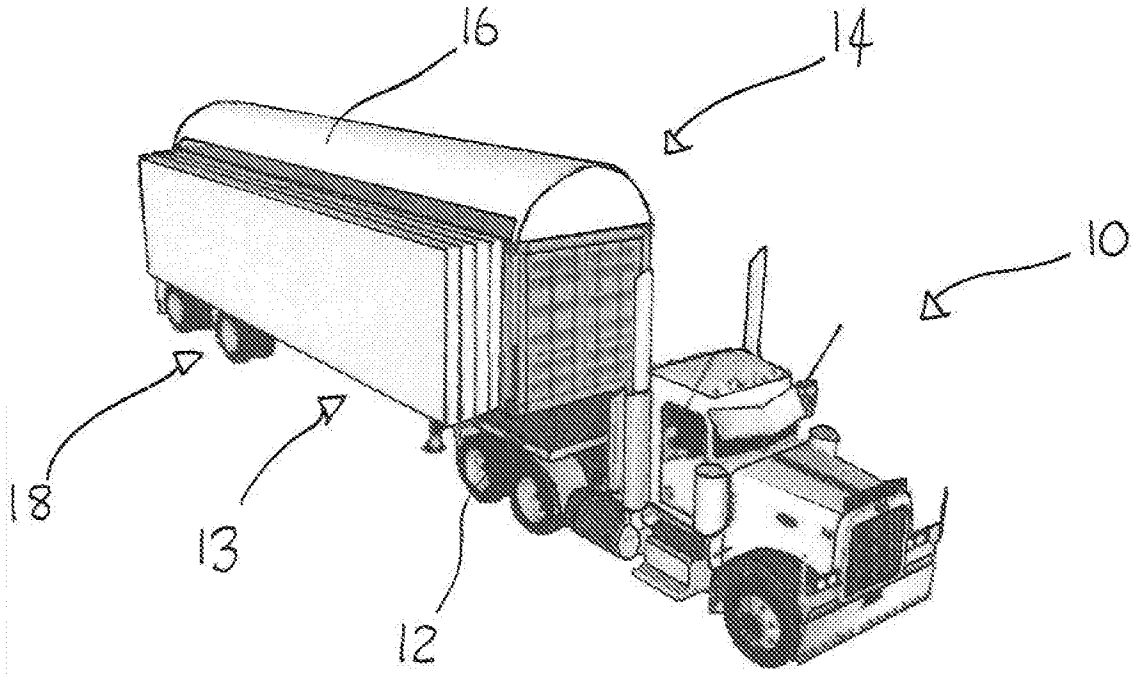


FIGURE 1

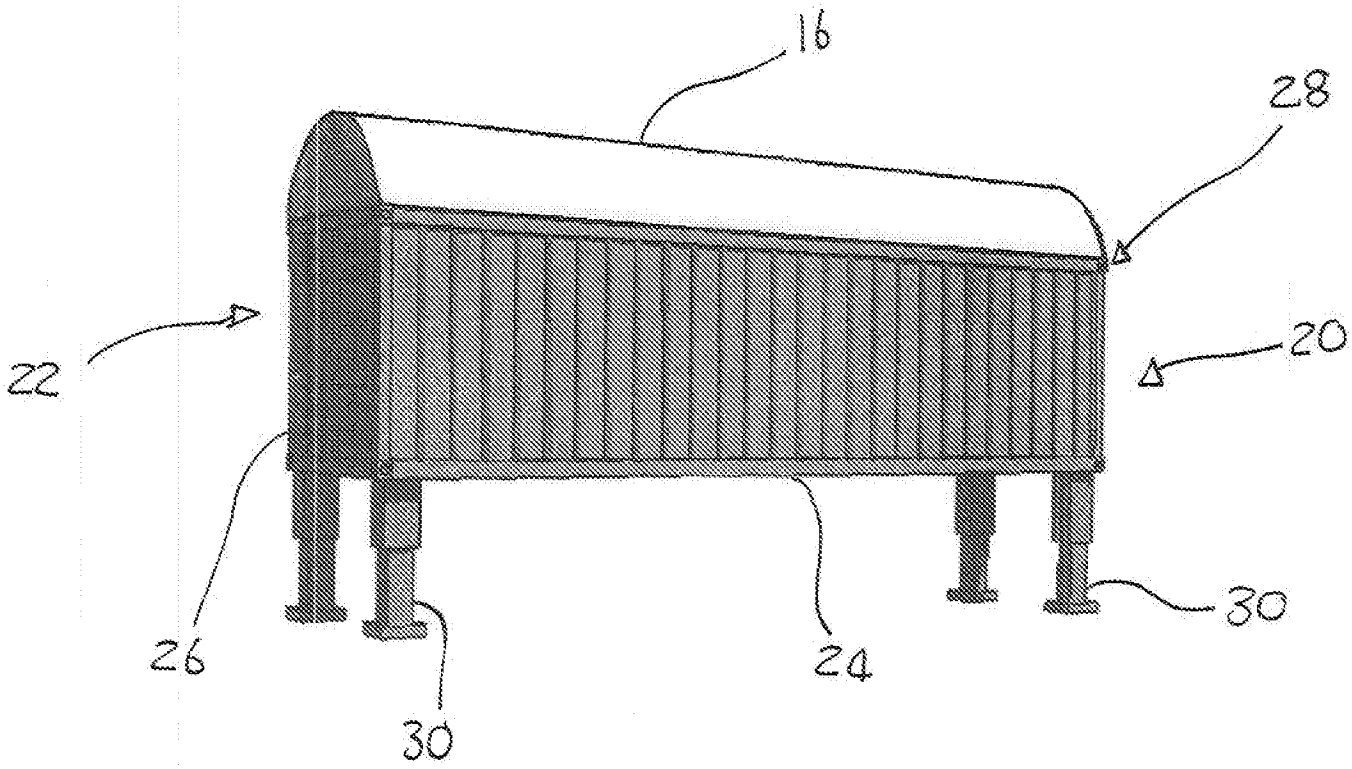


FIGURE 2

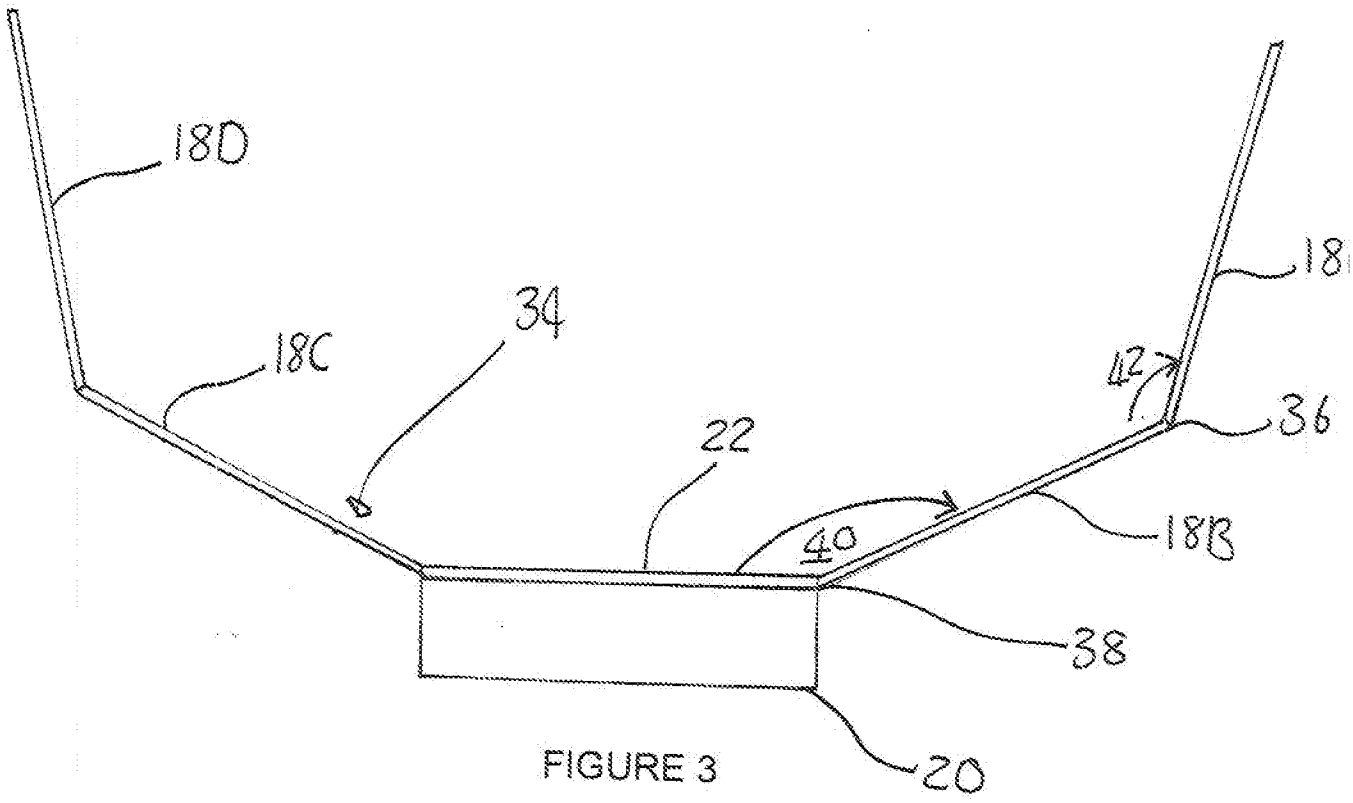


FIGURE 3

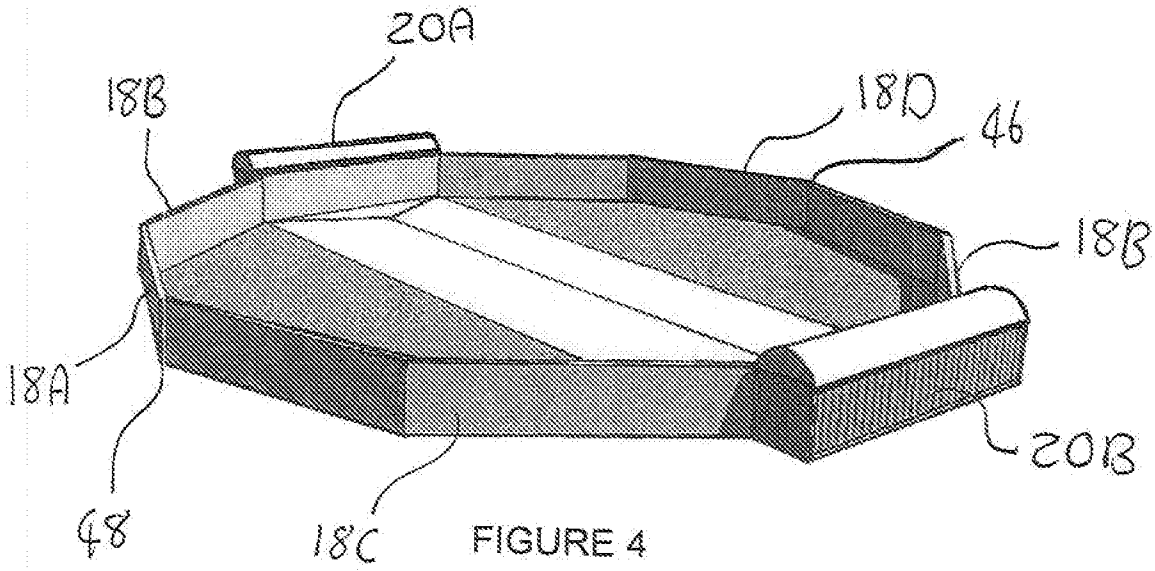


FIGURE 4

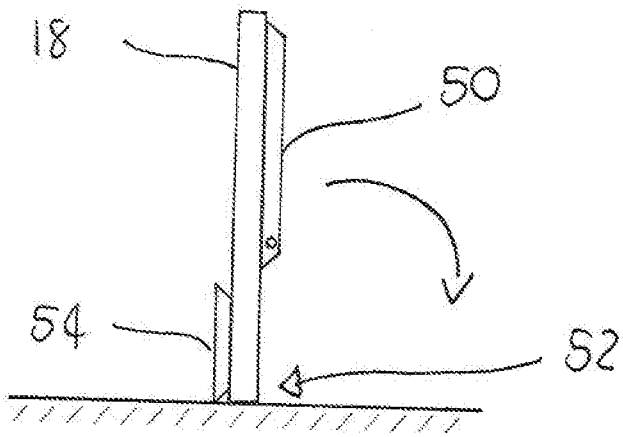


FIGURE 5

