



(11) **EP 3 485 117 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention
of the grant of the patent:

27.09.2023 Bulletin 2023/39

(21) Application number: **17828569.8**

(22) Date of filing: **14.07.2017**

(51) International Patent Classification (IPC):

E04H 9/14 (2006.01)	E06B 7/14 (2006.01)
E06B 3/38 (2006.01)	E06B 5/00 (2006.01)
F24F 7/04 (2006.01)	E21F 1/08 (2006.01)
E02B 7/20 (2006.01)	E02B 7/22 (2006.01)
E02D 19/02 (2006.01)	E05F 1/00 (2006.01)
E05F 5/00 (2017.01)	E06B 7/02 (2006.01)
F24F 13/02 (2006.01)	F24F 13/14 (2006.01)
F24F 7/06 (2006.01)	G08B 5/02 (2006.01)

(52) Cooperative Patent Classification (CPC):

E21F 1/08; E21F 1/003; E06B 2009/007;
F24F 13/02

(86) International application number:

PCT/US2017/042234

(87) International publication number:

WO 2018/013981 (18.01.2018 Gazette 2018/03)

(54) **FLOOD PROTECTION FOR UNDERGROUND AIR VENTS**

HOCHWASSERSCHUTZ FÜR UNTERIRDISCHE BELÜFTUNGSÖFFNUNGEN

PROTECTION CONTRE L'INONDATION POUR ÉVÉNEMENTS D'AÉRATION SOUTERRAINS

(84) Designated Contracting States:

AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR

(30) Priority: **15.07.2016 US 201662363024 P**

(43) Date of publication of application:

22.05.2019 Bulletin 2019/21

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Description

BACKGROUND OF THE DISCLOSURE

Technical Field

[0001] This invention relates to blocking flooding water from entering underground ventilation passages.

Background Art

[0002] Surface storm waters entering and flooding underground tunnels and chambers through ventilation ducts connecting the underground chambers or tunnels to air at ground surface affect without limitation, underground transportation tunnels for road vehicles, trains, and subways, and underground chambers, such as associated with a complex of connecting tunnels and shafts, for example as used for such things as underground hydroelectric-power plants, or with underground utilities which require ventilation, such as underground transformer rooms.

[0003] In a typical subway ventilation arrangement, ventilation ducts or shafts are incorporated into subway systems near stations to exhaust stale pushed air as the train nears a station and to pull in fresh outside air as a train leaves a station, also reducing the "piston effect" of air being forced through the tunnels at high speeds by moving trains. Typically, a ventilation duct communicates from an underground tunnel and terminates in a ventilation shaft structure below grade level that opens to the atmosphere at grade level such as a sidewalk where the opening is covered by a subway grating.

[0004] Subways have systems for handling water. When it rains, water runs down stairwells, onto platforms and thence onto tracks, and some gets in the ventilation systems through the surface gratings. Drains beneath the tracks pipe water to underground sumps in pump rooms next to the subway tracks. Pumps pull the water up to pressure relief manholes open to the atmosphere at street level; from there the water drains under gravity flow into city storm sewers. The problem is that in heavy rains, storm sewers are overwhelmed and flush water back into the streets, flooding the streets with water inundates sidewalks and pours down through subway gratings into the ventilation system thence into the tunnels and onto the tracks. The pumping system can only return water to the flooded street; from there the water reenters the flood pool pouring into the ventilation system, defeating the pumping system as a means of controlling subway flooding. The problem is especially acute in cities like New York and Lower Manhattan, which is low-lying, vulnerable to storm surges and dotted with grade-level gratings, stairwells and other points of entry for running water into the subways.

[0005] One solution for reducing entrance of runoff water from sidewalk grating openings through the ventilation ducts down into the underground systems was raising

the subway ventilation gratings above sidewalk level, as was done in some locations in New York City in Manhattan, Queens and Brooklyn after flooding from a severe rainstorm in 2007. This not only was costly to implement but also sacrificed much of the available sidewalk area available for pedestrians. In advance of the super storm Sandy in 2013, when predicted storm surge and high tides in addition to heavy rains signaled flooding of subways, workers resorted to sandbags and fastening plywood covers over subway ventilation gratings to try to prevent flooding. Sandy was testament to flood hazards of subways and vented subterranean structures. Fastening plywood covers over large numbers of air vent gratings in a short period of time as a solution is an imperfect labor and materials intensive process and can be too little too late, as was made clear by subway flooding from Sandy. A simpler, faster, relatively inexpensive and more effective method of preventing flooding through sidewalk air vent gratings is needed.

WO 2015/051352 describes apparatus for allowing ventilation as usual for underground tunnels through a ventilation shaft opening to atmosphere yet preventing underground flooding from surface waters pouring through the grate. The apparatus comprises an assembly that fits within the ventilation shaft and includes one or more panels held in an upright home position that allows ventilation as usual but is releasable to rotationally gravitate to a lower sealing position closing a passage between the ventilation shaft and atmosphere to prevent water from entering the underground tunnels. A panel position indicator moves from a hidden position to a visible position with lowering of the panels to visually signify that the panels are lowered and that flooding protection is activated. The present invention is set out in the appended claims.

DESCRIPTION OF DRAWINGS

[0006]

FIG. 1 is an isometric view of a quadrilateral (four sided) support structure for receiving the embodiment of FIG. 5

FIG. 2 is a top plan view of the quadrilateral embodiment of FIG. 1.

FIG. 2A is a cross section view of the quadrilateral embodiment of FIG. 1 taken along the lines 2A-2A of FIG. 2.

FIG. 3 is an isometric view of the panel assembly of FIG. 5 received in the quadrilateral support of FIGS. 1, 2 and 2A viewed in this perspective from a left side. FIG. 4 is an isometric view of the panel assembly of FIG. 5 received in the quadrilateral support of FIGS. 1, 2 and 2A rotated 180 degrees from the view of FIG. 3, that is, it is a view of the opposite side of FIG. 3 (the right side).

FIG. 5 is an isometric top view of a liftably removable panel assembly with panels in lowered position.

FIG. 6 is an enlargement of the portion of FIG. 5

shown in dashed lines indicated by the reference numeral 6.

FIG. 7 is an enlargement of the portion of FIG. 5 shown in dashed lines indicated by the reference numeral 7.

FIG. 8 is an enlargement of the portion of FIG. 5 shown in dashed lines indicated by the reference numeral 8.

FIG. 9 is an alternative embodiment to FIG. 6.

FIG. 10 is an alternative embodiment to FIG. 7.

FIG. 11 is a frontal graphic showing the panels of FIG. 5 in lowered position in place in the support of FIG. 1

FIG. 12A is an isometric view of the top side of an embodiment of a panel on the right side of the embodiment of FIG. 5, from the same perspective as in FIG. 5.

FIG. 12B is an isometric view of the bottom side of the embodiment of the panel of FIG. 10A.

FIG. 13A is an isometric view of the top side of an embodiment of a panel on the left side of the embodiment of FIG. 5, from the same perspective of the panel as in FIG. 5.

FIG. 13B is an isometric view of the bottom side of the embodiment of a panel of FIG. 13A.

FIG. 14 is an isometric view of the embodiment of FIGS. 3 and 5 presenting a view of the bottom of the embodiment.

FIG. 14A is an enlarged view of the bottom part of FIG. 14.

FIG. 15 is a perspective bottom view of the embodiment of FIGS. 3 and 5 showing lift arms with stays engaged.

FIG. 16 is a rear view of the stay and lift arm of the embodiment of FIGS. 14, 14A and 15.

FIG. 17 is a shadow view of the arrangement of lift arm and stay of FIG. 16.

FIG. 18 is a perspective bottom view of the embodiment of FIGS. 3 and 5 showing the lift arms with the stays released.

FIG. 19 is a top plan view of the embodiment of FIG. 4.

FIG. 19A is a cross sectional view of the embodiment of FIG. 19 taken along the line 19A-19A of FIG. 19 showing the lift arms with the stays engaged.

FIG. 20 is a top plan view of the embodiment of FIG. 19 showing the panels partially raised and the lift arms with stays released.

FIG. 20A is a cross sectional view of the embodiment of FIG. 20 taken along the line 20A-20A of FIG. 20 showing the lift arms with the stays released.

FIG. 21 is a top plan view of the embodiment of FIG. 19 showing the panels completely raised and the lift arms relaxed after deployment completing rotation of the panels to home position.

FIG. 21A is a cross sectional view of the embodiment of FIG. 19 taken along the line 21A-21A of FIG. 21 showing the panels completely raised and the lift

arms relaxed after deployment completing rotation of the panels to home position.

FIG. 22 is a top plan view of variations of the panel assembly of FIG. 5 and the cradle support of FIG. 1 (panels shown raised in home position).

FIG. 22A is a cross section viewed along the line 22A-22A of FIG. 22 showing a variant of the end of the beam portion of the panel assembly of FIG. 5.

FIG. 23 is a top plan view of variations of the panel assembly of FIG. 5 and the cradle support of FIG. 1 (panels shown raised in home position).

FIG. 23A is a cross section viewed along the line 23A-23A of FIG. 23 showing a variant of the end of the beam portion of the panel assembly of FIG. 5.

FIG. 24 is a perspective of the variant depicted in cross section in FIG. 23A.

FIG. 25 is a front elevation view of a cradle variant of the support of the embodiment of FIGS. 1-4.

FIG. 26 is a perspective view of the cradle variant depicted in FIG. 23.

FIG. 27 is a side elevation view of the cradle variant depicted in FIG. 23.

FIG. 28 is a top plan view of the cradle variant depicted in FIG. 23.

FIG. 29 is a cutaway isometric view of the panel assembly variant of FIG. 5 showing the cradle support variant of FIGS. 25-28 supporting a truncation of the variant assembly of FIG. 5.

FIG. 30 is a top plan view showing the variant of FIGS. 23A and 24 in place in the cradle variant support of FIGS. 25-28.

FIG. 31 is a perspective bottom view of an embodiment with some components removed showing the position of the variant panel assembly of FIG. 5 as it is lowered into place into the cradle of FIGS. 25-28 and into a lower support anchorage depicted in FIGS. 35-37.

FIG. 32 is a front elevation of a lower connector plate for the variant assembly of FIG. 5.

FIG. 33 is a side elevation view of the connector plate of FIG. 32.

FIG. 34 is a perspective view of the connector plate of FIG. 32.

FIG. 35 is a front elevation of an anchor bar for the variant assembly of FIG. 5

FIG. 36 is a side elevation view of the anchor bar of FIG. 35.

FIG. 37 is a perspective view of the anchor bar of FIG. 35.

FIG. 38 is a perspective bottom view with some components removed showing the position of the variant assembly of FIG. 5 in place in the cradle of FIGS. 25-28 and anchored in place in the lower anchorage support depicted in FIGS. 35-37.

FIG. 39 is a top plan view of the connector plate of FIGS. 32-34 anchored in place in the lower anchorage support depicted in FIGS. 35-37.

FIG. 40 is a top plan view of the panel of FIG. 10A.

FIG. 41 is a cross sectional view of the panel of FIG. 40 taken along the line 40-40 of FIG. 40.

FIG. 42 is an enlargement of the area indicated by "42" in FIG. 40.

FIG. 43 is a side elevational view of the panel of FIG. 40 showing the position of a plug assembly by dashed lines in raised and partially lowered positions and in solid lines in fully lowered position.

FIG. 44 is an isomeric view of a plug assembly part of the panel of FIG. 40.

FIG. 45 is a top plan view of the plug assembly of FIG. 44.

FIG. 45A is a cross section of the plug assembly of FIG. 44 taken along the line 45A-45A of FIG. 45.

FIG. 45B is a top plan and side view of a top plate component of the plug assembly of FIG. 44 better seen in the cross section view of FIG. 45A.

FIG. 45C is a top plan and side view of a bottom plate component of the plug assembly of FIG. 44 better seen in the cross section view of FIG. 45A.

FIG. 45D is a top plan and side view of a concave sealing gasket of the plug assembly of FIG. 44 better seen in the cross section view of FIG. 45A.

FIG. 46 is a top plan and side elevational view of a plug arm of the plug assembly of FIG. 44 also seen in the top plan view of FIG. 345 and the cross sectional view of FIG. 45A.

FIG. 47 is a cross sectional view of a variation of a plug assembly in place on a panel.

FIG. 48 is a cross sectional view of the plug arm portion of the plug assembly of FIG. 47.

FIGS. 49A, 49B and 49C are respectively side, frontal and perspective views of a tool for manual raising of components of embodiments of the invention.

FIG. 50 is a top plan view of a single panel assembly received in a quadrilateral support showing the panel deployed in a passage closed position.