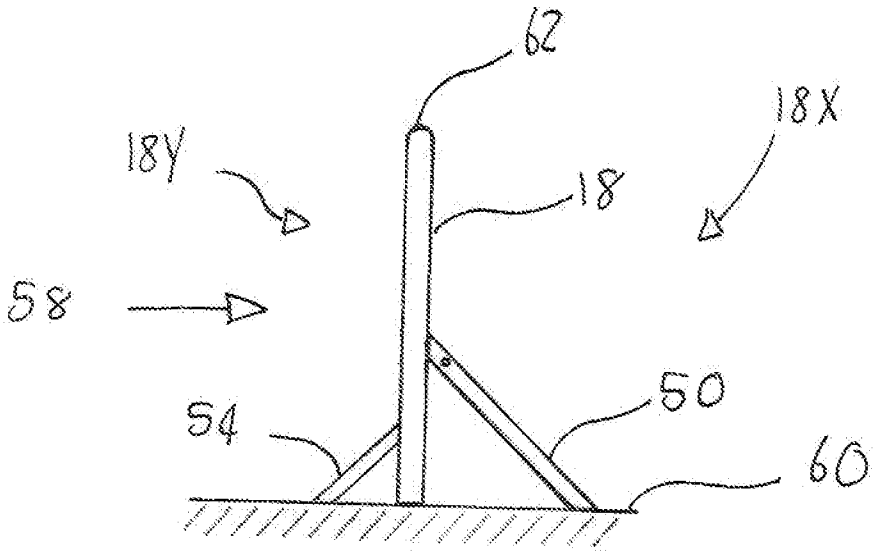


FIGURE 6

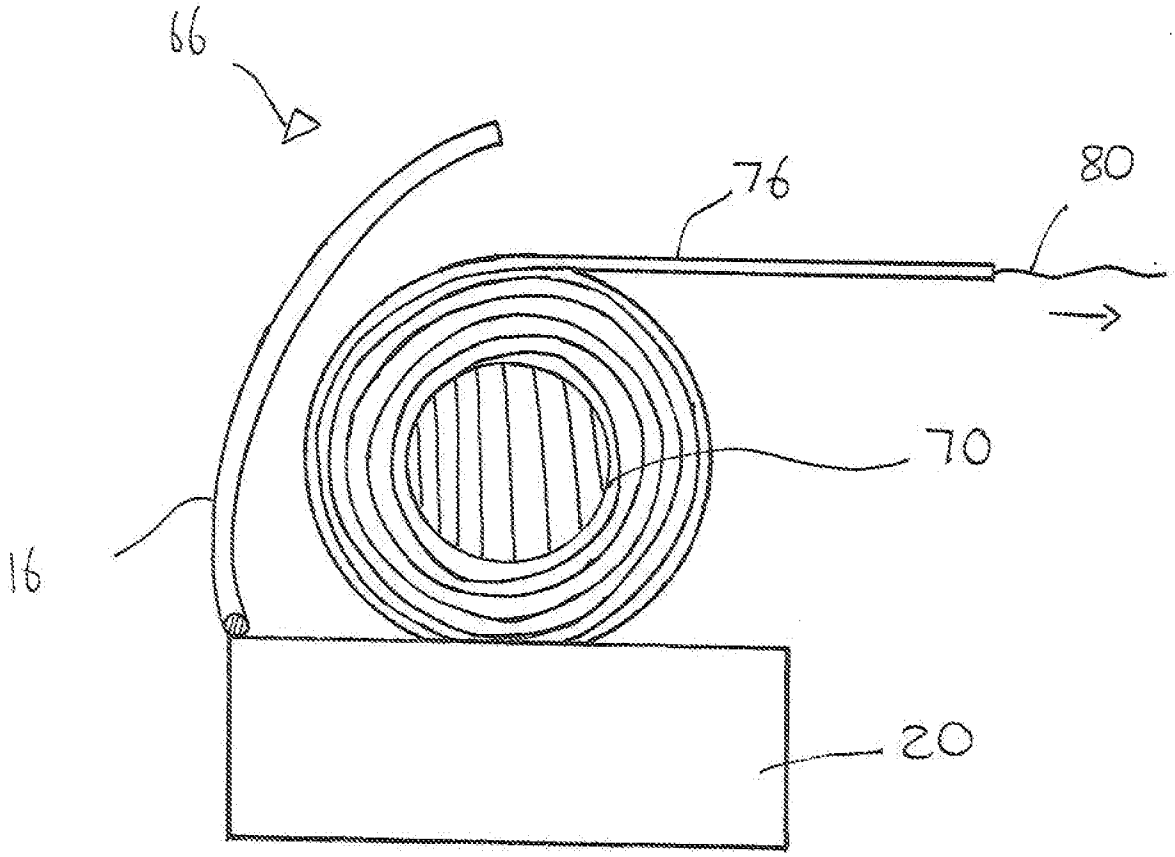


FIGURE 7

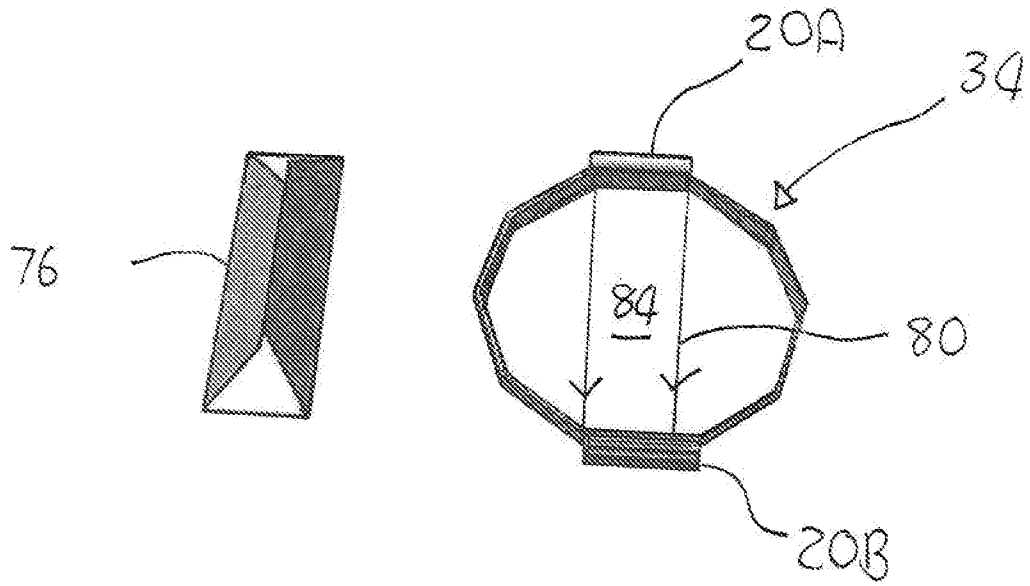


FIGURE 8

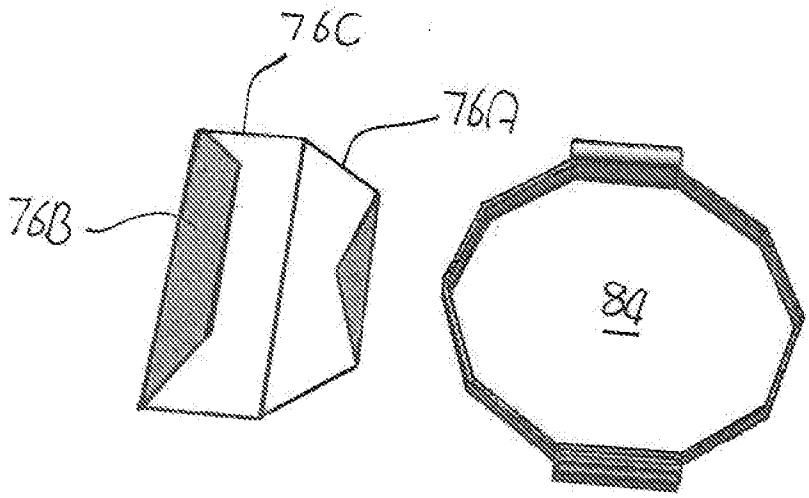


FIGURE 9

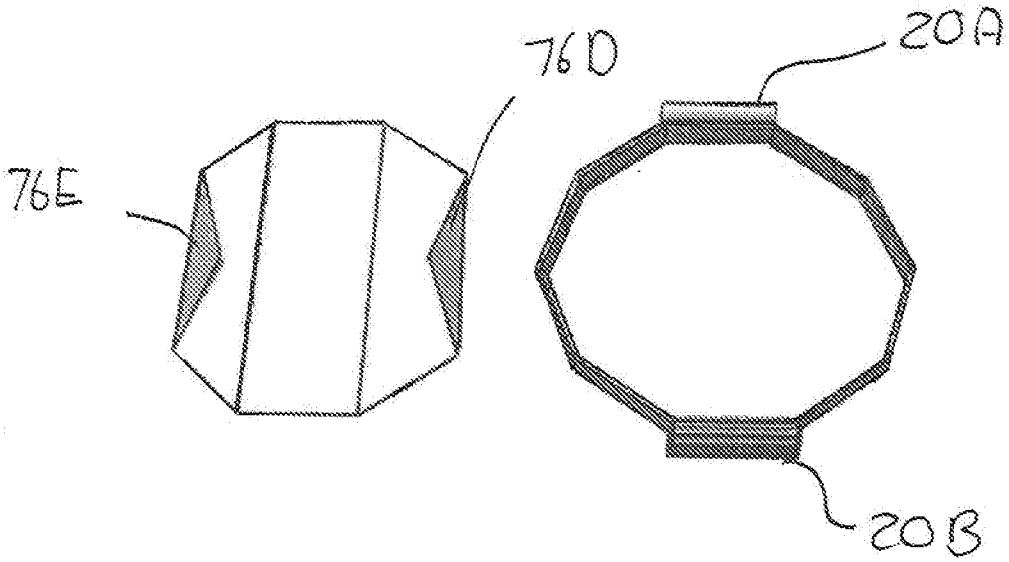


FIGURE 10