FIG. 50A is a cross sectional view of the embodiment of FIG. 40 taken along the line 50A-50A of FIG. 50.

FIG. 51 is a top plan view of a single panel assembly received in a quadrilateral support showing the panel completely raised to home position

FIG. 51A is a cross sectional view of the embodiment of FIG. 51 taken along the line 51A-51A of FIG. 51.

DESCRIPTION OF EMBODIMENTS

[0007] In accordance with this invention apparatus for installation in a ventilation shaft already fluidly communicating between an atmospheric opening and an underground ventilation duct allows the ventilation when there is no threat of flooding and on threat of flooding is manually operable to close ventilation from the atmospheric opening and prevent downward flow into the underground ventilation duct of surface water entering the atmospheric opening.

[0008] The concepts embodied in the exemplary embodiments of such apparatus described herein have ap-

plication to any system in which an atmospheric opening communicates with a ventilation duct for an underground chamber or tunnel or other underground structure requiring ventilation, and through which opening substantial volumes of water can enter, whether by heavy rain or by storm surge propelled by hurricane or tropical storm or otherwise.

[0009] In the descriptions of exemplary embodiments of the invention that follow, reference is made to the accompanying drawings, which form a part hereof and in which are shown, by way of illustration, specific embodiments in which the invention may be practiced. Specific details disclosed herein are in every case a non-limiting embodiment representing concrete ways in which the concepts of the invention may be practiced. This serves to teach one skilled in the art to employ the present invention in virtually any appropriately detailed system, structure or manner consistent with those concepts. It will be seen that various changes and alternatives to the specific described embodiments and the details of those embodiments may be made within the scope of the invention. Because many varying and different embodiments may be made within the scope of the inventive concepts herein described and in the specific embodiments herein detailed, it is to be understood that the details herein are to be interpreted as illustrative and not as limiting.

[0010] The various directions such as "upper," "lower," "bottom," "top," "transverse," "perpendicular," "vertical," "horizontal," and so forth used in the detailed description of embodiments are made only with respect to easier explanation in conjunction with the drawings. The components may be oriented differently while performing the same function and accomplishing the same result as the embodiments herein detailed embody the concepts of the invention, and such terminologies are not to be understood as limiting the concepts which the embodiments exemplify.

[0011] The term "perpendicular" means substantially at a right angle to a reference to a degree that if not absolutely a right angle will not materially adversely affect the arrangement and function of the element described as perpendicular. The terms "vertical" or "vertically" include but are not limited to literal vertical and generally mean oriented up and down with respect to the earth's horizon to a degree that if not absolutely vertical will not materially adversely affect the function of the element described as vertical. Similarly, the terms "horizontal" or "horizontally" include but are not limited to literal horizontal and generally mean not out of level with respect to the earth's horizon to a degree that will materially adversely affect the function of the element described as horizontal.

[0012] As used herein, the use of the word "a" or "an" when used in conjunction with the term "comprising" (or the synonymous "having" or "including") in the claims and/or the specification may mean "one," but it is also consistent with the meaning of "one or more," "at least

one," and "one or more than one." In addition, as used herein, the phrase "connected to" means joined to or placed into communication with, either directly or through intermediate components.

[0013] For components of described embodiments that are the same, in some cases the first mentioned component is identified by a given reference numeral, and the second such component is the same reference number marked with an apostrophe, for example "panel handle 259" identifies a first mentioned component, and the second such like component is identified as "panel handle 259' ". Coupling the two reference numerals separated by a coma, for example "panel handles 259, 259' " means either component "panel handle 259" or "panel handle 259' " is being described unless the context means both are being described together.

[0014] For illustrative purposes of an application of the concepts herein disclosed for blocking entrance of water into a ventilation duct, the embodied concepts are described in reference to a specific ventilation environment. The exemplary application is for a subway system. In the specific embodiments described herein as examples, it is assumed the atmospheric opening through which flooding waters enter has a rectilinear shape, as for grating covered grade level sidewalk openings for subway ventilation systems, which at least in New York City typically are rectangular. Although the detailed descriptions of specific embodiments relate to a rectilinear shape and for a particular environment, the invention does not require that the opening be rectilinear or that embodiments of the invention conform to a rectilinear shape or that the atmospheric opening be at grade level. The elements of the invention can be configured to fit within downwardly vertically projected dimensions of any ventilation shaft surface opening serving any underground tunnel, chamber, room or other underground structure, whether rectilinear, circular or oval or some other shape.

[0015] In the descriptions of exemplary embodiments that follow, the passage closing position is one in which the panel or panels of the embodiments are horizontal. The concept of the invention is not limited to this disposition. Restrains or stops for stopping panel lowering may be positioned to stop the downward travel above horizontal and still close a ventilation passage. The described embodiments are non-limiting illustrations of examples in which the concepts of the invention may be implemented.

[0016] The exemplary embodiments of the invention comprise a ventilation shaft manual closure assembly. Support for the exemplary assembly embodiment includes opposed lateral sidewalls for arrangement in a vertical ventilation shaft to an underground ventilation duct fluidly communicating through the ventilation shaft to an atmospheric opening of the shaft. The atmospheric opening may be cylindrical and the support cylindrical. The atmospheric opening may be rectilinear and the support quadrilateral. As mentioned, in the exemplary embodiments, the atmospheric opening is rectilinear.

[0017] The support inclusive of the lateral sidewalls is sized to internally fit in the vertical shaft between the ventilation duct and the atmospheric opening. In an embodiment, the support has horizontal flanges transverse to the sidewalls for projection across a top of the shaft to hang the support in the shaft. The support defines a passage between top and bottom openings of the support for fluid communication of the ventilation duct up through the support to the atmospheric opening.

[0018] In an exemplary embodiment, one or more downwardly rotatable panels may be used, mounted in an upright home position not obstructing the ventilation passage that fluidly communicates the underground ventilation duct with the atmospheric opening of the ventilation shaft, to allow ventilation as usual when there is no flooding threat. In one exemplary embodiment, a single panel is mounted in the home position to a side of such a passage to alone gravitationally fall from home position to a passage closing position across the entirety of the passage to protect the underground ventilation duct from flooding. In another exemplary embodiment, a pair of panels is mounted on opposite sides of the passage, to gravitationally fall from home position down toward each other to passage closing positions to combine to close the passage. In yet another exemplary embodiment, a pair of panels is mounted centrally in the passage for rotation of the panels in directions opposite each other from the home position to a lower passage closing position. An advantage of paired panels is that they may be used to close a passage that is wider than it would be feasible for a single taller panel to close.

[0019] The manual closure assembly comprises one or more panels having proximal and distal ends, a top side and a bottom side. The proximal end connects with a horizontal hinge having an axis perpendicular to the opposed lateral sidewalls for manual rotation of a panel upwardly to an upright home position not obstructing the passage and rotation from the home position downwardly solely by gravitational impetus of its own weight to reach a lower passage closing position. The one or more panels have a profile that closes the passage when each panel gravitationally rotates to the passage closing position.

[0020] In an exemplary embodiment, a panel holder for holding each panel in the upright home position comprises a moveable member carried either by a panel or by the suspension member below the suspension member, and a non-moveable member carried by the other of the panel or the suspension member not carrying the moveable member, the moveable member capturing and holding the nonmoving member when the panel is rotated upwardly to the home position. The embodiment further comprises a panel releaser for the panel holder comprising linkage connected to the moveable or non-moveable panel holder member carried by the suspension member, the linkage being vertically moveable relative to the suspension member to translate the moveable or non-moveable member to cause it to release the panel from the upright home position and allow the panel to gravitation-

ally rotationally fall to the lower passage closing position. In an exemplary embodiment the nonmoveable member of the panel holder comprises a latch catch and the moveable member of the panel holder comprises a latch engageable with the latch catch.

[0021] At least one restraint limits the downward rotation of each panel to the lower passage closing position. The restraint may be one or more foldable or flexible members anchored at one end to an upper portion of a suspension member (next mentioned) and fastened at the other end to the topside of a panel, or it may comprise one or more stops that do not obstruct the passage and that are located within and connected to the support proximate the bottom opening.

[0022] In an exemplary embodiment, adjacent sidewalls include a base having rounded corners with a first radius of curvature and in which the distal portions of the panels have rounded corners with a radius of curvature substantially the same as the first radius of curvature of the sidewall corners they sweep when rotating to the passage closing position. In an exemplary embodiment, the panels include seals for sealing the passage in the passage closing position.

[0023] In an exemplary embodiment, means are provided for manually rotating the panels to home position, including a panel handle on the top side of the one or more panels for manually rotationally raising the one or more panels from the passage closing position toward the home position, and a lift arm for each panel, each lift arm having a proximal end pivotally connected by pivot pin to the bottom side of a panel on a pivotation axis parallel to the hinge axis and a distal end optionally comprising a terminal round, suitably a wheel. Each lift arm has a dimension allowing it to contact the terminal round with one of the opposed lateral sidewalls when the distal end is pivoted upward inside the sidewall for exertion of lateral force onto the connected panel being raised with the panel handle to complete rotation of the panel into the home position.

[0024] In an exemplary embodiment, the lift arms are spring biased to force the distal ends rotationally outwardly and upwardly. In an exemplary embodiment, a spring is centrally coiled around the lift arm pivot pin. The spring terminates on opposite first and second ends and has a straight portion comprising a proximal shank and a distal portion bent at a right angle to the shank. The distal portion of the first end extends engagingly across an underside of the lift arm proximate the pivot pin and the distal portion of the second end extends engagingly across a topside of the lift arm more distant from the pivot pin than the distal portion of the first end.

[0025] In an exemplary embodiment, a releasable stay is provided for each lift arm. A stay pivot pin adjacent the lift arm pivot pin pivotally connects an upper end of each stay. A lower end of the stay angles outwardly toward an adjacent lift arm to extend across and releasably contact a proximal portion of the top side of the lift arm. The spring bias presses the lift arms against the stays, restraining

the lift arms from rotation outwardly and upwardly.

[0026] The stay is releasable by a reach tool vertically lowered from the atmospheric opening, allowing the spring biased distal end of the lift arm to pivot laterally outward for capture by the reach tool reach tool vertically lowered from the atmospheric opening.

[0027] In an exemplary embodiment each lift arm has a configuration at an bottom portion of the arm for engagement by a reach tool vertically lowered from the atmospheric opening to engage and pivotally pull the stay released lift arm upwardly such that the distal end of the arm travels upward on the sidewall. In an exemplary embodiment, the distal end is a round, optionally a wheel.

[0028] A suspension member unobstructively horizontally spans the passage proximate the support top opening and holds the one or more hinge connected panels in the passage. The suspension member is supported on the opposed lateral sidewalls proximate the support top and bottom openings. The suspension member has at least one handle connected to the suspension member for holding the suspension member to move it vertically into or out from the supports on the opposed lateral sidewalls. The suspension member may comprise a single unitary vertically extending member holding the horizontal hinge and the panels connected to the hinge, or may comprise a beam having vertically hung straps holding the horizontal hinge and the panels connected to the hinge.

[0029] In an exemplary embodiment, the horizontal hinge comprises a hinge mounting member held by the suspension member and a plurality of hinge members mounted on the hinge mounting member. In an exemplary embodiment, each hinge member comprises a stationary member, a moveable member and a hinge pin interconnecting the stationary and moveable members, the stationary member connecting to the hinge mounting member, and the moveable hinge member connecting to the proximal end of a panel. The horizontal hinge may also comprise a continuous hinge, sometimes called a piano hinge, or any other hinge comprising a moveable joint that connects two linked panels and on which the panels may raise and lower.

[0030] In an exemplary embodiment, the suspension member is liftably removably supported centrally between the opposed lateral sidewalls, and suspends a pair of panels in the ventilation passage for rotation of the panels in directions opposite each other from or to said upright home position. In an exemplary embodiment, the atmospheric opening is rectilinear and said support is quadrilateral, the opposing sidewalls each attach centrally in the ventilation passage adjacent the top opening of the shaft a cradle having a pair of spaced apart parallel vertical arms connecting to and standing upright on a horizontal bar for liftably removably receiving and supporting the beam within such vertical arms and on the horizontal bar.