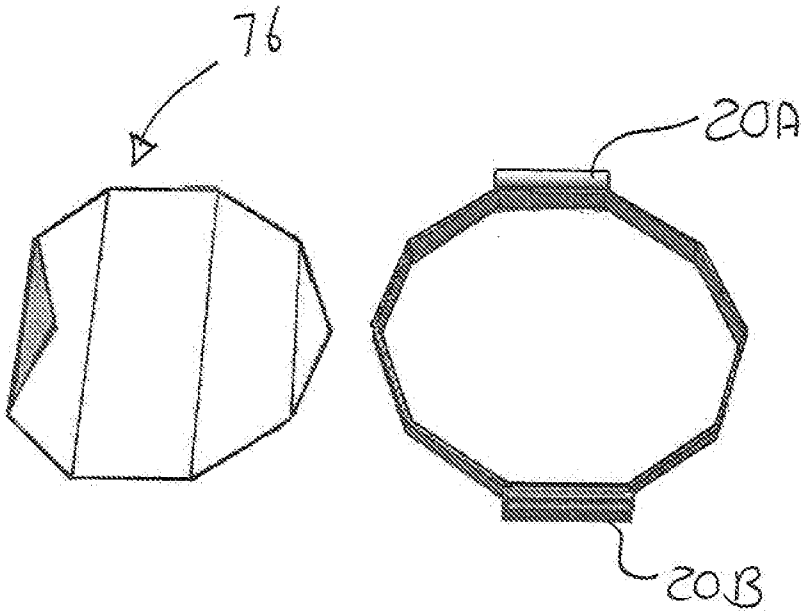


FIGURE 11

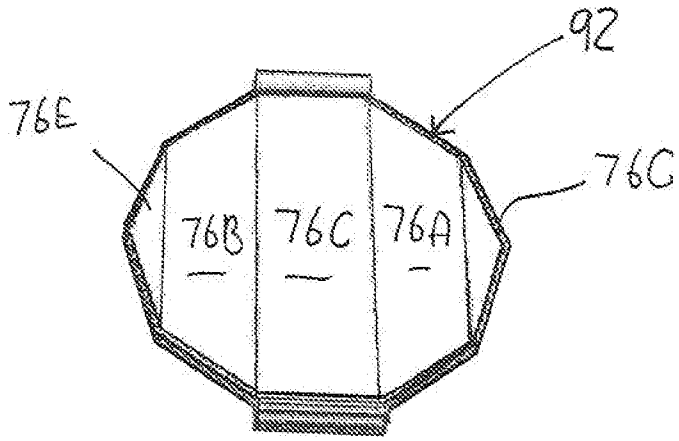


FIGURE 12

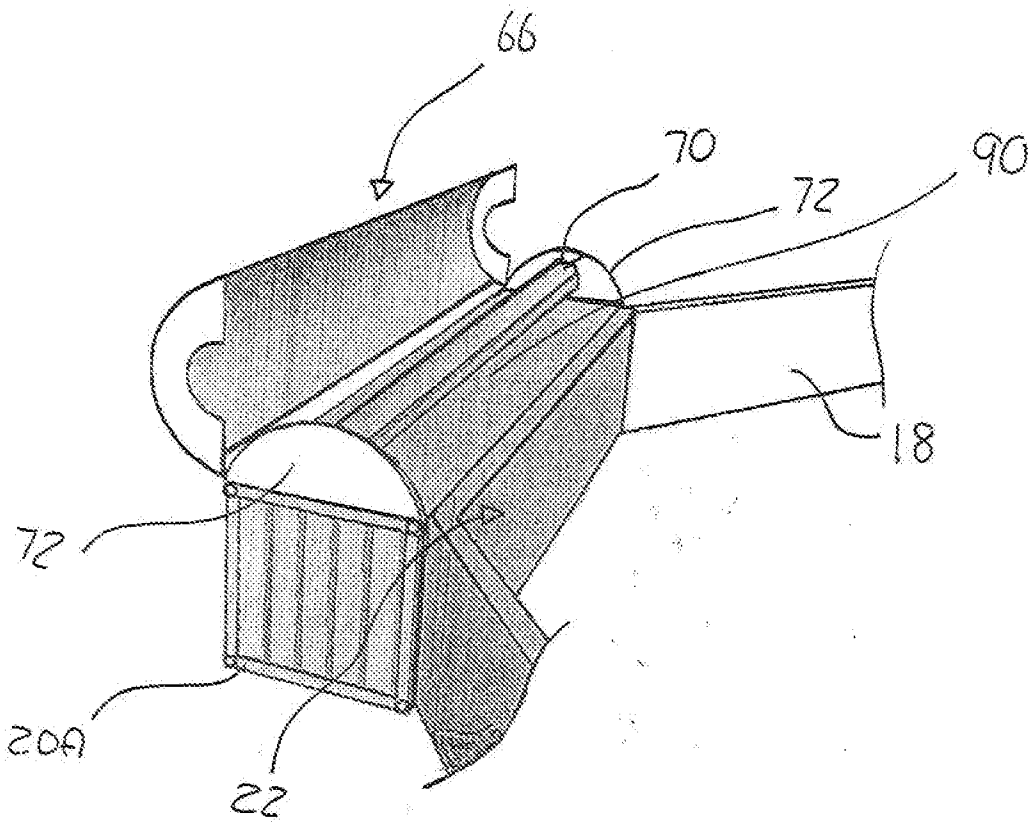


FIGURE 13

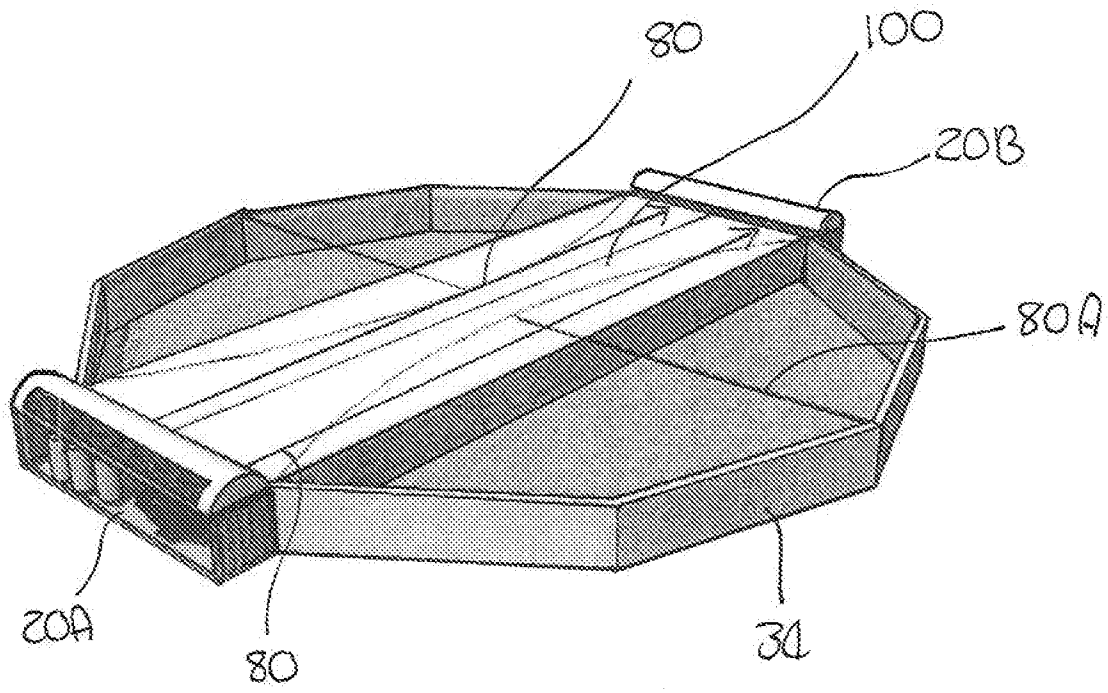


FIGURE 14

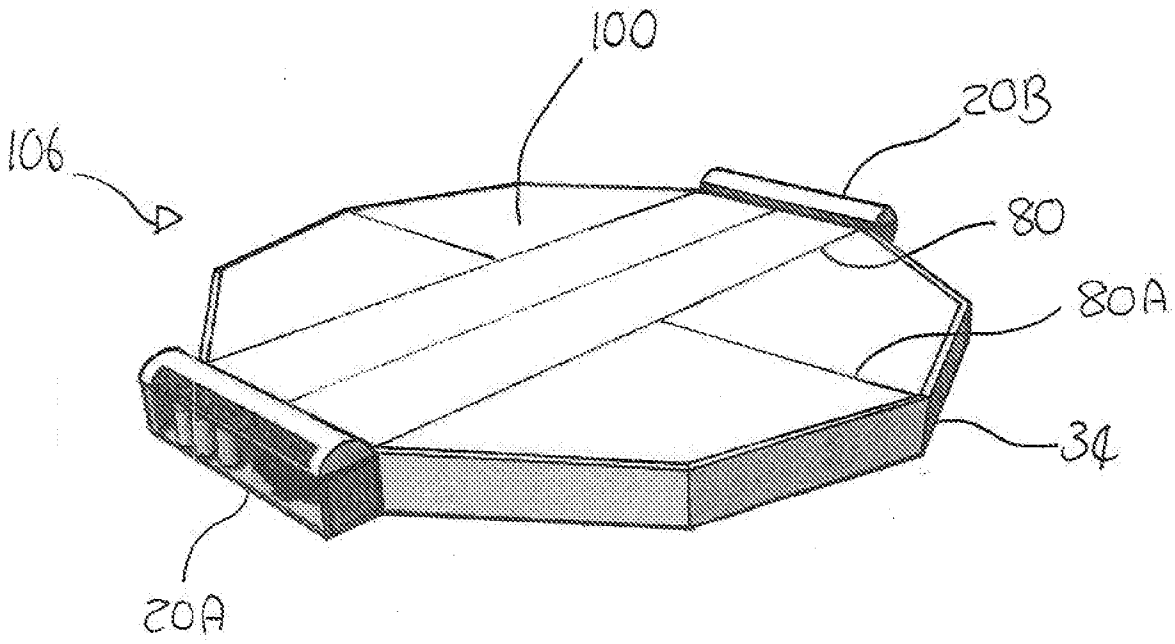