[0031] In an exemplary embodiment, a quadrilateral support has at least one indicator on at least one sidewall

adjacent the opposed lateral sidewalls to indicate where structure on a panel is located below the indicator. In such embodiment, the suspension member has ends each of which bears a key extending laterally past a side of the suspension member and each cradle is keyed to receive the key only in one arm of the cradle so a the panel having that structure is located below the indicator

[0032] In an exemplary embodiment employing such suspension support cradles, such centrally supported suspension member may comprise a beam having vertically hung straps holding the horizontal hinge and the panels connected with said horizontal hinge. Such beam has ends, lateral sides between the beam ends, and a quadrilateral beam end plate attached to each beam end. Each beam end plate has lateral sides extending laterally past the lateral sides of the beam ends. The cradles each comprise a vertical included right angle between vertical mutually perpendicular projections of the vertical arm, one projection of each vertical arm attaching to one of the opposed sidewalls. The other projection of each vertical arm is unattached to such one sidewall. Such unattached projections and the included right angles of the vertical arms face each other. The attached projections are spaced apart sufficiently for vertically receiving the beam end plate within the pair of vertical arms. In an exemplary embodiment having such cradles and beam end plates, one side of the lateral sides of each beam end plate extends laterally further than the other lateral side of such beam end plate, and one unattached projection of one vertical arm of a cradle has a length longer than the unattached projection of the other vertical arm of that cradle for accepting the lateral side of the beam end plate that extends further than the other lateral side of that beam end plate, thereby to receive the beam end plate within the pair of vertical arms.

[0033] In an exemplary embodiment, the quadrilateral support has at least one indicator on at least one sidewall adjacent the opposed lateral sidewalls. The indicator indicates that certain structure on a panel is to be located below the indicator. The longer side of the beam end plates and the longer inset of the vertical arms accepting only the longer side of the end plates allow the beam to be horizontally placed in the cradles only in an orientation placing the particular panel having that structure below the indicator when the panel is in the passage closing position.

[0034] In an exemplary embodiment in which the beam support cradles allow the beam to be positioned only in one horizontal orientation, the hinge mounting member has ends, lateral sides between the hinge mounting member ends, and a quadrilateral hinge mounting member end plate attached to each hinge mounting member end. The hinge mounting member end plates each have lateral sides extending laterally past the lateral sides of the hinge mounting member ends. The opposing sidewalls each attach a pair of spaced apart horizontal anchor bars centrally in the passage below the cradle and adjacent the bottom opening. Each anchor bar comprises an

included right angle between mutually perpendicular horizontal projections of unequal length, the shorter projection of each anchor bar attaching to one of the opposed sidewalls, the longer projection of that anchor bar being unattached to the one sidewall. The unattached projections and the included right angles of the anchor bars face each other. The attached projections are spaced apart sufficiently to vertically receive the hinge mounting member end plate within the pair of anchor bars. Thus where the quadrilateral support has at least one indicator on at least one wall adjacent the opposed lateral sidewalls to indicate that structure on a panel is located below the indicator, the beam end plate, the cradle vertical arms, the hinge mounting member end plate and the anchor bars cooperatively orient placement of the beam and the hinge mounting member hung from the beam so a panel having that structure will be located below the indicator when the panel is in the passage closing position.

[0035] In an exemplary embodiment, a drain is provided in at least one of the one or more panels intermediate the proximate and distal ends thereof. The drain comprises a conduit such as a hollow tube passing through the panel. The conduit has an opening at the panel top side. The drain includes a self actuating drain closure. The closure comprises a plug pivoting rotatably on a drain plug axis positioned between the drain tube and the distal end of the panel having the drain. The drain plug axis parallels the horizontal hinge axis of the panels. The plug is manually pivotable upwardly on the drain plug axis to remove the plug from the drain opening to drain water contained above the one or more panels when the one or more panels is in the passage closing position. The plug by gravitational impetus of its own weight automatically pivots downward to place the plug in the conduit opening when the panel containing the drain is pivotally raised upward to the home position. Then when the panel gravitationally rotates downwardly to the passage closing position, the drain opening is already closed.

[0036] In an exemplary embodiment, the self actuating drain closure plug includes an upwardly concave sealing gasket around the plug periphery to seal any space between the plug periphery and the conduit opening when the panel containing the plug is in the passage closing position.

[0037] In an exemplary embodiment a panel containing a self actuating drain closure has spaced posts fixedly mounted to the top side of the panel between the drain and the distal end of each the panel. The drain plug axis comprises a rod spanning between the posts supported by the posts parallel to the horizontal hinge axis and above the panel top side. The drain closure comprises a plug arm pivotally rotatable at a proximal end of the arm with or on the rod for movement of the arm to a raised drain opening position and to a lowered drain closing position. The rod may be fixed to the posts with the plug arm rotating on the rod, or the plug arm may be fixed to the pivot axis rod with the rod rotating in the posts. The

plug arm is weighted to place the center of gravity of the plug arm remotely from the rod. The plug arm comprises an attachment projection remote from the rod, an upwardly concave sealing gasket, a top plate and a bottom plate. The top and bottom plates are both smaller in size than the gasket. The concave sealing gasket is secured between the top and bottom plates, at least the bottom plate being of size configured to enter and plug the conduit opening. The plates expose an outer upwardly concave gasket portion extending above the bottom plate. The plates are fixedly connected to the arm at the attachment projection locating the center of gravity of the arm remotely past the pivot axis of the rod in the direction of the drain, so that after a plug arm is raised from the drain opening to empty water above the panel while the panel is in the passage closing position, rotating the panel upwardly toward the home position causes the plug arm solely by reason of gravity acting on the center of gravity of the raised plug arm, to automatically rotate downwardly from the position raised from draining the panel to a position parallel to the panel, placing at least the bottom plate in the drain conduit opening closing the opening with the outer upwardly concave gasket portion sealing space between the plates and the opening. In an exemplary embodiment the plug arm includes a relief on an underside of the arm distal from the rod for capture of the arm by an arm lifting reach tool.

[0038] Turning now to the drawings, they show exemplary embodiments of an apparatus for preventing downward flow of surface water into an underground ventilation duct fluidly communicating through a ventilation shaft to a rectilinear atmospheric opening of the shaft FIGS. 1-39 show exemplary embodiments having a pair of panels. FIGS. 50-51A show exemplary embodiments having a single panel. Referring initially to FIGS. 4, 5 and 5A, an exemplary embodiment comprises a support embodied in a quadrilateral or four-sided box 210 inclusive of sidewalls 224 (224a, 224b, 224c, 224d) having at the upper extent of the sidewalls flanges 220 (220a, 220b, 220c, 220d) transverse to the sidewalls 224 for extension over a top of walls of a ventilation shaft for suspension of box 210 vertically in the shaft to define a passage 225 between top opening 226 and bottom opening 228 of box 210 for fluid communication of a ventilation duct up through box 210 to an atmospheric opening above top opening 226. Cradles 211a, 211c are formed in the upper sides of opposing sidewalls 224a and 224c respectively. The apparatus shown is suitable as a drop in solution to sealing vent passages from storm waters by lowering it into a ventilation shaft to rest on walls of the shaft. In place, a grating (not pictured) covers top opening 226. In normal operation, operator access to the interior of box 210 is through the grating.

[0039] Although an embodiment as described herein employs a quadrilateral box support 210, some locations may allow use of a support in the shape of a hollow cylinder also having stops 230 proximate a bottom opening of the support, and this form is comprehended within the

scope of the invention.

[0040] Stops 230a, 230 b, 230c and 230d in the form of corner braces in box 210 are within and connected to sidewalls 224 proximate bottom opening 228 and do not obstruct passage 225. Adjacent sidewalls include a base 227 having rounded corners 227a, 227d above respective stops 230a, 230d, and a base 229 having rounded corners 229b and 229c above respective stops 230b, 230c. Rounded corners 227a, 227d and 229b, 229c have a round corner radius of curvature.

[0041] Referring now to FIGS. 3 and 4, a beam 242 comprising extruded tubing unobstructively horizontally spans across passage 225 and connects to opposed sidewalls 224a, 224c of box 210 proximate top opening 226. Beam 242 is lodged in cradles 211a, 211c, and is conveniently lowered into channels 211a, 211c by operators holding beam foldable handles 212a, 212c. Beam 242 and straps 244 described below comprise a suspension member for equipment described below. Beam 242 and its attached equipment can be lowered into place as a complete assembled unit 201 after box 210 is installed in ventilation shaft resting on flanges 220. This assembled unit 201 can be removed from box 210 for servicing by withdrawing beam 242 from channels 211a, 211c by means of handles 212a, 212c.

[0042] Although an embodiment as described employs a suspension member comprising a beam 242 and straps 244 for supporting equipment described below, the scope of the invention is not limited to such embodiment. A suspension member may be employed other than beam 242 and straps 244, for example a suspension member can be a single unitary vertically extending solid or fenestrated plate suspending the hinged panels the same as beam 242 and straps 244. An advantage of the described beam 242 and straps 244 is a lighter weight imposing a lesser load on flanges 220 than a solid plate, but a fenestrated plate would serve a lighter load advantage as well, albeit likely a more costly element.

[0043] Referring particularly to FIG. 11, a hinge mounting member 245 unobstructively horizontally spans across passage 225 the same as beam 242 connected by a plurality of straps 244a, 244b, 244c, 244d to beam 242. Lodged in cradles 211a and 211c, beam 242 and hinge mounting member 245 spanning between sidewalls 224a, 224c are centered in passage 225 of box 210 with beam 242 directly over hinge mounting member 245. Hinge mounting member 245 mounts and supports a plurality of hinge members 243. Hinge members 243 each comprise a stationary member 243b, a moveable member 243a and a hinge pin 243c that interconnects stationary member 243b and moveable member 243a. Stationary member 243b connects to hinge mounting member 245.

[0044] A pair of opposing panels 234, 236 each having proximal and distal portions, respectively 234a, 234b and 236a, 236b, are connected at proximal portions 234a, 236a by moveable hinge members 243a to stationary hinge members 243b and thereby to a hinge mounting

member 245 and from hinge mounting member 245 via straps 244a, 244b, 244c and 244d to beam 242. The connection of moveable hinge members 243a to the proximal portions 234a, 236a of panels 234, 236 on hinge pins 243c forms respective pivot axes of panels 234, 236 for vertical rotation of panels 234, 236. Panels 234, 236 rotate in directions opposite each other from or to an upright home position tucked under beam 242. Rotation of the panels upwardly (one clockwise, the other counter-clockwise) to home position is effected manually as further described below. The home position of the panels tucked under beam 242 does not occlude passage 225. Panels 234, 236 in rotation fall solely under the gravitational impetus of their own weight from the upright home position to a lower passage closing position (indicated generally by reference numeral 215) where further rotation is prevented by stops 230a, 230b, 230c, and 230d. Each panel has a profile that closes the passage when the panels gravitationally rotate to the passage closing position.

[0045] Referring to FIGS 2A-3B, panels 234, 236 have a top side plate 238 and a bottom side 232. Bottom side 232 is crisscrossed with internal cross braces 237, 239 for rigidity. The distal portions of the panels have rounded corners 219 with a radius of curvature substantially the same as the radius of curvature of the sidewall corners 229a, 229b, 229c and 229d they sweep when rotating to the passage closing position. The panels include peripheral distal and lateral seals 221, 222 for sealing the passage in the passage closing position, seals 221a, 222a for panel 234 and seals 221b, 222b for panel 236. A gasket seal 223 (223a for panel 234, 223b for panel 236) spans the proximal ends of bases of panels 234, 236 below pin 243c and seals bottom opening 228 at the proximal ends of panels 234, 236 when the panels are in the passage closing position. At least one of the panels, such as panel 236 is fitted with a drain 270 intermediate the proximate and distal ends of the panel, as shown in FIGS. 2A and 2B, and further described below.

[0046] In the embodiment illustrated in FIG. 12A-13A each panel 234, 236 topside 238 includes a recess 233 or 233'. Referring to FIGS 5-7, the recess contains a panel holder latch catch 235 for panel 234, 235' for panel 236 (latch catch 235' is shielded from view in FIG. 12A but will be understood to be the same and operate the same as latch catch 235). A panel holder 240 latch 247 for panel 234, 249 for panel 236 (latch 249 is shielded from view in FIG. 6 but will be understood to be the same and operate the same as latch 247.) Panel holder 240 inclusive of latches 247, 249 is carried by the suspension member 242. Latches 247, 249 are vertically pivotal on a horizontal axis 254 at a proximate end of the latches. The latches axis 254 is parallel to the panel axes of pins 243c paralleling either side of hinge mounting member 245. Each panel holder latch 247, 249 pivotally extends externally from latch axis 254 distally to an inferior return having a sloped surface ending at an inset notch 251, 251'. Recesses 233, 233' and latches 247, 249 are hor-

izontally and vertically aligned with each other such that when panel 234, 236 is rotated vertically upward, the inferior return of latch 247, 249 is brought into sliding contact with ramp 241, 241' carried by the panel and the sloped surface of the latch slides on ramp 241, 241' until inset notch 251, 251' passes over latch catch edge, 235, 235', capturing latch 247, 249. This capture holds panel 234, 236 in home position 213.