FIGURE 15

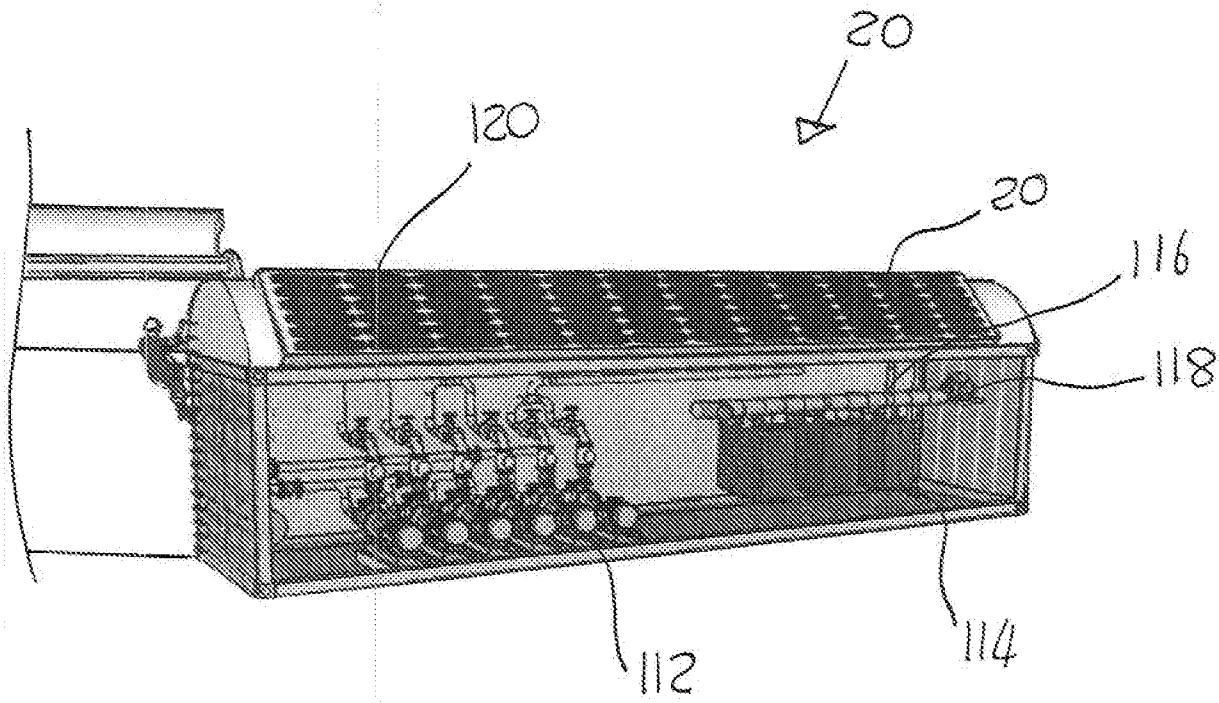


FIGURE 16

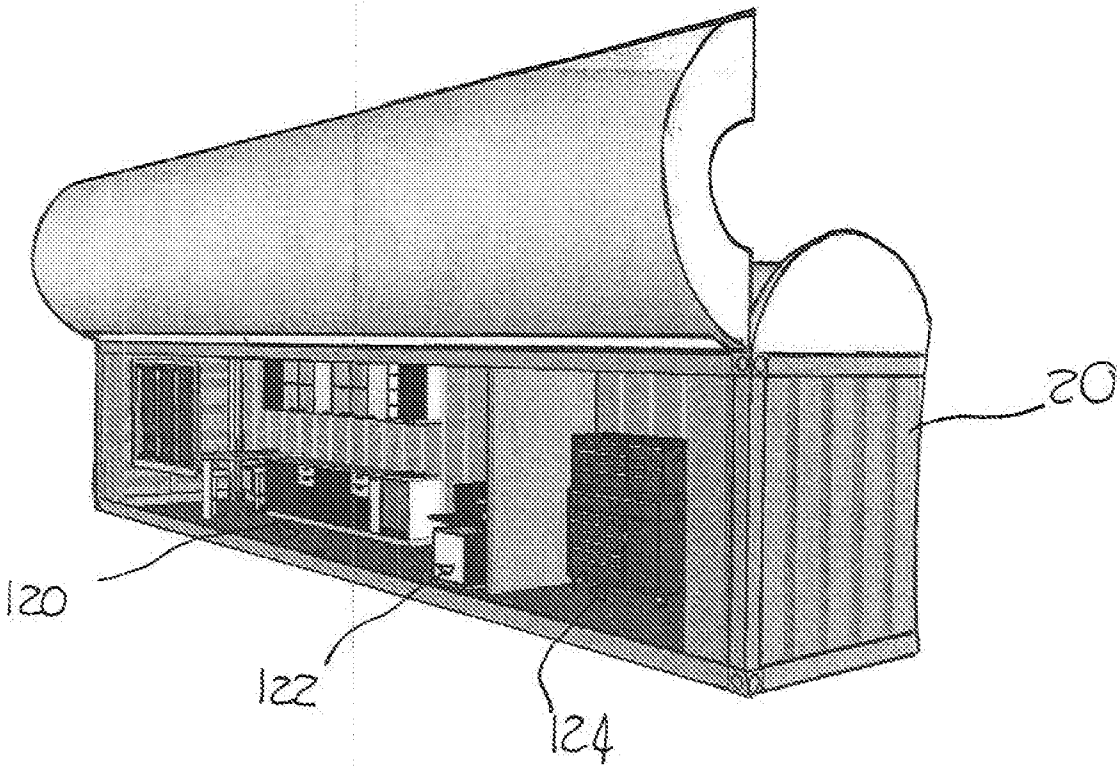


FIGURE 17

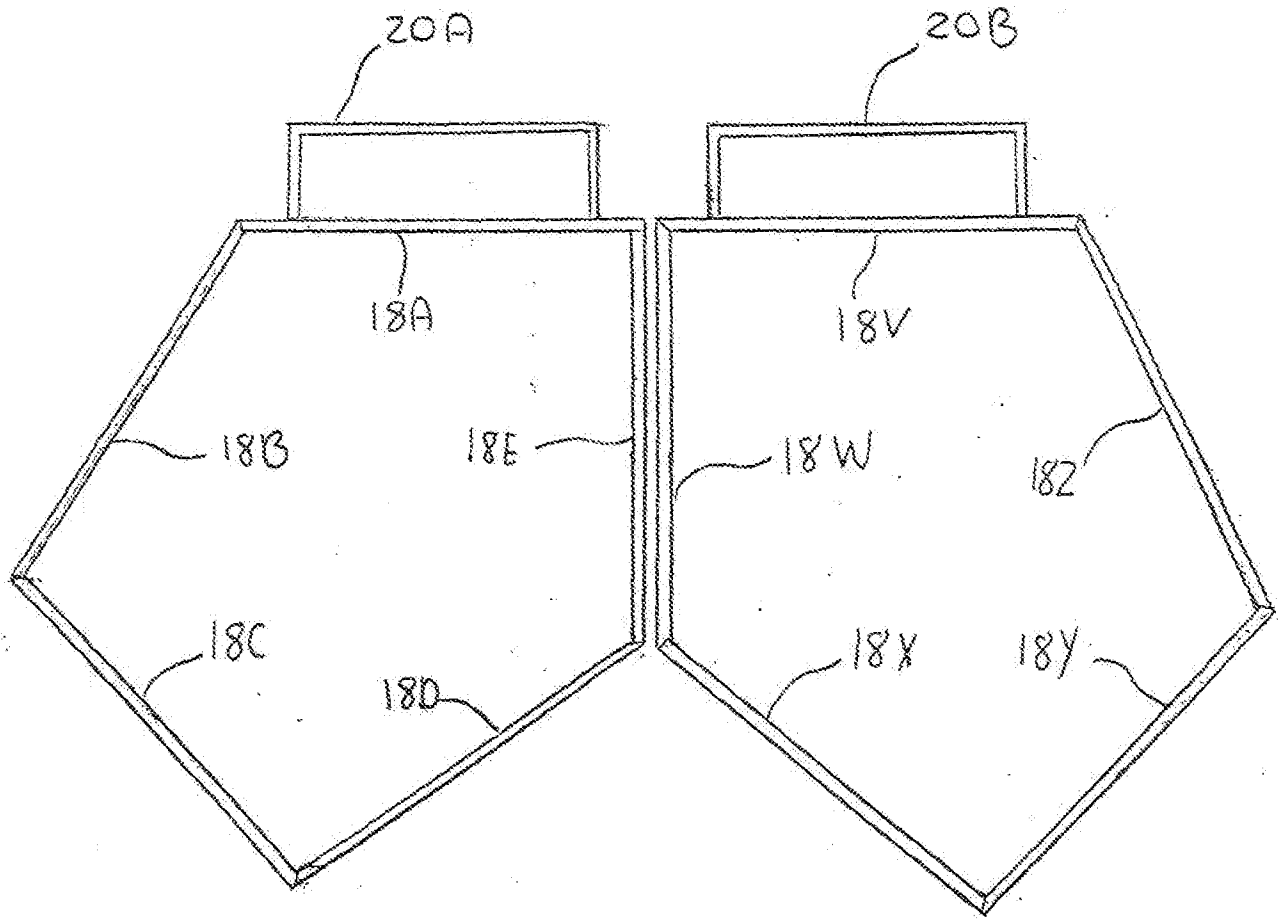


FIGURE 18

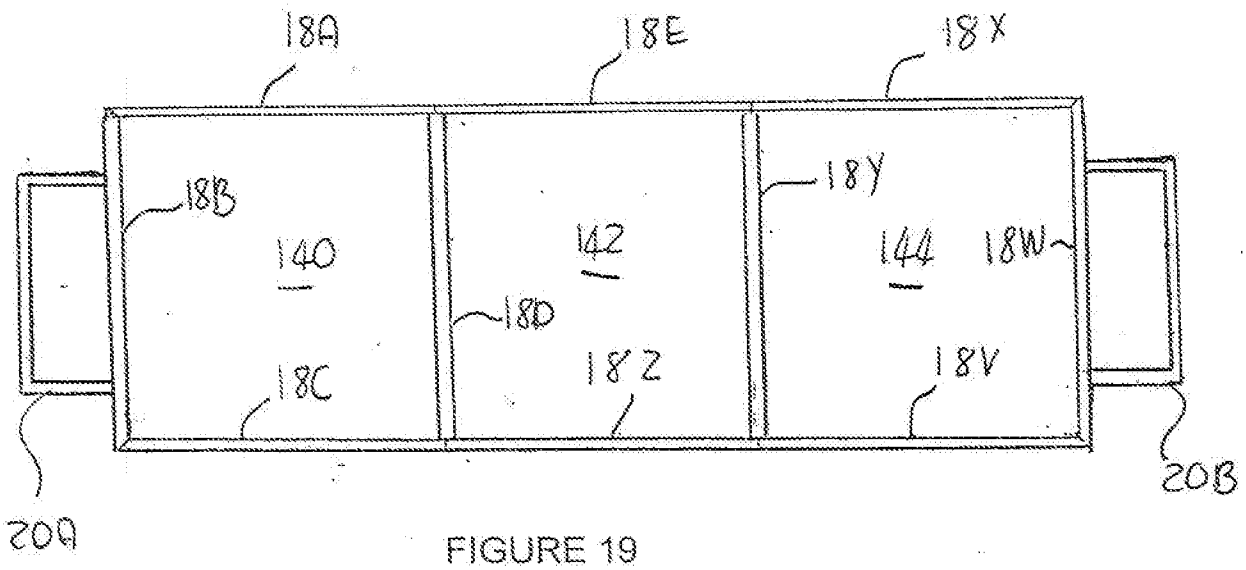


FIGURE 19

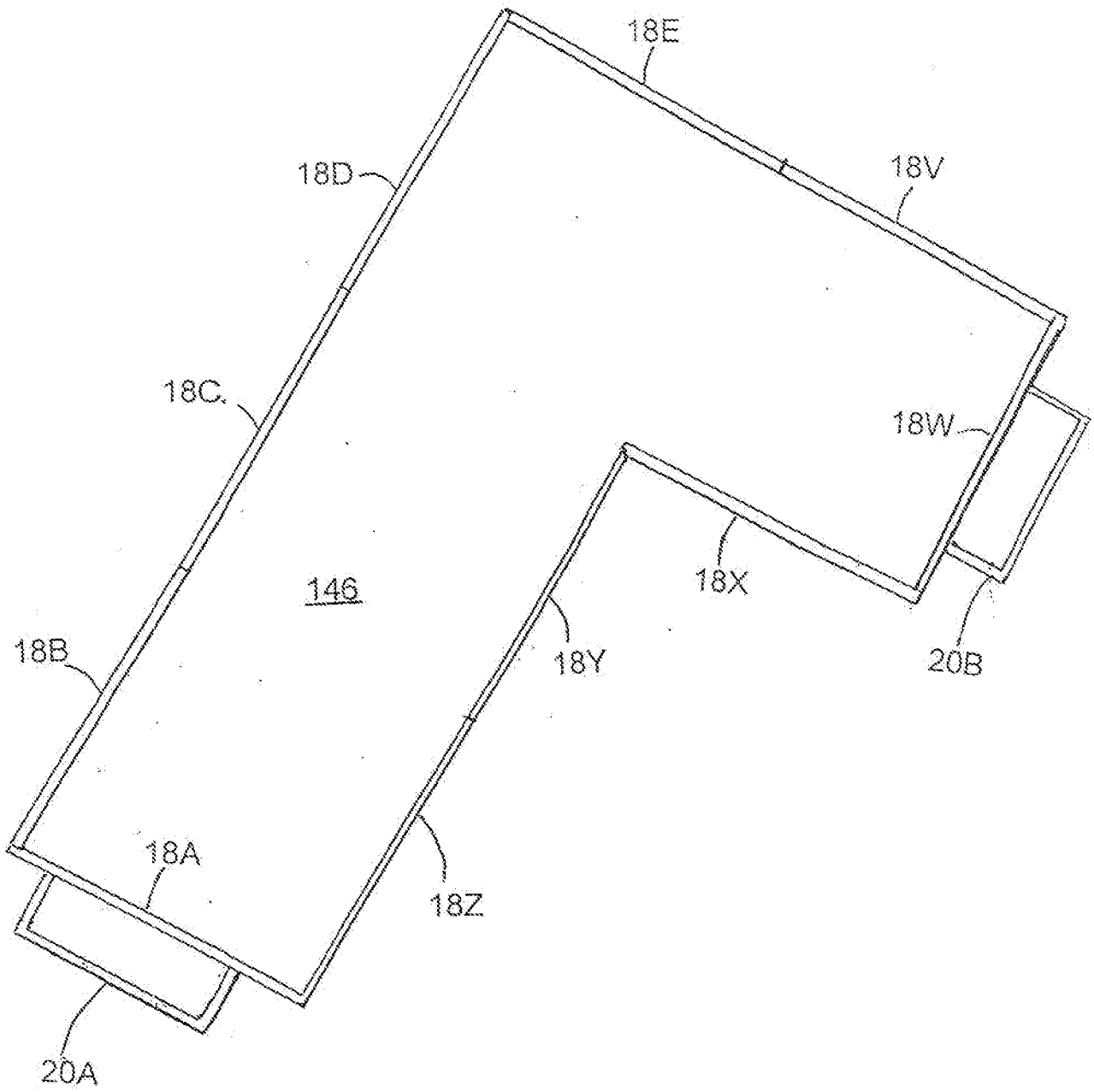


FIGURE 20

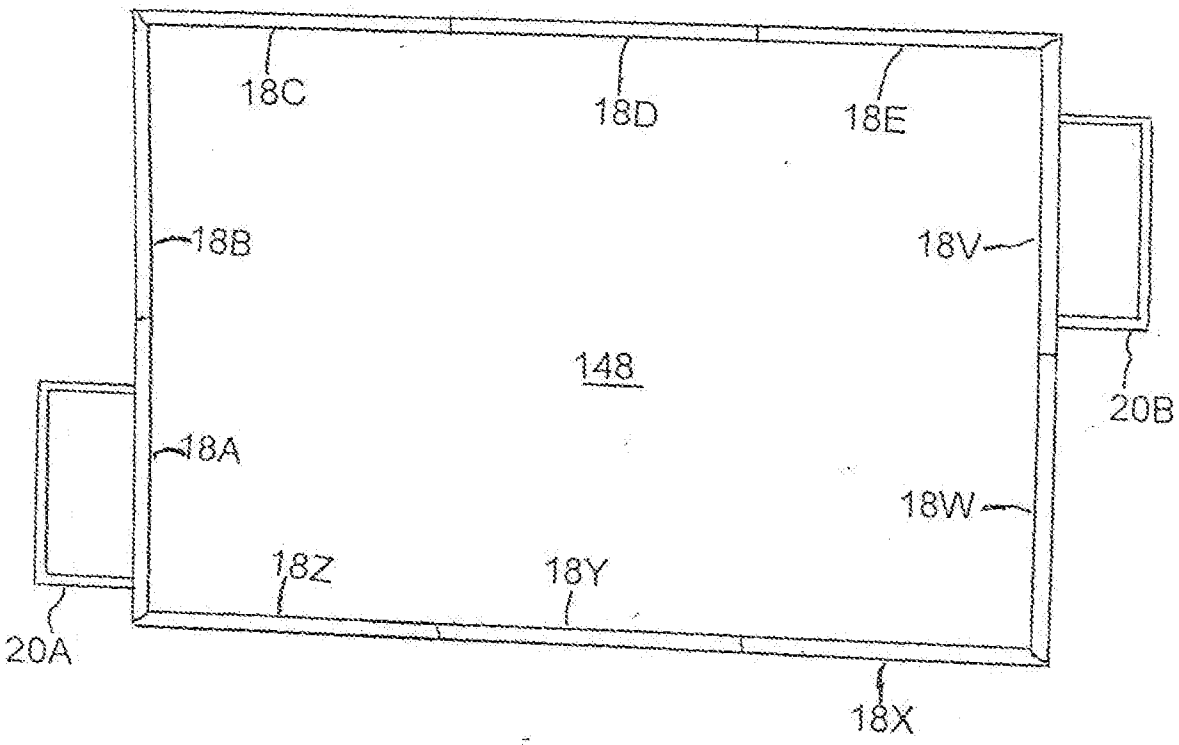


FIGURE 21

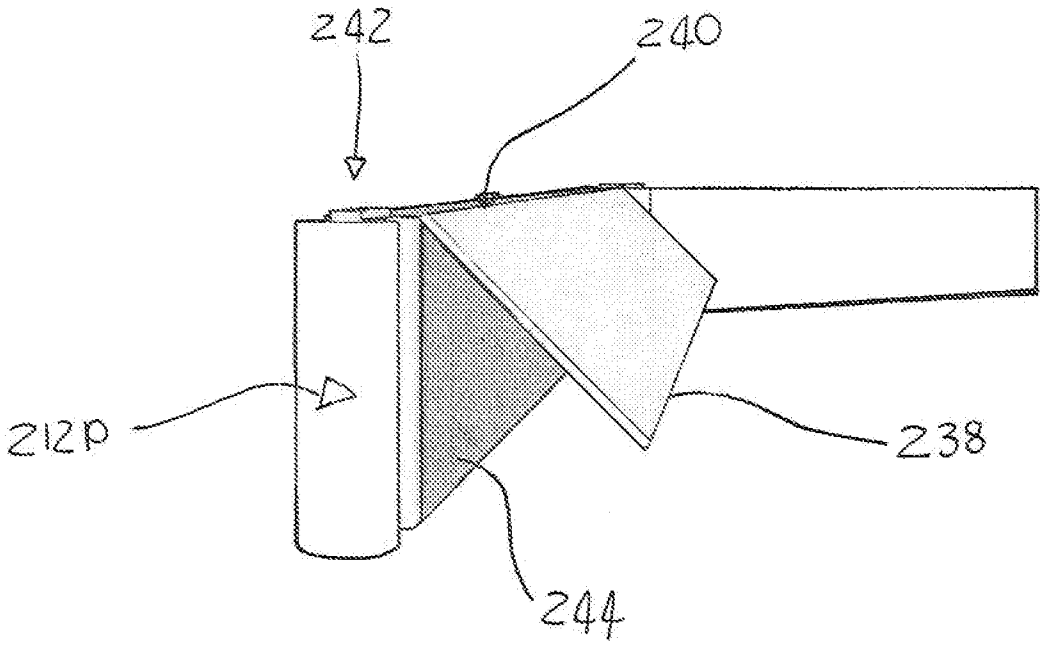


FIGURE 22

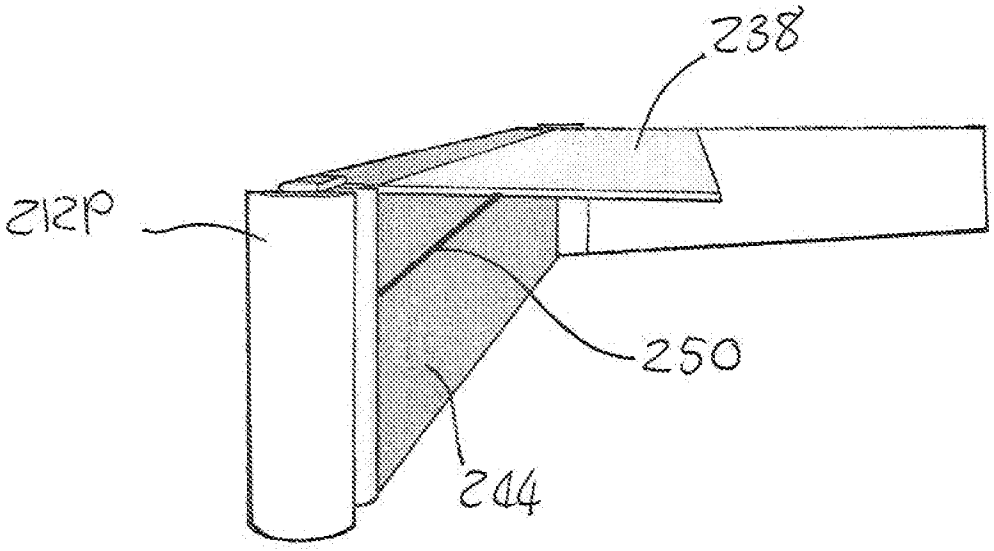


FIGURE 23

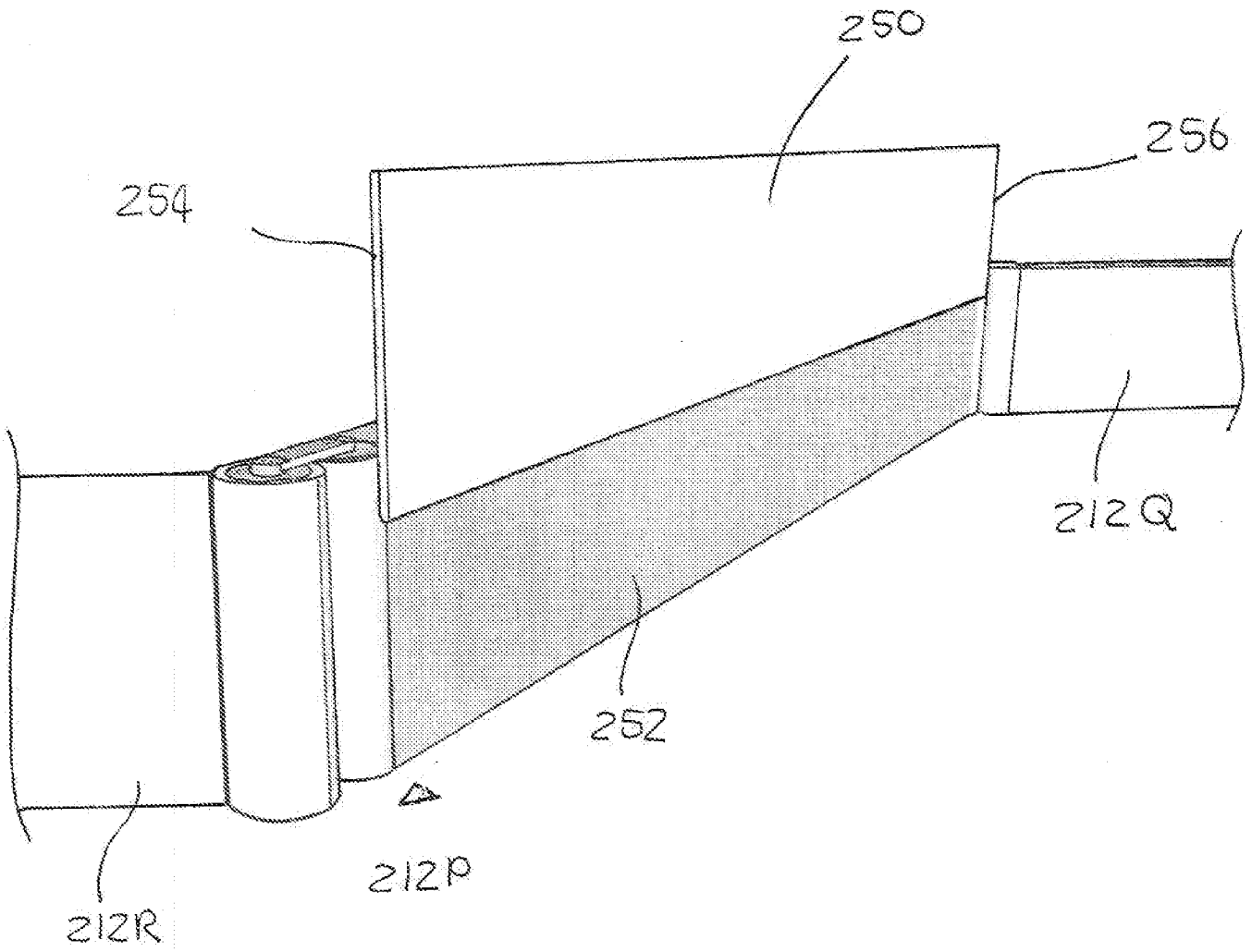
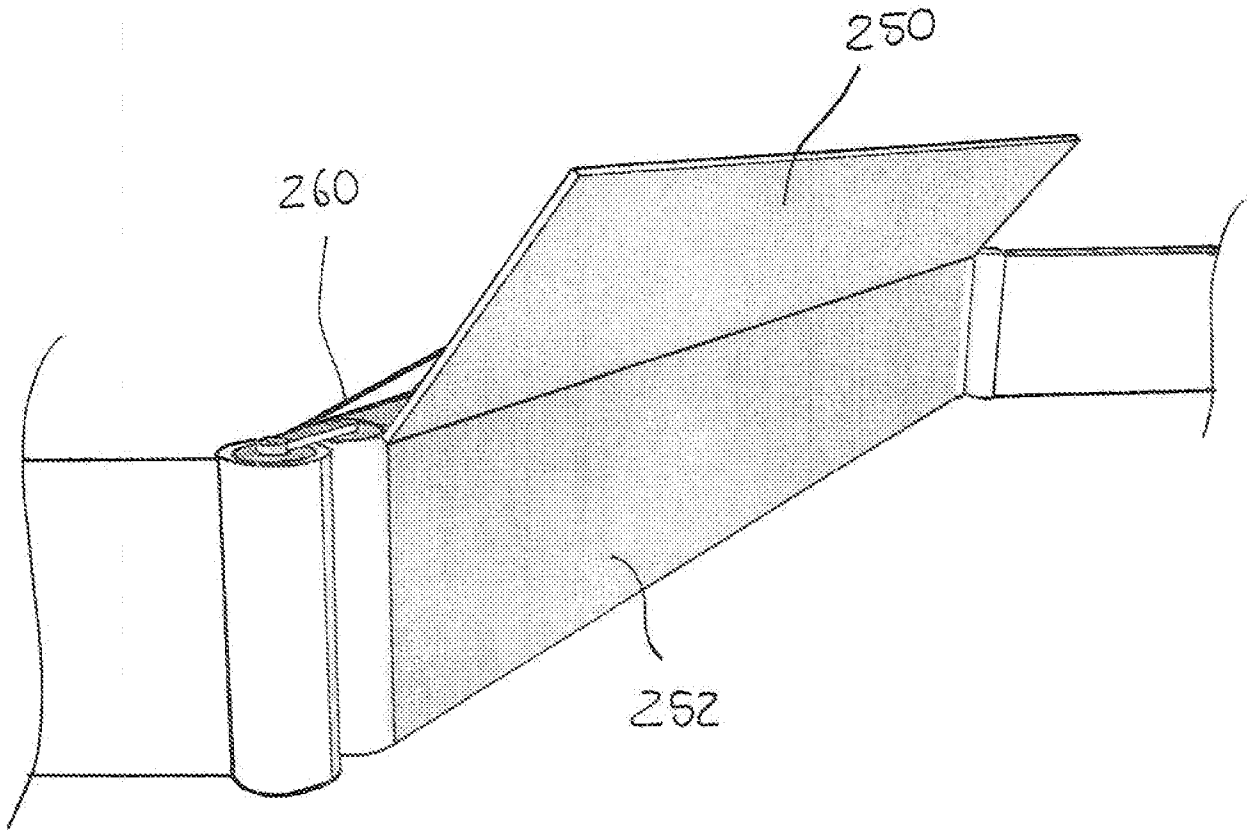