[0047] Panel holder 240 is movable suspended from suspension member 242 by a rod 246 connected to panel holder 240. Rod 246 is mounted through beam 242 slideably translatable through a brace 255 fastened between straps 244b, 244c and terminates above beam 242 at T-handle 252 under a cover 253 sheltering T-handle 252 from pedestrian view through a grating covering quadrilateral support 210. Cover 253 reduces if not avoiding gratuitous tampering with the apparatus and unwanted deployment of the panels by mischief makers.

[0048] Rod 246 and T-handle 252 comprise a panel releaser. The T-handle provides convenient holding, such as by a projection or hook of a reach tool that can be vertically inserted through a small opening in a grating covering support 210 to reach under cover 253 and hook T-handle 252 for lifting panel holder 240. Lifting rod 246 by T-handle 252 moves panel holder 240 upwardly to cause moveable members 247, 249 to lose their hold on catch 241, 241' and release panels 234, 236, allowing panels 234, 236 to rotationally gravitationally fall solely by impetus of their own weight from the upright home position 213 to the lower passage closing position 215.

[0049] Panels 234, 236 are provided with structure to raise the panels manually to home position 213. Each panel 234, 236 has a handle 259, 259' on its top side 238, 238' remote from the pivot axes of pins 243c of the hinge members 243 to which the proximate ends 234a, 236a of the panels 234, 236 are connected. A tool such as hooking tool 290 can be used by an operator and inserted through a grating over box 210 to grasp handle 259, 259' to lift panel 234, 236. FIGS. 20 and 20A depict panels 234, 236 partially raised from the resting position shown in FIGS. 19 and 19A. The lifting operation however must be performed through a small opening in the grating that covers the support 210. The opening not only is small but it is deep, limiting operation to only vertical manipulation. Lifting panel 234, 236 with a tool 290 to rotate the panel upward fully to home position 213 thus becomes difficult as home position is approached, for very little lateral force can be applied. Each panel 234, 236 is provided with an assist mechanism that allows straight vertical movement manipulation through a small opening in the grate to push laterally against panel 234, 236 to facilitate full closure to home position 213.

[0050] This mechanical assist mechanism comprises a lift arm 260 for panel 234 and a lift arm 260' for panel 236. Referring particularly to FIGS. 14 and 14A, each lift arm 260, 260' has a proximal end 261, 261' pivotally connected by pivot pin 267 to a bracket 262, 262' fastened to a brace cross member 239 on the bottom side

232 of the panel 234, 236, and each has a pendent distal end 263, 263', optionally comprising a round, which in this embodiment is a terminal wheel 264, 264', but may be a rounded terminus of the end 263, 263'. Each lift arm 260, 260' is of a dimension to contact its distal end 263, 263', in this embodiment, wheel 264, 264', with the opposing lateral sidewalls 224a, 224c parallel to beam 242 when distal end 263, 263' pivots outwardly and upwardly inside support box 210.

[0051] Referring to FIGS. 16 and 17, lift arms 260, 260' are spring biased to extend the distal ends 263, 263' rotationally outwardly and upwardly, by means of force expressed by a spring 257, 257' centrally coiled around lift arm pivot pin 267, 267', with a proximal short end 257a extending at a right angle across the superior side of lift arm 260, 260' and a distal long end 257b extending at a right angle across the inferior side of lift arm 260, 260'.

[0052] Referring to FIG. 14A, 15-17, 19A, lift arms 260, 260' are restrained from spring biased extension by stays 266, 266' pivotally connected at an upper end by pivot pin 268, 268' to a bracket 256, 256' fastened to brace cross member 239 adjacent the pivotal attachment of the proximal ends of lift arms 260, 260'. The lower end 269, 269' of stays 266, 266' is outwardly angled toward lift arms 260, 266' to extend across and releasably contact the proximal superior side of lift arms 260, 260'. The spring bias of lift arms 260, 260' presses lift arms 260, 260' against stays 266, 266' to maintain the restraining contact. The restraint imposed by stays 266, 266' enables beam 242 and the equipment suspended from beam 242 by straps 244a-244d to be lowered into box 210 for support by the cradles 211a, 211c of box 210 with the biased lift arms 260, 260' tucked inwardly so as to not interferingly contact the lateral sidewalls 224b, 224d parallel to beam 242 during the drop in installation of the beam and beam supported equipment.

[0053] Using a reach tool such as hooking tool 290 vertically lowered through a grate small opening, the lower ends 269, 269' of stays 266, 266' can be slipped off lift arms 260, 260' to allow the spring biased lift arms 260, 260' to extend outwardly and upwardly under the force expressed by of spring 257. See FIG. 18.

[0054] Each lift arm 260, 260' has a configuration at an inferior portion of the arm, such a relief slot 265, 265', for engagement by a hook 291 of a second hooking reach tool 290 lowered through a grate small opening into the box support 210. Referring to FIGS. 20-20A, with panels 234, 236 partially raised by a first hooking tool such as tool 290 and lift arms 260, 260' released from stays 266, 266', the extended outwardly lift arms 260, 260' can be engaged by snagging slot 266, 266' using the second hooking tool 290. With lift arm 260, 260' thus engaged while panel 234, 236 is incompletely lifted using a first hooking reach tool 290, an operator can next withdraw the first hooking tool that pulled up the panel 234 or 236 being lifted, holding that panel partially lifted by interference of the distal edge of the panel with the shank 292 of the second tool 290. This removes the first hooking

tool from a position where it would interfere with closing of panel 234, 236 to full upright home position 213 by operation of lifting arm 260, 260'. The operator then vertically pulls the shank 292 of second tool 290 up through the small opening on the grate. This pivots the engaged lift arm 260 or 260' upward such that the distal end 263, 263' of the arm, here wheel 264, 264', travels upward on sidewall 224a, 224c. Referring to FIG. 20 and 20A, vertical pull of tool 290 continues until proximal end 261, 261' of lift arm 260, 260' exerts sufficient lateral force against its connected panel 234 or 236 to push panel 234, 236 to completed rotation into home position 213. Referring to FIGS. 21, 21A, in nearing completion to home position, the panel 234, 236 with included recess 233, 233' and ramp 241 have engaged the slope of distal return 248 of latches 247, 249 and inset notch 251 has slide past ramp latch catch edge 235, capturing panel 234, 236 against panel holder 240 with panels 234, 236 essentially vertically disposed. The hooking tool 290 is the fully vertically withdrawn through the small opening in the grate.

[0055] Panel 236 as in the depicted embodiment in FIGS. 12A, 12B, 40 and 43 is fitted with a drain 270 intermediate the proximate and distal ends of the panel. Drain 270 comprises a conduit such as hollow tube 271 passing through panel 236 and has an opening 272 at panel top side 238. Referring particularly to FIGS. 40-48, a self actuating drain closure, indicated generally by reference numeral 273, includes a plug 274 suitably pivoting rotatably on an axis 275 parallel to the panel axis 243c of panel 236. Plug axis 275 is positioned between drain conduit 271 and the distal end 236b of panel 236. Operatively plug 274 is manually pivoted upwardly on pivot axis 275 to remove the plug from drain opening 272 while panel 236 is in the passage closing position, to drain flooding water contained in box 210 that has been prevented by panels from entering ventilation shafts guarded by apparatus 200. As panel 236 is pivotally raised upward to the home position after drainage of box 210 to allow resumption of ventilation between the atmospheric opening and the protected ventilation duct, plug 274 by force of gravity automatically pivots downward to place the plug in conduit aperture 272.

[0056] More particularly, panel 236 has spaced posts 276, 276' fixedly mounted to the top side 238 of panel 236 between drain 270 and distal end 236b of panel 236. A pivot axis rod 275 is supported parallel to the axis 243c of panel 236 by posts 276, 276' and spans between the posts above top side 238 of panel 236. Drain closure 273 comprises a plug arm 277 pivotally rotating cooperatively at one end 277a thereof with pivot axis rod 275 for movement of arm 277 to a raised drain opening position and to a lowered drain closing position. Pivot axis rod 275 may be fixed to posts 276, 276' with plug arm 277 rotating on pivot axis rod 275, or pivot axis rod 275 may rotate in posts 276, 276' with plug arm 277 fixed to pivot axis rod 275.

[0057] Plug arm 277 comprises an attachment projec-

tion 278 remote from pivot axis rod 275. Plug 274 further comprises a concave sealing gasket 280, a top plate 281 and a bottom plate 282, both smaller in size than gasket 280. As shown in the drawings, the drain conduit 271 is a cylinder, the top and bottom plates 281 and 282 are circular discs and the concave gasket 280 is circular. Other complementary conduit, gasket and plate shapes may be used, circular being suitable and perhaps less complicated but not necessary. Concave sealing gasket 280 is secured between top and bottom plates 281 and 282 by fasteners 283 in holes 284, 284'. At least bottom plate 282 is of a size configured to enter and plug conduit opening 272. Plates 281, 282 sandwiching gasket 280 expose an outer upwardly concave gasket portion 280' extending above bottom plate 281. Plates 281, 282 are fixedly connected to plug arm 277 at attachment projection 278, thereby locating a center of gravity of plug 274 past pivot axis rod 275 in the direction of drain 270. Thus when panel 236 has plug 274 in raised position for draining box 210 with panel 236 in the passage closing position 215, and panel 236 (with plug 274 in raised position) is then rotated upwardly toward home position to restore ventilation through box 210, plug 274-by reason of gravity acting on the centered mass of the raised plug forward of plug axis 275-falls rotating downwardly from the raised position to a position parallel to panel 236, placing at least bottom plate 282 in the drain conduit opening 272, thereby closing drain conduit opening 272, with the outer upwardly concave gasket portion 280' sealing space between plates 281, 282 and opening 272.

[0058] Plug arm 274 suitably includes an inferior relief 279 intermediate the attachment projection and a terminus of arm 274 remote from rod 275 and plug axis 275 for hooking capture of plug arm 274 by a projection such as 291 on hooking reach tool 290. An operator insert tool 290 through an opening in a grating covering the support 210, hooks the inferior relief 279 and lifts tool 290 to raise the captured arm 274 to remove plug 274 from drain aperture 270 to drain box 210 while panel 236 is in passage closing position 215.

[0059] Referring to FIGS. 47 and 48, the same reference numerals are used as in FIGS. 40-46 where applicable for a variation of the plug 274. The variant plug is indicated generally by reference numeral 310. FIG. 47 compares to FIG. 35A. Plug 310 places the location where a reach tool such as 290 can capture plug arm 277 at an inset 310 formed in the distal end 311 of plug arm 277 above top plate 210. Bottom plate 282 is configured to an inverted frustoconical member of greater mass and deeper reach into opening 272 of drain conduit 270, increasing the center of gravity of plug arm 277

[0060] Without the presence of self actuating drain closure 273, there is a risk that with another kind of drain closure an operator might raise panel 236 into home position with the other kind of drain closure remaining open, creating a situation where water entering box 210 through top opening 226 would enter the ventilation shaft meant to be closed when panel 236 is in passage closing posi-

tion 215. The presence of the "fool proof" self actuating means for automatically closing aperture 272 by the action of raising panel 236 assures that drain aperture 270 is already closed when panel 236 is subsequently lowered to panel closing position 215.

[0061] Referring now to FIGS. 50-51A, another exemplary embodiment employs a single panel. Components in the single panel embodiments that are the same as in the exemplary pair of panels embodiments have the same reference numbers as in the exemplary pair of panels embodiments. The single panel exemplary embodiment, as with the other exemplary embodiments, assumes a rectilinear atmospheric opening of a vertical ventilation shaft and allows ventilation as usual through the shaft to an underground ventilation duct fluidly communicating through the ventilation shaft to an atmospheric opening at a grating over the shaft and on threat of flooding is operable to prevent downward flow of surface water into the underground ventilation duct. The single panel exemplary embodiment, like the pair of panels exemplary embodiments comprises a support embodied as a four-sided vertical box open at bottom and top to define a passage 225 between top and bottom openings of the box support. Some details are omitted for simplicity of exposition but will be understood from descriptions of the pair of panels exemplary embodiments. Exemplary flanges, e.g. 220b, 220c horizontally extend and rest atop vertical walls of a ventilation shaft (flanges 220a, 220d are not indicated by reference numerals in FIGS 50-51A but are understood from the prior embodiments). Support box sidewalls 224b, 224c and 224d are visible in the sectional views FIGS 50A and 51 A (sidewall 224a will be understood from descriptions of the embodiments of the pair of panels. The four sidewalls 224a, 224b, 224c, 224d of box 218 vertically fit inside the four vertical ventilation shaft walls, as in the pair of panels exemplary embodiments. Stops like stops 230a, 230d in the pair of panels exemplary embodiments are within and connected to sidewalls, respectively, 224a, 224b and 224a, 224d, proximate bottom opening like 229 in the exemplary embodiments of FIGS. 1-2A where they do not obstruct passage 225. Adjacent sidewalls include a base 227 having rounded corners 227a, 127d above respective stops 230a, 230d.