FIGURE 24



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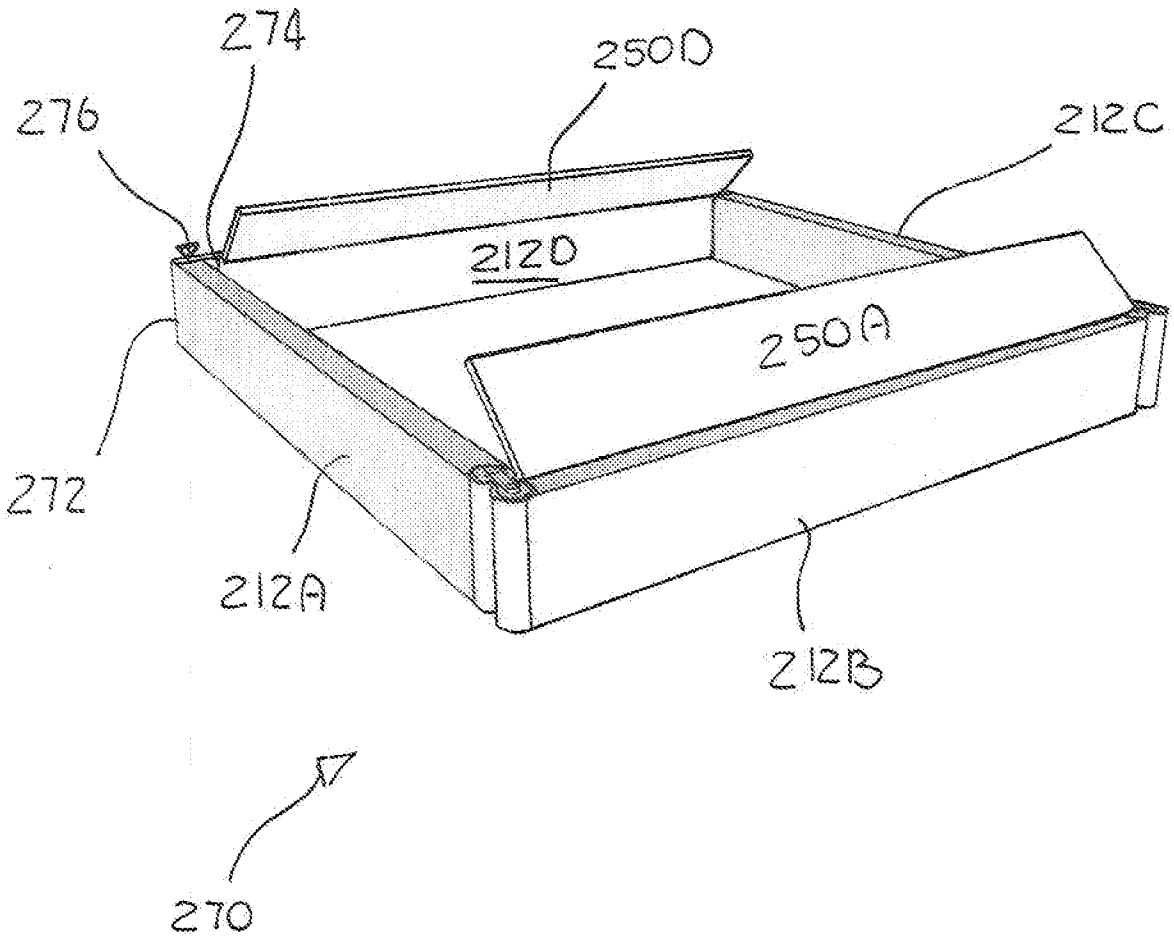

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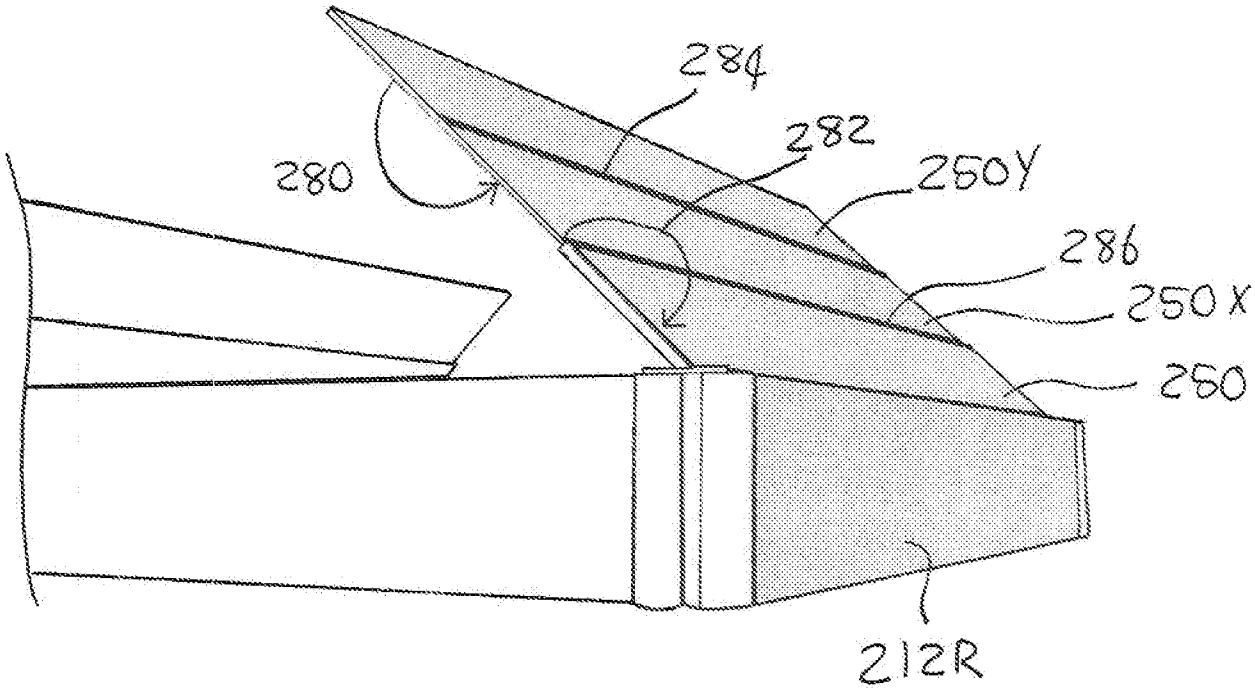

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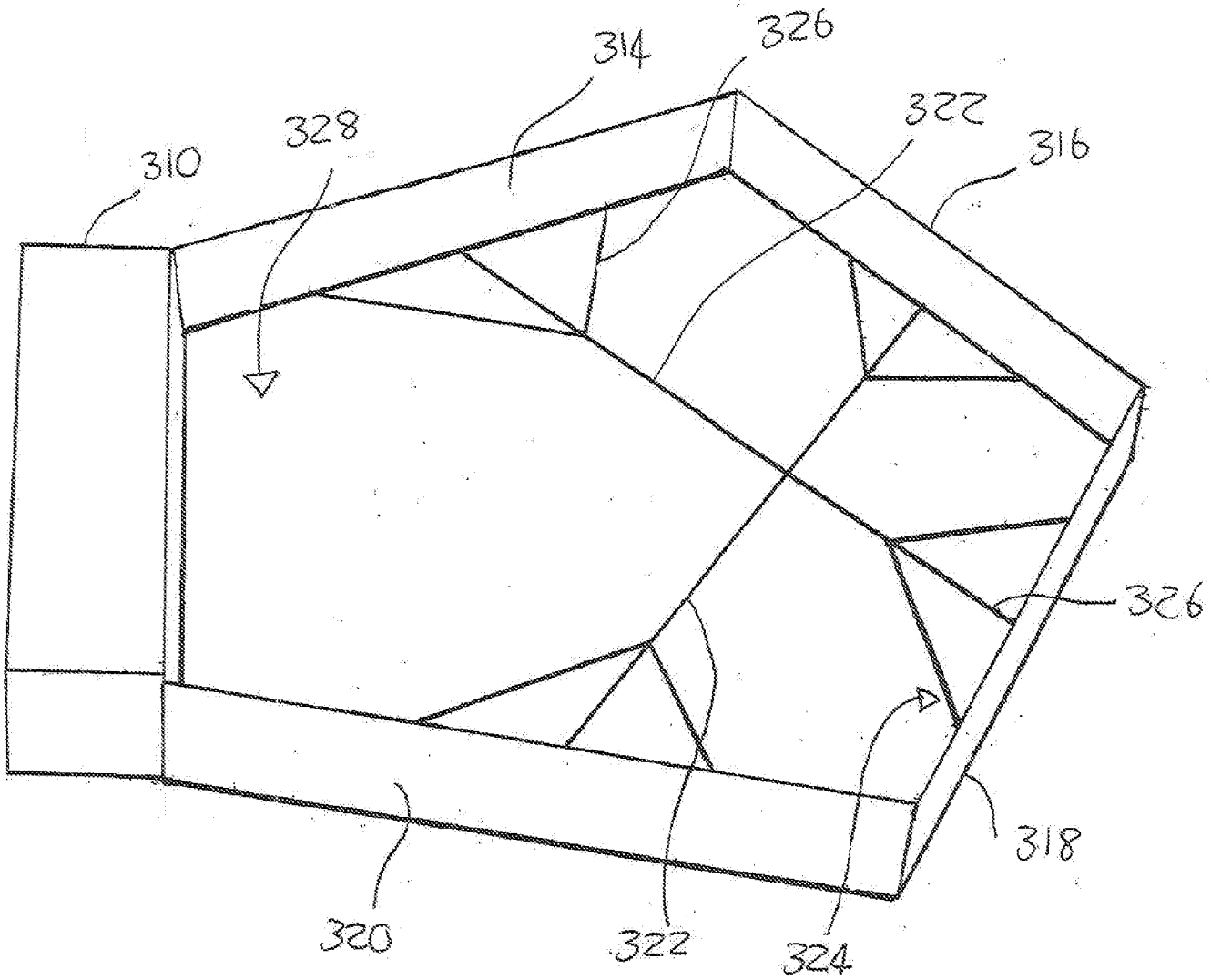

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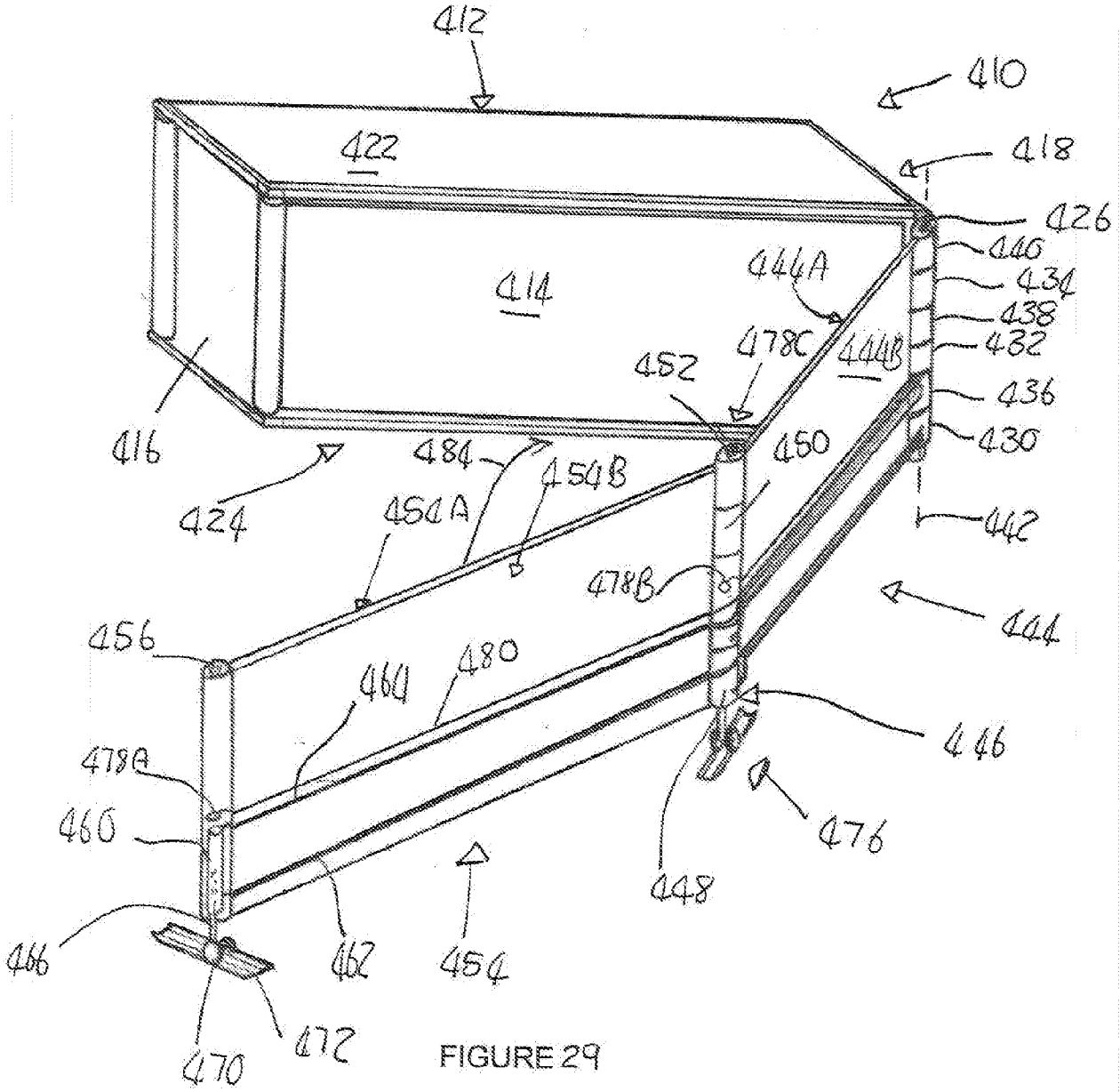