[0062] Cradles 211a, 211c are formed in the upper sides of opposing sidewalls 224a and 224c respectively, adjacent sidewall 224d. The apparatus shown is suitable as a drop in solution to seal vent passages from storm waters by lowering it into a ventilation shaft to rest on walls of the shaft. In place, a grating (not pictured) covers top opening 226. In normal operation, operator access to the interior of the support box is through the grating.

[0063] Referring now to FIGS. 50-51A, a beam 242 comprising extruded tubing unobstructively horizontally spans across passage 225 and connects to opposed sidewalls 224a, 224c of box 210 adjacent side wall 224d and proximate top opening 226. Beam 242 is lodged in cradles 211a, 211c, and is conveniently lowered into

channels 211a, 211c by operators holding beam foldable handles 212a, 212c. Beam 242 and straps 244 comprise a suspension member. Beam 242 and its attached equipment can be lowered into place as a complete assembled unit after the support box is installed in ventilation shaft resting on flanges 220. This assembled unit can be removed from the support box for servicing by withdrawing beam 242 from channels 211a, 211c by means of handles 212a, 212c.

[0064] Referring particularly to FIG. 51A, a hinge mounting member 245 unobstructively horizontally spans across passage 225 the same as beam 242 connected by a plurality of straps 244 to beam 242 (only 244d is seen in the sectional views of FIGS. 50A and 51A). Lodged in cradles 211a and 211c, beam 242 and hinge mounting member 245 spans between sidewalls 224a, 224c adjacent sidewall 224d with beam 242 directly over hinge mounting member 245. Hinge mounting member 245 mounts and supports a plurality of hinge members 243. The hinge members 243, as in the pair of panels exemplary embodiments, each comprise a stationary member 243b, a moveable member 243a and a hinge pin 243c that interconnects stationary member 243b and moveable member 243a, stationary member 243b connecting to hinge mounting member 245. In FIG. 51A, only moveable member 243a is referenced to avoid obfuscation of elements,

[0065] A single panel 236 having proximal and distal portions, respectively (understood the same as 236a, 236b in the pair of panels exemplars) are connected at proximal portion 236a by moveable hinge members 243a to stationary hinge members 243b and thereby to a hinge mounting member 245 and from hinge mounting member 245 via straps 244a, 244b, 244c and 244d to beam 242, as in the pair of panels exemplars. The connection of moveable hinge members 243a to the proximal portion 236a of panels 236 on hinge pins 243c forms a pivot axis of panels 236 for vertical rotation of panel 236. Panel 236 rotates from or to an upright home position tucked under beam 242. Rotation of panel 236 upwardly (counterclockwise in the exemplary embodiment shown) to home position is effected manually as further described below. The home position of panel 236 tucked under beam 242 does not occlude passage 225. Panel 236 in rotation falls solely under the gravitational impetus of its own weight from the upright home position to a lower passage closing position where further rotation is prevented by stops 230a, 230d. Each panel has a profile that closes the passage when the panels gravitationally rotate to the passage closing position.

[0066] In the embodiment illustrated in FIGS. 50-51A, panel 236 the same as panel 236 in the pair of panels exemplar includes a recess 233' that contains a panel holder latch catch 235'. A panel holder 240 latch 249 for panel 236. Panel holder 240 inclusive of latch 249 is carried by the suspension member 242. Latch 249 is vertically pivotal on a horizontal axis at a proximate end of the latches. The latch axis is parallel to the panel axes

of pins 243c. Panel holder latch 249, like latch 247 in FIG. 6 pivotally extends externally from the latch axis distally to an inferior return having a sloped surface ending at an inset notch 251'. Recess 233' and latch 249 are horizontally and vertically aligned with each other such that when panel 236 is rotated vertically upward, the inferior return of latch 249 is brought into sliding contact with ramp 241' carried by the panel, and the sloped surface of the latch slides on ramp 241' until inset notch 251' passes over latch catch edge 235', capturing latch 249. This capture holds panel 234, 236 in home position 213. As in the case of the pair of panels exemplar, the placement of the latch and latch catch can be reversed.

[0067] As in the case of the pair of panel exemplars, panel holder 240 is movably suspended from suspension member 242 by a rod 246 connected to panel holder 240. Rod 246 is mounted through beam 242 slideably translatable through a brace 255 fastened between straps 244b, 244c and terminates above beam 242 at T-handle 252 under a cover 253 sheltering T-handle 252 from pedestrian view through a grating covering quadrilateral support 210. Rod 246 and T-handle 252 comprise a panel releaser. The T-handle provides convenient holding, such as by a projection or hook of a reach tool that can be vertically inserted through a small opening in a grating covering support 210 to reach under cover 253 and hook T-handle 252 for lifting panel holder 240. Lifting rod 246 by T-handle 252 moves panel holder 240 upwardly to cause moveable members 247, 249 to lose their hold on catch 241, 241' and release panels 234, 236, allowing panels 234, 236 to rotationally gravitationally fall solely by impetus of their own weight from the upright home position 213 to the lower passage closing position 215.

[0068] As shown in FIG. 51, as in the case of the pair of panels exemplars, the single panel exemplary embodiment includes a lift arm 260' having a proximal end 261' pivotally connected by pivot pin 267 to the bottom side of panel 236 on a pivotation axis parallel to the hinge axis 243c and a distal end 263', the lift arm 260' being of dimension to contact distal end 263' with opposed lateral sidewall 224b when distal end 263' is pivoted upward inside sidewall 224b for exertion of lateral force onto connected panel 236 being raised with panel handle 259' to complete rotation of panel 236 into the home position.

[0069] As shown in FIGS. 50-51A, as also in the case of the pair of panels exemplars, the single panel exemplary embodiment includes a drain 270 in panel 236 intermediate the proximate and distal ends thereof, the drain 270 comprising a conduit 271 passing through panel 236. Conduit 271 has an opening 272 at the top side of panel 236 and a self actuating drain closure 273 comprising a plug 274 pivotingly rotatable on a drain plug axis 275 positioned between the drain conduit 271 and the distal end 236b of panel 236, the drain plug axis 275 paralleling the horizontal hinge axis 243c. Operatively, plug 274 is manually pivotable upwardly on the drain plug axis 275 to remove the plug from the drain opening 272 to drain water contained in the support box that has been

prevented by panel 236 from entering a ventilation shaft when panel 236 is in the passage closing position. After drainage of the support box, as panel 236 is pivotally raised upward to the home position to allow resumption of ventilation between the atmospheric opening and the protected ventilation duct, plug 274 by gravitational impetus of its own weight automatically pivots downward to place the plug in the conduit opening 272. Consequently, drain conduit opening 272 is already closed when panel 236 gravitationally rotates downwardly to the passage closing position.

[0070] Having described illustrative examples of embodiments that incorporate concepts of the invention, those skilled in the art will be able to use these concepts as guided by these embodiments, and may form alternative variations that nonetheless embrace the concepts herein disclosed and still be within the scope of my invention as claimed in the claims that follow.

Claims

1. Apparatus for allowing ventilation through a vertical ventilation shaft to an underground ventilation duct fluidly communicating through the ventilation shaft to an atmospheric opening of the shaft and on threat of flooding manually operable to prevent downward flow of surface water into the underground ventilation duct, comprising

a support (210) comprising opposed lateral side-walls (224) for arrangement in said shaft defining a passage between top (226) and bottom (220) openings of the support for fluid communication of said ventilation duct up through said support to said atmospheric opening,
 one or more panels (234; 236) having proximal and distal ends (234a; 234b; 236a; 236b), a top side (232) and a bottom side (238), said proximal end connecting with a horizontal hinge (243) having a hinge axis perpendicular to said opposed lateral sidewalls (224) for rotation of each said panel (234; 236) upwardly to an upright home position not obstructing said passage and rotation from said home position downwardly by gravitational impetus of its own weight to reach a lower passage closing position, said one or more panels having a profile that closes said passage when each said panel gravitationally rotates to said passage closing position,
 at least one restraint limiting said downward rotation of each panel to said lower passage closing position,
 a suspension member (242; 244) unobstructively horizontally spanning said passage (225) supported on said opposed lateral sidewalls (224) proximate said top opening (226) and holding said one or more hinge connected panels (234;

236) in said passage proximate said bottom opening,
 a panel holder (240) for holding each said panel in said upright home position, comprising:

a moveable member (247; 249) carried either by a said panel (234; 236) or by said suspension member (242; 244) below said suspension member, and
 a non-movable member (235; 235') carried by the other of the panel (234; 236) or the suspension member not carrying said moveable member,

said movable member (247; 249) capturing and holding said non-movable member (235; 235') when said panel is rotated upwardly to said home position,

a panel releaser (246; 252) for said panel holder, comprising linkage connected to said moveable or non-movable panel holder member carried by said suspension member (242; 244), said linkage being movable relative to said suspension member (242; 244) to translate said movable or non-movable member to release the panel from said upright home position and allow said panel to gravitationally rotationally fall to said lower passage closing position,

a panel handle (259) on said top side of said one or more panels for manually rotationally raising said one or more panels from said passage closing position toward said home position,

a lift arm (260; 260') for each panel, each lift arm having a proximal end pivotally connected by pivot pin (267) to said bottom side of a said panel (226) on a pivotation axis parallel to said hinge axis (243a) and a distal end (263), each said lift arm (260) being of dimension to contact said distal end with one of said opposed lateral side-walls (224) when said distal end is pivoted upward inside said sidewall for exertion of lateral force onto the connected panel being raised with said panel handle (259) to complete rotation of said panel into said home position, and

a drain (270) in at least one of said one or more panels (234; 236) intermediate said proximate and distal ends thereof, said drain (270) comprising a conduit (271) passing through said panel (234; 236), said conduit (271) having an opening (272) at said panel top side (231) and a self actuating drain closure (273) on each said panel having a drain, said closure comprising a plug (274) pivotingly rotatable on a drain plug axis (275) positioned between said drain conduit (270) and said distal end of each said panel, said drain plug axis (275) paralleling said horizontal hinge axis, said plug being manually pivotable upwardly on said drain plug axis to re-

- move said plug from said drain opening to drain water contained above said one or more panels when each said panel is in said passage closing position, said plug by gravitational impetus of its own weight automatically pivoting downward to place said plug in said conduit opening when said panel containing said drain is pivotally raised upward to said home position, whereby the conduit opening is already closed when the panel gravitationally rotates downwardly to said passage closing position.
2. The apparatus of claim 1 in which said atmospheric opening is rectilinear and said support (210) is quadrilateral, and in which said opposing sidewalls (224) each attach centrally in said passage adjacent said top opening to a cradle (211) having a pair of spaced apart parallel vertical arms connecting to and standing upright on a horizontal bar (242) for liftably receiving and supporting said beam within said vertical arms and on said horizontal bar (242).
 3. The apparatus of claim 2 in which said quadrilateral support (210) has at least one indicator on at least one sidewall adjacent said opposed lateral sidewalls (224) to indicate where structure on a panel (234; 236) is located below the indicator, and wherein said suspension member (242; 244) has ends each of which bears a key extending laterally past a side of the suspension member, and wherein each said cradle (211) is keyed to receive said key only in one arm of the cradle so a said panel having that structure is located below said indicator.
 4. The apparatus of claim 1 in which said non-movable member of said panel holder (240) comprises a latch catch (235; 235') and said moveable member (247; 249) of said panel holder comprises a latch engageable with said latch catch (235; 235').
 5. The apparatus of claim 4 in which said panel topside (238) includes said latch catch (235; 235') and said latch (247; 249) is carried by said suspension member (242; 244).
 6. The apparatus of claim 4 in which said panel top side (238) includes said latch (247; 249) and said latch catch (235; 235') is carried by said suspension member (242; 244).
 7. The apparatus of claim 1 in which said lift arms (260; 260') are spring biased to force the distal ends rotationally outwardly and upwardly.
 8. The apparatus of claim 7 in which a spring (257; 257') is centrally coiled around said lift arm pivot pin (267), the spring terminating on opposite first and second ends having a straight portion comprising a proximal shank (257a) and a distal portion (257) bent at a right angle to the shank, the distal portion of the first end extending engagingly across an underside of the lift arm proximate the pivot pin (267) and the distal portion of the second end extending engagingly across a topside of the lift arm (260) more distant from the pivot pin (267) than the distal portion of the first end.
 9. The apparatus of claim 8 further comprising a stay (266; 268) for each lift arm (260), a stay pivot pin adjacent said lift arm pivot pin (267) pivotally connecting an upper end of each stay (266; 266'), a lower end of said stay (266; 268) angling outwardly toward an adjacent lift arm (260; 260') to extend across and releasably contact a proximal portion of said top side of the lift arm, said spring bias pressing said lift arms against said stays restrain said lift arms from rotation outwardly and upwardly.
 10. The apparatus of claim 9 in which each said lift arm (260; 260') has a configuration at a bottom portion of said arm for engagement by a reach tool (290) vertically lowered from said atmospheric opening to engage and pivotally pull the lift arm (260; 260') upwardly such that said distal end of the arm travels upward on said sidewall.
 11. The apparatus of claim 9 in which said stay (260; 260') is releasable by a reach tool (290) vertically lowered from said atmospheric opening, allowing the spring biased distal end of said lift arm (260; 260') to pivot laterally outward for capture by said reach tool vertically lowered from said atmospheric opening to engage and pivotally pull the lift arm (260; 260') upwardly such that said distal end of the lift arm (260; 260') travels upward on said sidewall.
 12. The apparatus of claim 1 in which said plug (274) further comprises an upwardly concave sealing gasket (280) around said plug periphery to seal any space between said plug periphery and said conduit opening when said panel containing said plug (274) is in said passage closing position.
 13. The apparatus of claim 1 in which each said panel (234; 236) containing a said drain (270) has spaced posts (276; 276') fixedly mounted to said top side of each said panel (234; 236) between said drain (270) and said distal end of each said panel (234; 236), and in which said drain plug axis comprises a rod (275) supported parallel to said horizontal hinge axis by said posts (276; 276') and spans between said posts above said panel top side, each said drain closure comprising:
 - a plug arm (277) pivotally rotatable at a proximal end of said arm with or on said rod (275) for movement of said arm to a raised drain opening

position and to a lowered drain closing position, said plug arm comprising an attachment projection remote from said rod (275),
 an upwardly concave sealing gasket (280),
 a top plate (281) and a bottom plate (282), both 5
 smaller in size than said gasket (280),
 said concave sealing gasket (280) being secured between said top and bottom plates (281; 282), at least said bottom plate (282) being of 10
 size configured to enter and plug said conduit opening, said plates (281; 282) exposing an outer upwardly concave gasket portion extending above said bottom plate (282), said plates being 15
 fixedly connected to said arm at said attachment projection locating a center of gravity of said arm past said pivot axis of said rod (275) in said direction of said drain (270), so that after a panel (234; 236) containing said drain (270) has a said 20
 plug arm (277) in said raised position to drain water above the panel while said panel is in said passage closing position, when said panel containing said drain (270) with said plug arm (277) in raised position is rotated upwardly toward said 25
 home position, said plug arm (277) by reason of gravity acting on said center of gravity of said raised plug arm (277) rotates said plug arm downwardly from said raised position to a position parallel to said parallel to said panel (234; 236), placing at least said bottom plate (282) in 30
 said drain conduit opening thereby closing said opening with said outer upwardly concave gasket portion (280) sealing space between said plates and said opening.

14. The apparatus of claim 13 in which said plug arm 35
 (277) includes a relief on an underside of the arm distal from said rod (275) for capture of the arm by an arm lifting reach tool.
15. The apparatus of claim 13 in which said plug arm 40
 (277) includes a recess on a end of the arm distal from said rod (275) for capture of the arm by an arm lifting reach tool.

Patentansprüche

1. Eine Vorrichtung zum Ermöglichen einer Lüftung 50
 über einen vertikalen Lüftungsschacht zu einem unterirdischen Lüftungskanal, der über den Lüftungsschacht mit einer atmosphärischen Öffnung des Schachts fluidisch kommuniziert, und die bei Gefahr einer Überschwemmung manuell betätigt werden kann, um einen Abwärtsfluss von Oberflächenwasser in den unterirdischen Lüftungskanal zu verhindern, umfassend: 55

eine Abstützung (210), umfassend entgegenge-

setzte laterale Seitenwände (224), zur Anordnung in dem genannten Schacht, die einen Durchgang zwischen einer oberen (226) und unteren (220) Öffnung der Abstützung zur Fluidkommunikation des genannten Lüftungskanals nach oben über die genannte Abstützung zur genannten atmosphärischen Öffnung definiert, eine oder mehrere Platten (234; 236), die ein proximales und distales Ende (234a; 234b; 236a; 236b), eine obere Seite (232) und eine untere Seite (238) aufweisen, wobei das genannte proximale Ende mit einem horizontalen Scharnier (243) verbunden ist, das eine zu den genannten entgegengesetzten lateralen Seitenwänden (224) perpendikuläre Scharnierachse aufweist, zur Drehung von jeder genannten Platte (234; 236) aufwärts zu einer aufrechten Grundposition, die den genannten Durchgang nicht blockiert, und zur Drehung von der genannten Grundposition abwärts per Gravitationsimpuls ihres Eigengewichts, um eine untere den Durchgang schließende Position zu erreichen, wobei die genannte/n eine oder mehreren Platten ein Profil aufweisen, das den Durchgang schließt, wenn sich jede genannte Platte gravitativ zu der genannten den Durchgang schließenden Position dreht, mindestens eine Rückhaltung, die die genannte Abwärtsdrehung von jeder Platte zu der genannten unteren den Durchgang schließenden Position beschränkt, ein Aufhängungsglied (242; 244), das sich unblockierend horizontal über den genannten Durchgang (225) spannt, auf den genannten entgegengesetzten lateralen Seitenwänden (224) in der Nähe der genannten oberen Öffnung (226) abgestützt ist und die genannte/n eine oder mehreren scharnierverbundenen Platten (234; 236) in dem genannten Durchgang in der Nähe der genannten unteren Öffnung hält, einen Plattenhalter (240) zum Halten von jeder genannten Platte in der genannten aufrechten Grundposition, umfassend:

ein bewegbares Glied (247; 249), das entweder von einer genannten Platte (234; 236) oder von dem genannten Aufhängungsglied (242; 244) unterhalb des genannten Aufhängungsglieds getragen wird, und ein nicht bewegbares Glied (235; 235') das von dem anderen der Platte (234; 236) oder dem Aufhängungsglied, die/das das genannte bewegbare Glied nicht trägt, getragen wird,

wobei das genannte bewegbare Glied (247; 249) das genannte nicht bewegbare Glied (235;

235') erfasst und hält, wenn die genannte Platte aufwärts zur genannten Grundposition gedreht wird,

einen Plattenausrücker (246; 252) für den genannten Plattenhalter, umfassend ein Gestänge, das mit dem genannten bewegbaren oder nicht bewegbaren Plattenhalterglied, das von dem genannten Aufhängungsglied (242; 244) getragen wird, verbunden ist, wobei das genannte Gestänge relativ zu dem genannten Aufhängungsglied (242; 244) bewegbar ist, um das genannte bewegbare oder nicht bewegbare Glied zu verschieben, um die Platte von der genannten aufrechten Grundposition auszurücken und der genannten Platte zu ermöglichen, gravitativ drehend auf die genannte untere den Durchgang schließende Position zu fallen, einen Plattengriff (259) auf der genannten oberen Seite der genannten einen oder mehreren Platten zum manuellen drehenden Heben der genannten einen oder mehreren der Platten von der genannten den Durchgang schließenden Position zur genannten Grundposition hin, einen Hebearm (260; 260') für jede Platte, wobei jeder Hebearm ein proximales Ende, das durch einen Schwenkstift (267) mit der genannten unteren Seite einer genannten Platte (226) auf einer zu der genannten Scharnierachse (243a) parallelen Schwenkachse schwenkend verbunden ist, und ein distales Ende (263) aufweist, wobei jeder Hebearm (260) eine Abmessung aufweist, um das genannte distale Ende mit einer der genannten entgegengesetzten lateralen Seitenwände (224) zu berühren, wenn das genannte distale Ende innerhalb der genannten Seitenwand aufwärts geschwenkt wird, zur Ausübung einer lateralen Kraft auf die verbundene Platte, die mit dem genannten Plattengriff (259) gehoben wird, um eine Drehung der genannten Platte in die genannte Grundposition auszuführen, und

einen Abfluss (270) in mindestens einer der genannten einen oder mehreren Platten (234; 236) zwischen dem genannten proximalen und distalen Ende von diesen, wobei der genannte Abfluss (270) eine Leitung (271) umfasst, die durch die genannte Platte (234; 236) durchgeht, wobei die genannte Leitung (271) eine Öffnung (272) auf der genannten oberen Plattenseite (231) und einen selbsttätigen Abflussverschluss (273) auf jeder genannten Platte, die einen Abfluss aufweist, aufweist, wobei der genannte Verschluss einen Stopfen (274) umfasst, der auf einer Abflusstopfenachse (275) schwenkend drehbar ist, positioniert zwischen der genannten Abflussleitung (270) und dem genannten distalen Ende von jeder genannten Platte, wobei die genannte Abflusstopfenachse (275) zur ge-

nannten horizontalen Scharnierachse parallel liegt, wobei der genannte Stopfen auf der genannten Abflusstopfenachse manuell aufwärts schwenkbar ist, um den genannten Stopfen von der genannten Abflussöffnung zu entfernen, um oberhalb der/den genannten einen oder mehreren Platten enthaltenes Wasser abfließen zu lassen, wenn jede genannte Platte in der genannten den Durchgang schließenden Position ist, wobei der genannte Stopfen per Gravitationsimpuls seines Eigengewichts automatisch abwärts schwenkt, um den genannten Stopfen in der genannten Leitungsöffnung zu platzieren, wenn die genannte Platte, die den genannten Abfluss enthält, schwenkend aufwärts zur genannten Grundposition gehoben wird, wobei die Leitungsöffnung bereits geschlossen ist, wenn sich die Platte gravitativ abwärts zur genannten den Durchgang schließenden Position dreht.

2. Die Vorrichtung nach Anspruch 1, bei der die genannte atmosphärische Öffnung rechtlinig ist und die genannte Abstützung (210) vierseitig ist, und bei der an den genannten entgegengesetzten Seitenwänden (224) jeweils mittig in dem genannten Durchgang angrenzend zur genannten Öffnung eine Wiege (211) befestigt ist, die ein Paar beabstandeter paralleler vertikaler Arme aufweist, die mit einem horizontalen Stab (242) verbunden sind und auf diesem aufrecht stehen, zum hebenden entfernbaren Aufnehmen und Abstützen des genannten Trägers innerhalb der genannten vertikalen Arme und auf dem genannten horizontalen Stab (242) .

3. Die Vorrichtung nach Anspruch 2, bei der die vierseitige Abstützung (210) mindestens eine Anzeige auf mindestens einer Seitenwand angrenzend zu den genannten entgegengesetzten lateralen Seitenwänden (224) aufweist, um anzuzeigen, wo sich eine Struktur auf einer Platte (234; 236) unterhalb der Anzeige befindet, und wo das genannte Aufhängungsglied (242; 244) Enden aufweist, die jeweils einen Keil besitzen, der sich lateral an einer Seite des Aufhängungsglieds vorbei erstreckt, und wobei jede genannte Wiege (211) verkeilt ist, um den genannten Keil nur in einem Arm der Wiege aufzunehmen, sodass sich eine genannte Platte, die diese Struktur aufweist, unterhalb der genannten Anzeige befindet.

4. Die Vorrichtung nach Anspruch 1, bei der das genannte nicht bewegbare Glied des genannten Plattenhalters (240) einen Riegelfänger (235; 235') umfasst und das genannte bewegbare Glied (247; 249) des genannten Plattenhalters einen Riegel umfasst, der in dem genannten Riegelfänger (235; 235') eingreifbar ist.