FIGURE 29

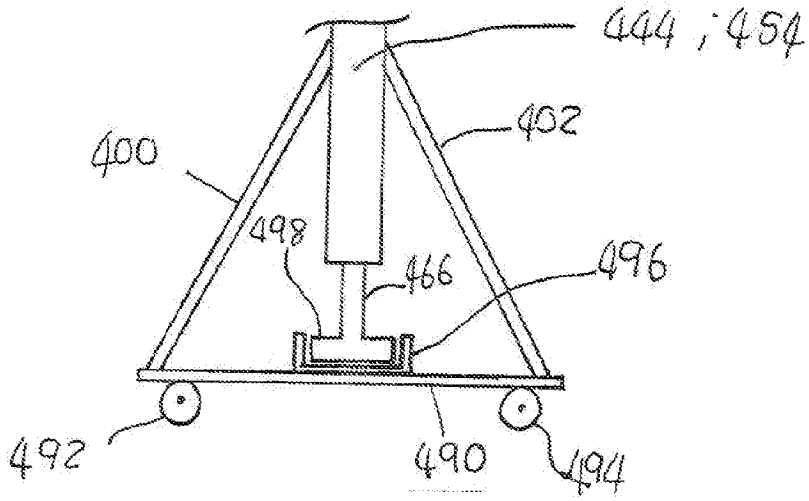

FIGURE 30

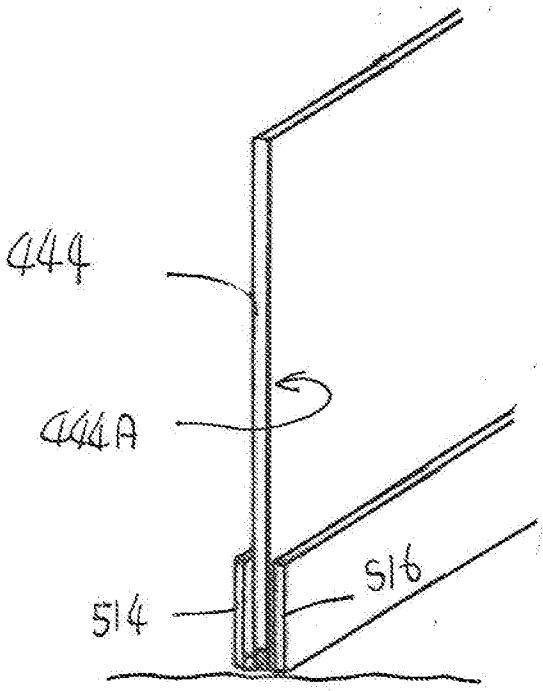

FIGURE 31

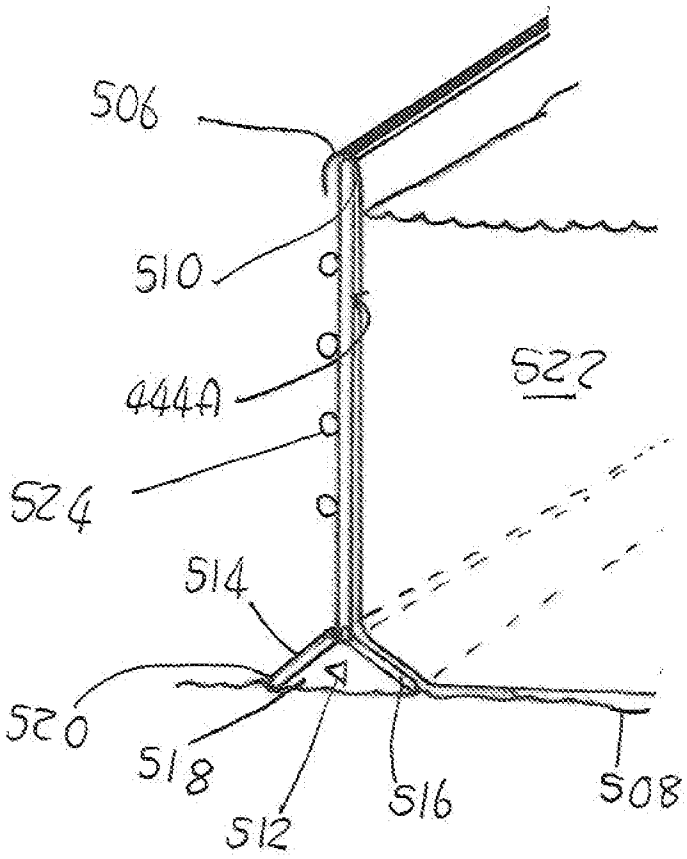

FIGURE 32

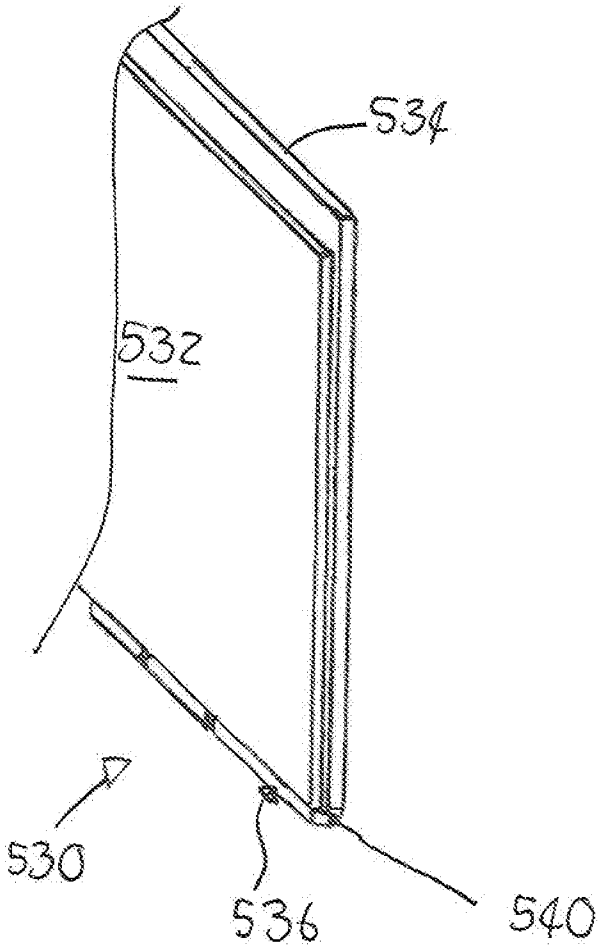

FIGURE 33

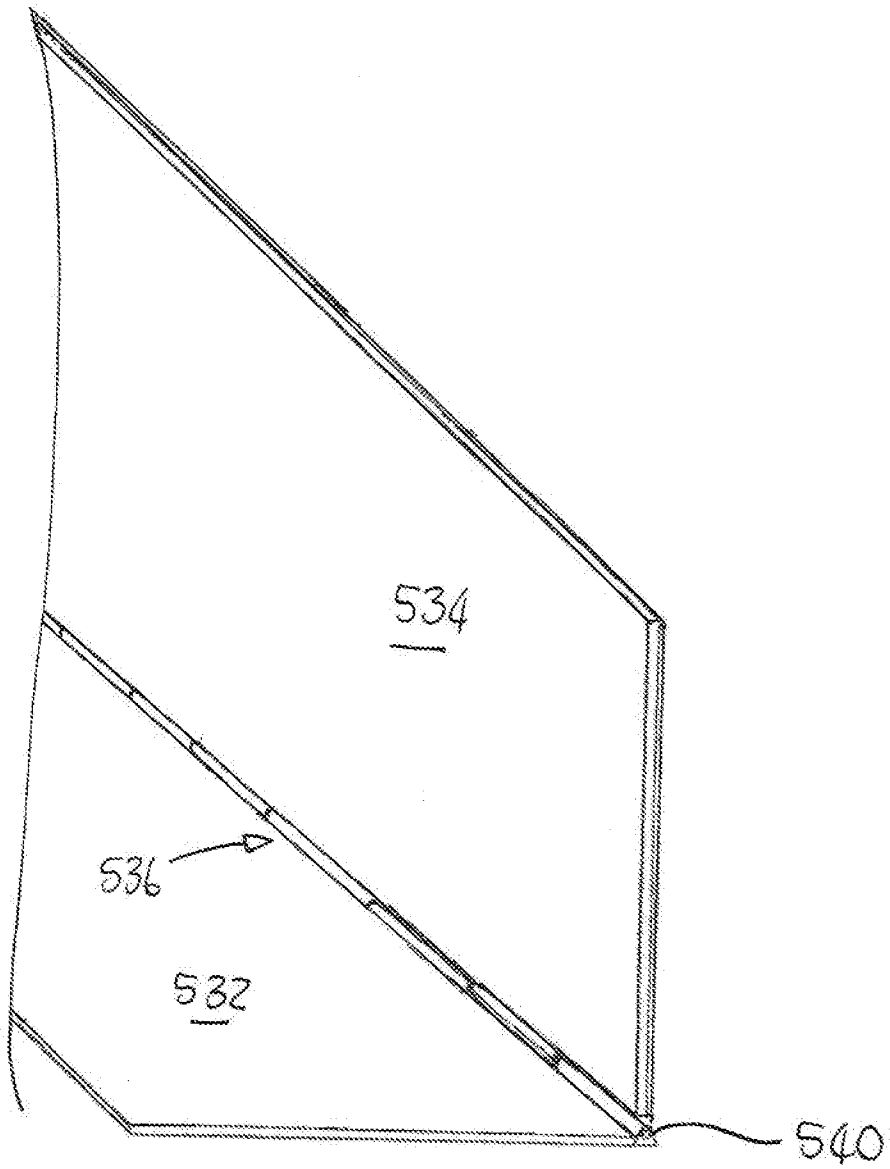

FIGURE 34

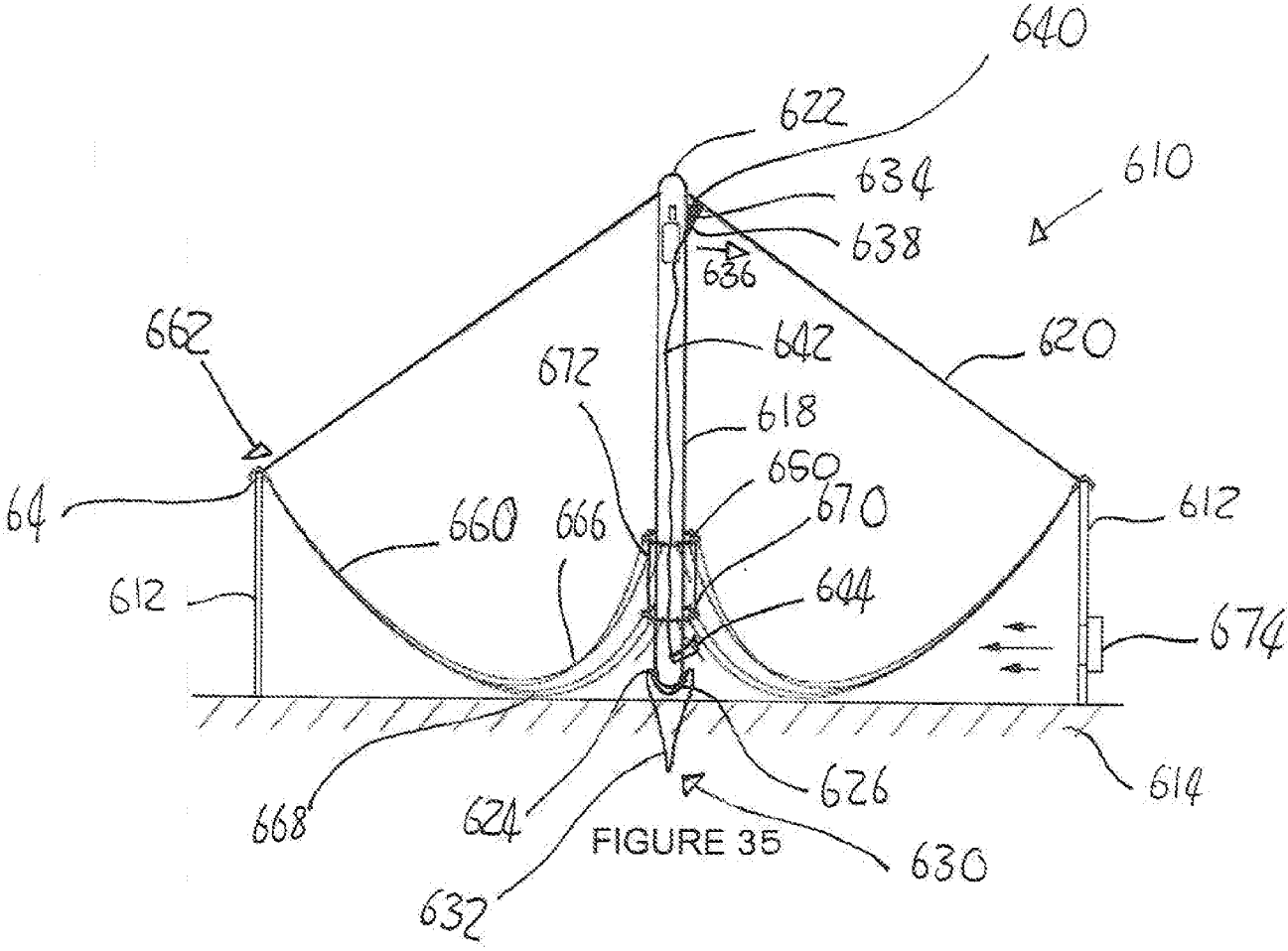

FIGURE 35

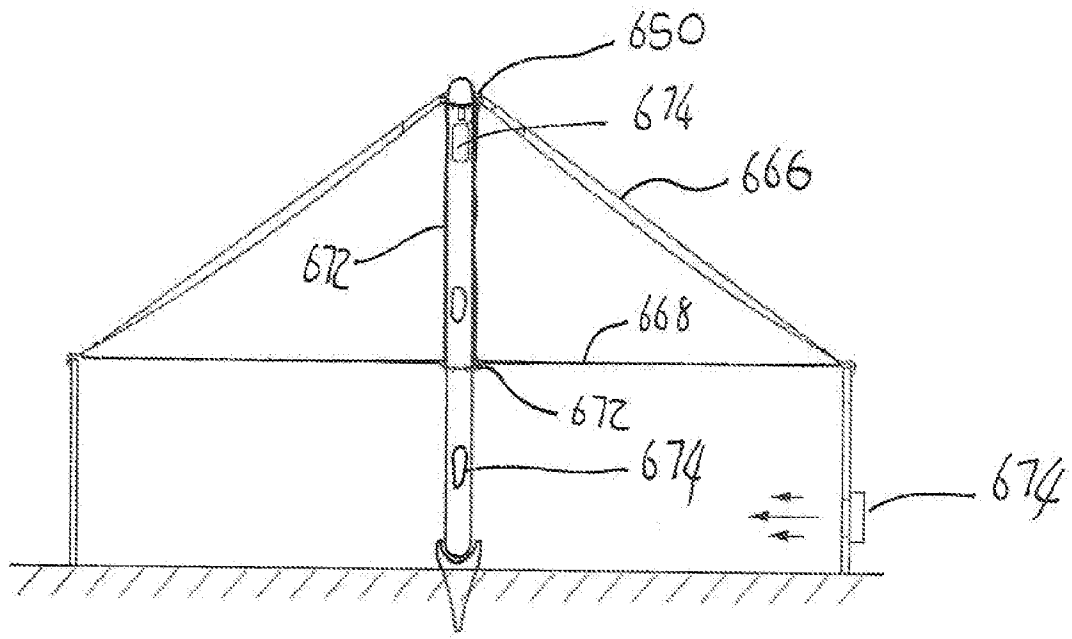

FIGURE 36

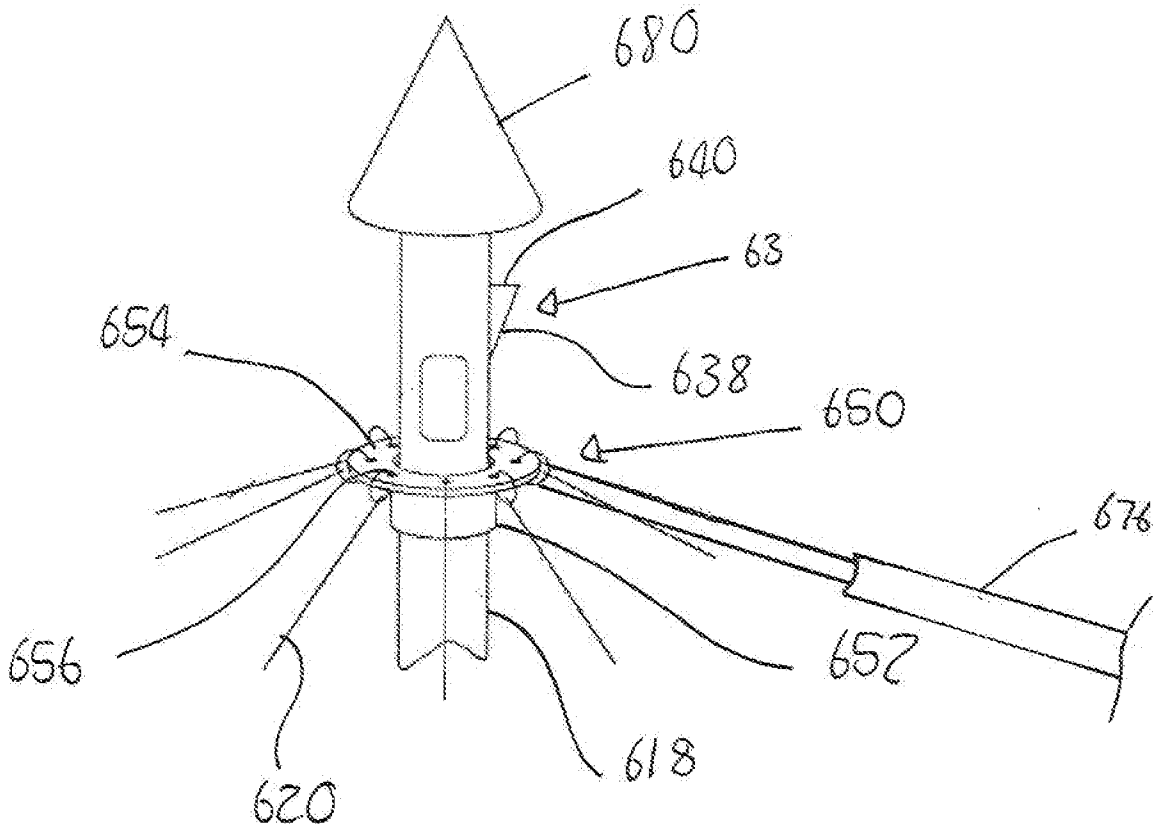

FIGURE 37