5. Die Vorrichtung nach Anspruch 4, bei der die ge-

- nannte obere Plattenseite (238) den genannten Rie-
gelfänger (235; 235') beinhaltet und der genannte
Riegel (247; 249) von dem genannten Aufhängungs-
glied (242; 244) getragen wird.
6. Die Vorrichtung nach Anspruch 4, bei der die ge-
nannte obere Plattenseite (238) den genannten Rie-
gel (247; 249) beinhaltet und der genannte Riegel-
fänger (235; 235') von dem genannten Aufhän-
gungsglied (242; 244) getragen wird.
7. Die Vorrichtung nach Anspruch 1, bei der die ge-
nannten Hebearme (260; 260') federvorgespannt
sind, um die distalen Enden drehend auswärts und
aufwärts zu zwingen.
8. Die Vorrichtung nach Anspruch 7, bei der eine Feder
(257; 257') mittig um den genannten Hebearm-
Schwenkstift (267) herum gewickelt ist, wobei die
Feder auf entgegengesetzten ersten und zweiten
Enden abschließt, einen geraden Abschnitt aufwei-
send, umfassend einen proximalen Schaft (257a)
und einen distalen Abschnitt (257), der in einem
rechten Winkel zum Schaft gebogen ist, wobei sich
der distale Abschnitt des ersten Endes eingreifend
über eine Unterseite des Hebearms in der Nähe des
Schwenkstifts (267) erstreckt und der distale Ab-
schnitt des zweiten Endes eingreifend über eine obe-
re Seite des Hebearms (260), entfernter von dem
Schwenkstift (267) als der distale Abschnitt des ers-
ten Endes, erstreckt.
9. Die Vorrichtung nach Anspruch 8, ferner umfassend
eine Strebe (266; 268) für jeden Hebearm (260), ei-
nen Strebenschenkelstift angrenzend zu dem ge-
nannten Hebearm-Schwenkstift (267), der ein obe-
res Ende von jeder Strebe (266; 266') schwenkend
verbindet, wobei ein unteres Ende der genannten
Strebe (266; 268) auswärts zu einem angrenzenden
Hebearm (260; 260') hin gewinkelt ist, um sich über
einen proximalen Abschnitt der genannten oberen
Seite des Hebearms zu erstrecken und diesen aus-
rückbar zu berühren, wobei die genannte Federvor-
spannung, die die genannten Hebearme gegen die
genannten Streben drückt, die genannten Hebear-
me von einer Drehung auswärts und aufwärts zu-
rückhält.
10. Die Vorrichtung nach Anspruch 9, bei der jeder He-
bearm (260; 260') eine Konfiguration an einem un-
teren Abschnitt des genannten Arms zum Eingriff
durch ein Greifwerkzeug (290) aufweist, das vertikal
von der genannten atmosphärischen Öffnung ge-
senkt wird, um in den Hebearm (260; 260') einzu-
greifen und diesen schwenkend aufwärts zu ziehen,
sodass sich das genannte distale Ende des Arms
aufwärts auf der genannten Seitenwand bewegt.
11. Die Vorrichtung nach Anspruch 9, bei der die ge-
nannte Strebe (260; 260') durch ein Greifwerkzeug
(290) ausrückbar ist, das vertikal von der genannten
atmosphärischen Öffnung gesenkt wird, wodurch
dem federvorgespannten distalen Ende des ge-
nannten Hebearms (260; 260') ermöglicht wird, la-
teral auswärts zu schwenken, zur Erfassung durch
das genannte Greifwerkzeug, das vertikal von der
genannten atmosphärischen Öffnung gesenkt wird,
um in den Hebearm (260; 260') einzugreifen und die-
sen schwenkend aufwärts zu ziehen, sodass sich
das genannte distale Ende des Hebearms (260;
260') aufwärts auf der genannten Seitenwand be-
wegt.
12. Die Vorrichtung nach Anspruch 1, bei der der ge-
nannte Stopfen (274) ferner eine aufwärts konkave
Dichtungsmanschette (280) um den genannten
Stopfenumfang herum umfasst, um einen Raum zwi-
schen dem genannten Stopfenumfang und der ge-
nannten Leitungsöffnung abzudichten, wenn die
Platte, die den genannten Stopfen (274) enthält, in
der genannten den Durchgang schließenden Posi-
tion ist.
13. Die Vorrichtung nach Anspruch 1, bei der jede ge-
nannte Platte (234; 236), die einen genannten Ab-
fluss (270) enthält, beabstandete Pfosten (276; 276')
aufweist, die an der genannten oberen Seite von je-
der genannten Platte (234; 236) zwischen dem ge-
nannten Abfluss (270) und dem genannten distalen
Ende von jeder genannten Platte (234; 236) fest
montiert sind, und bei der die genannte Abflussstop-
fenachse eine Stange (275) umfasst, die parallel zu
der genannten horizontalen Scharnierachse durch
die genannten Pfosten (276; 276') abgestützt wird
und sich zwischen den genannten Pfosten oberhalb
der genannten oberen Plattenseite spannt, wobei je-
der genannte Abflussverschluss Folgendes um-
fasst:
- einen Stopfenarm (277), der an einem proxima-
len Ende des genannten Arms mit oder auf der
genannten Stange (275) schwenkend drehbar
ist, zur Bewegung des genannten Arms zu einer
gehobenen Abflussöffnungsposition und zu ei-
ner gesenkten Abschlussverschlussposition,
wobei der genannte Stopfenarm einen Befesti-
gungsvorsprung abseits von der genannten
Stange (275) umfasst,
eine aufwärts konkave Dichtungsmanschette
(280),
eine obere Platte (281) und eine untere Platte
(282), die beide eine kleinere Größe als die Man-
schette (280) aufweisen,
wobei die konkave Dichtungsmanschette (280)
zwischen der genannten oberen und unteren
Platte (281; 282) gesichert ist, wobei mindes-

- tens die genannte untere Platte (282) eine Größe aufweist, die konfiguriert ist, um in die genannte Leitungsöffnung einzutreten und diese zuzustopfen, wobei die genannten Platten (281; 282) einen äußeren aufwärts konkaven Manschettenabschnitt exponieren, der sich oberhalb der genannten unteren Platte (282) erstreckt, wobei die genannten Platten mit dem genannten Arm an dem genannten Befestigungsvorsprung fest verbunden sind, wobei ein Schwerpunkt des genannten Arms an der genannten Schwenkachse der genannten Stange (275) vorbei in der genannten Richtung des genannten Abflusses (270) angesetzt wird, so dass, nachdem eine Platte (234; 236), die den genannten Abfluss (270) enthält, einen genannten Stopfenarm (277) in der genannten gehobenen Position hat, um Wasser oberhalb der Platte abfließen zu lassen, während die genannte Platte in der genannten den Durchgang schließen Position ist, wenn die genannte Platte, die den genannten Abfluss (270) mit dem genannten Stopfenarm (277) in gehobener Position enthält, aufwärts zu der genannten Grundposition hin gedreht wird, der genannte Stopfenarm (277) aufgrund Schwerkraft, die auf den genannten Schwerpunkt des genannten gehobenen Stopfenarms (277) wirkt, den genannten Stopfenarm von der genannten gehobenen Position auf eine zu der genannten Platte (234; 236) parallelen Position abwärts dreht, wobei mindestens eine untere Platte (282) in der genannten Abflussleitungsöffnung platziert wird, wodurch die genannte Öffnung mit dem genannten äußeren aufwärts konkaven Manschettenabschnitt (280) verschlossen wird, wobei der Raum zwischen den genannten Platten und der genannten Öffnung abgedichtet wird.
14. Die Vorrichtung nach Anspruch 13, bei der der genannte Stopfenarm (277) ein Relief auf einer Unterseite des Arms distal von der genannten Stange (275) zur Erfassung des Arms durch ein Armhebegreifwerkzeug beinhaltet.
15. Die Vorrichtung nach Anspruch 13, bei der der genannte Stopfenarm (277) eine Vertiefung auf einem Ende des Arms distal von der genannten Stange (275) zur Erfassung des Arms durch ein Armhebegreifwerkzeug beinhaltet.

Revendications

1. Appareil pour permettre une ventilation à travers un puits de ventilation vertical à une gaine de ventilation souterraine communiquant de manière fluïdique à travers le puits de ventilation vers une ouverture à

l'atmosphère du puits et, lors d'un risque d'inondation, opérable manuellement pour empêcher un écoulement vers le bas de l'eau de ruissellement jusque dans la gaine de ventilation souterraine, comprenant

un support (210) comprenant des parois latérales opposées (224) pour un agencement dans ledit puits définissant un passage entre des ouvertures supérieure (226) et inférieure (220) du support pour une communication de fluïde de ladite gaine de ventilation vers le haut à travers ledit support jusqu'à ladite ouverture à l'atmosphère,

un ou plusieurs panneaux (234 ; 236) ayant des extrémités proximale et distale (234a ; 234b ; 236a ; 236b), un côté supérieur (232) et un côté inférieur (238), ladite extrémité proximale étant raccordée avec une articulation horizontale (243) ayant un axe d'articulation qui est perpendiculaire auxdites parois latérales opposées (224) pour une rotation dudit chaque panneau (234 ; 236) vers le haut jusqu'à une position de repos dressée n'obstruant pas ledit passage et une rotation à partir de ladite position de repos vers le bas en vertu d'une impulsion gravitationnelle sous son propre poids afin d'atteindre une position de fermeture de passage inférieure, lesdits un ou plusieurs panneaux ayant un profil qui ferme ledit passage lorsque ledit chaque panneau tourne de manière gravitationnelle vers ladite position de fermeture de passage, au moins une retenue qui limite ladite rotation vers le bas de chaque panneau vers ladite position de fermeture de passage inférieure, un élément de suspension (242 ; 244) enjambant de manière non obstructive dans le plan horizontal ledit passage (225) soutenu sur lesdites parois latérales opposées (224) à proximité de ladite ouverture supérieure (226) et maintenant lesdits un ou plusieurs panneaux raccordés par une articulation (234 ; 236) dans ledit passage à proximité de ladite ouverture inférieure,

un dispositif de maintien de panneau (240) pour maintenir ledit chaque panneau dans ladite position de repos dressée, comprenant :

un élément mobile (247 ; 249) porté soit par ledit un panneau (234 ; 236) ou par ledit élément de suspension (242 ; 244) en dessous dudit élément de suspension, et un élément non mobile (235 ; 235') porté par l'autre poste parmi le panneau (234 ; 236) ou l'élément de suspension ne portant pas ledit élément mobile,

ledit élément mobile (247 ; 249) saisissant et

maintenant ledit élément non mobile (235 ; 235') lorsque ledit panneau est tourné vers le haut jusqu'à ladite position de repos, un dispositif de libération de panneau (246 ; 252) pour ledit dispositif de maintien de panneau, comprenant une tringlerie raccordée audit élément de maintien de panneau mobile ou non mobile porté par ledit élément de suspension (242 ; 244), ladite tringlerie étant mobile relativement audit élément de suspension (242 ; 244) afin d'effectuer la translation dudit élément mobile ou non mobile pour libérer le panneau depuis ladite position de repos dressée et permettre audit panneau de tomber par rotation de manière gravitationnelle vers ladite position de fermeture de passage inférieure, une poignée de panneau (259) sur ledit côté supérieur desdits un ou plusieurs panneaux afin de relever manuellement de manière rotative lesdits un ou plusieurs parmi les panneaux depuis ladite position de fermeture de passage vers ladite position de repos, un bras de levage (260 ; 260') pour chaque panneau, chaque bras de levage ayant une extrémité proximale raccordée de manière pivotante par une broche-pivot (267) audit côté inférieur dudit un panneau (226) sur un axe de pivotement parallèle audit axe d'articulation (243a) et une extrémité distale (263), ledit chaque bras de levage (260) ayant une dimension lui permettant de mettre en contact ladite extrémité distale avec une desdites parois latérales opposées (224) lorsque ladite extrémité distale est pivotée vers le haut à l'intérieur de ladite paroi latérale pour exercer une force latérale sur ledit panneau raccordé qui est relevé avec ladite poignée de panneau (259) afin d'achever la rotation dudit panneau jusque dans ladite position de repos, et un drain (270) dans au moins un desdits un ou plusieurs panneaux (234 ; 236) entre lesdites extrémités proximale et distale de ceux-ci, ledit drain (270) comprenant un conduit (271) qui passe à travers ledit panneau (234 ; 236), ledit conduit (271) ayant une ouverture (272) au niveau dudit côté supérieur de panneau (231) et une fermeture de drain à actionnement automatique (273) sur ledit chaque panneau ayant un drain, ladite fermeture comprenant un obturateur (274) apte à tourner de manière pivotante sur un axe d'obturateur de drain (275) positionné entre ledit conduit de drain (270) et ladite extrémité distale dudit chaque panneau, ledit axe d'obturateur de drain (275) étant en parallèle auxdits axes d'articulation horizontaux, ledit obturateur étant apte à pivoter manuellement vers le haut sur ledit axe d'obturateur de drain afin d'enlever ledit obturateur de ladite ouverture de drain pour drainer l'eau contenue au-dessus

desdits un ou plusieurs panneaux lorsque ledit chaque panneau se trouve dans ladite position de fermeture de passage, ledit obturateur en vertu de l'impulsion gravitationnelle sous son propre poids pivotant automatiquement vers le bas afin de placer ledit obturateur dans ladite ouverture de conduit lorsque ledit panneau contenant ledit drain est relevé de manière pivotante vers le haut jusqu'à ladite position de repos, de ce fait l'ouverture de conduit est déjà fermée lorsque le panneau tourne de manière gravitationnelle vers le bas jusqu'à ladite position de fermeture de passage.

2. Appareil de la revendication 1 dans lequel ladite ouverture à l'atmosphère est rectiligne et ledit support (210) est quadrilatéral, et dans lequel lesdites parois latérales opposées (224) s'attachent chacune centralement dans ledit passage adjacent à ladite ouverture supérieure à un berceau (211) ayant une paire de bras verticaux parallèles espacés l'un de l'autre se raccordant à et se tenant en position dressée sur une barre horizontale (242) afin de recevoir et de soutenir de manière détachable par levage ladite poutrelle au sein desdits bras verticaux et sur ladite barre horizontale (242).
3. Appareil de la revendication 2 dans lequel ledit support quadrilatéral (210) a au moins un indicateur sur au moins une paroi latérale adjacente auxdites parois latérales opposées (224) afin d'indiquer l'endroit où une structure sur un panneau (234 ; 236) est localisée en dessous de l'indicateur, et dans lequel ledit élément de suspension (242 ; 244) a des extrémités dont chacune porte une clavette s'étendant latéralement par-devant un côté de l'élément de suspension, et dans lequel ledit chaque berceau (211) est claveté pour recevoir ladite clavette uniquement dans un bras du berceau de sorte que ledit un panneau ayant cette structure est localisé en dessous dudit indicateur.
4. Appareil de la revendication 1 dans lequel ledit élément non mobile dudit dispositif de maintien de panneau (240) comprend un taquet de verrou (235 ; 235') et ledit élément mobile (247 ; 249) dudit dispositif de maintien de panneau comprend un verrou apte à être mis en prise avec ledit taquet de verrou (235 ; 235').
5. Appareil de la revendication 4 dans lequel ledit côté supérieur de panneau (238) inclut ledit taquet de verrou (235 ; 235') et ledit verrou (247 ; 249) est porté par ledit élément de suspension (242 ; 244).
6. Appareil de la revendication 4 dans lequel ledit côté supérieur de panneau (238) inclut ledit verrou (247 ; 249) et ledit taquet de verrou (235 ; 235') est porté

par ledit élément de suspension (242 ; 244).

7. Appareil de la revendication 1 dans lequel lesdits bras de levage (260 ; 260') sont sollicités par ressort pour forcer les extrémités distales par rotation vers l'extérieur et vers le haut. 5
8. Appareil de la revendication 7 dans lequel un ressort (257 ; 257') est enroulé centralement autour de ladite broche-pivot de bras de levage (267), le ressort se terminant sur des première et deuxième extrémités opposées ayant une portion droite comprenant une tige proximale (257a) et une portion distale (257) recourbée à angle droit par rapport à la tige, la portion distale de la première extrémité s'étendant par mise en prise en travers d'une face inférieure du bras de levage à proximité de la broche-pivot (267) et la portion distale de la deuxième extrémité s'étendant par mise en prise en travers d'une face supérieure du bras de levage (260) plus distante de la broche-pivot (267) que la portion distale de la première extrémité. 10
9. Appareil de la revendication 8 comprenant en outre un étau (266 ; 268) pour chaque bras de levage (260), une broche-pivot d'étau adjacente à ladite broche-pivot de bras de levage (267) raccordant de manière pivotante une extrémité supérieure de chaque étau (266 ; 266'), une extrémité inférieure dudit étau (266 ; 268) en inclinaison vers l'extérieur vers un bras de levage adjacent (260 ; 260') pour s'étendre en travers et se mettre au contact de manière libérable d'une portion proximale dudit côté supérieur du bras de levage, la sollicitation par ressort pressant lesdits bras de levage contre lesdits étais limitant lesdits bras de levage contre une rotation vers l'extérieur et vers le haut. 25 30 35
10. Appareil de la revendication 9 dans lequel ledit chaque bras de levage (260 ; 260') a une configuration au niveau d'une portion inférieure dudit bras pour une mise en prise par un outil à portée (290) qui est abaissé verticalement à partir de ladite ouverture à l'atmosphère afin de se mettre en prise avec et tirer par pivotement le bras de levage (260 ; 260') vers le haut de telle sorte que ladite extrémité distale du bras se déplace vers le haut sur ladite paroi latérale. 40 45
11. Appareil de la revendication 9 dans lequel ledit étau (260 ; 260') est libérable par un outil à portée (290) qui est abaissé verticalement à partir de ladite ouverture à l'atmosphère, ce qui permet à l'extrémité distale sollicitée par ressort dudit bras de levage (260 ; 260') de pivoter latéralement vers l'extérieur pour une capture par ledit outil à portée qui est abaissé verticalement à partir de ladite ouverture à l'atmosphère afin de se mettre en prise avec et tirer par pivotement le bras de levage (260 ; 260') vers le haut de telle sorte que ladite extrémité distale du bras de 50 55

levage(260 ; 260') se déplace vers le haut sur ladite paroi latérale.

12. Appareil de la revendication 1 dans lequel ledit obturateur (274) comprend en outre une garniture d'étanchéité concave vers le haut (280) autour de ladite périphérie d'obturateur afin d'étanchéifier tout espace entre ladite périphérie d'obturateur et ladite ouverture de conduit lorsque ledit panneau contenant ledit obturateur (274) se trouve dans ladite position de fermeture de passage.
13. Appareil de la revendication 1 dans lequel ledit chaque panneau (234 ; 236) contenant ledit un drain (270) a des montants espacés (276 ; 276') montés de manière fixe sur ledit côté supérieur dudit chaque panneau (234 ; 236) entre ledit drain (270) et ladite extrémité distale dudit chaque panneau (234 ; 236), et dans lequel ledit axe d'obturateur de drain comprend une tige (275) soutenue en parallèle audit axe d'articulation horizontal par lesdits montants (276 ; 276') et s'étend entre lesdits montants au-dessus dudit côté supérieur de panneau, ladite chaque fermeture de drain comprenant :

un bras d'obturateur (277) apte à tourner de manière pivotante au niveau d'une extrémité proximale dudit bras avec ou sur ladite tige (275) pour permettre un mouvement dudit bras jusqu'à une position d'ouverture de drain relevée et jusqu'à une position de fermeture de drain abaissée, ledit bras d'obturateur comprenant une saillie d'attache qui est éloignée de ladite tige (275), une garniture d'étanchéité concave vers le haut (280), une plaque supérieure (281) et une plaque inférieure (282), toutes les deux ayant une dimension plus petite que ladite garniture (280), ladite garniture d'étanchéité concave (280) étant assujettie entre lesdites plaques supérieure et inférieure (281 ; 282), au moins ladite plaque inférieure (282) ayant une dimension configurée de façon à entrer dans et obturer ladite ouverture de conduit, lesdites plaques (281 ; 282) exposant une portion de garniture concave vers le haut s'étendant au-dessus de ladite plaque inférieure (282), lesdites plaques étant raccordées de manière fixe audit bras au niveau de ladite saillie d'attache qui localise un centre de gravité dudit bras devant ledit axe-pivot de ladite tige (275) dans ladite direction dudit drain (270), de sorte qu'après un panneau (234 ; 236) contenant ledit drain (270) présente ledit un bras d'obturateur (277) dans ladite position relevée pour drainer l'eau au-dessus du panneau pendant que ledit panneau se trouve dans ladite position de fermeture de passage, lorsque ledit panneau contenant ledit drain (270) avec ledit

bras d'obturateur (277) en position relevée est tourné vers le haut vers ladite position de repos, ledit bras d'obturateur (277) en raison de la gravité qui agit sur ledit centre de gravité dudit bras d'obturateur relevé (277) tourne ledit bras d'obturateur vers le bas à partir de ladite position relevée jusqu'à une position parallèle audit panneau (234 ; 236), plaçant au moins ladite plaque inférieure (282) dans ladite ouverture de conduit de drain ce qui permet ainsi de fermer ladite ouverture avec ladite portion de garniture concave externe vers le haut (280) étanchéifiant l'espace entre lesdites plaques et ladite ouverture.

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14. Appareil de la revendication 13 dans lequel ledit bras d'obturateur (277) inclut un élément en relief sur une sous-face du bras qui est distale par rapport à ladite tige (275) pour capturer le bras à l'aide d'un outil à portée de levage de bras.

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15. Appareil de la revendication 13 dans lequel ledit bras d'obturateur (277) inclut un renforcement sur une extrémité du bras qui est distale par rapport à ladite tige (275) pour capturer le bras à l'aide d'un outil à portée de levage de bras.

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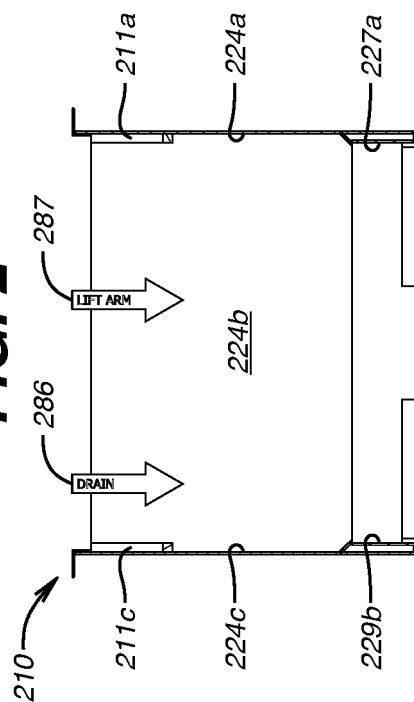
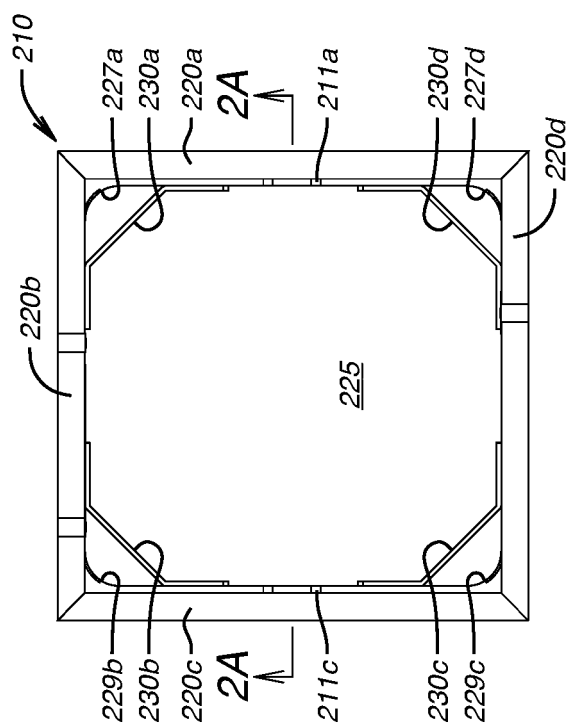


FIG. 2A

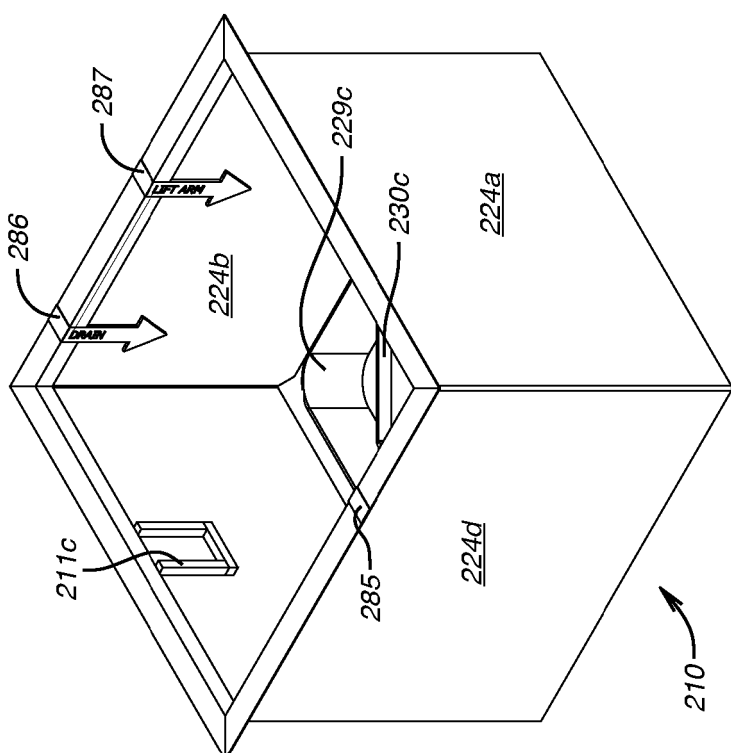


FIG. 1

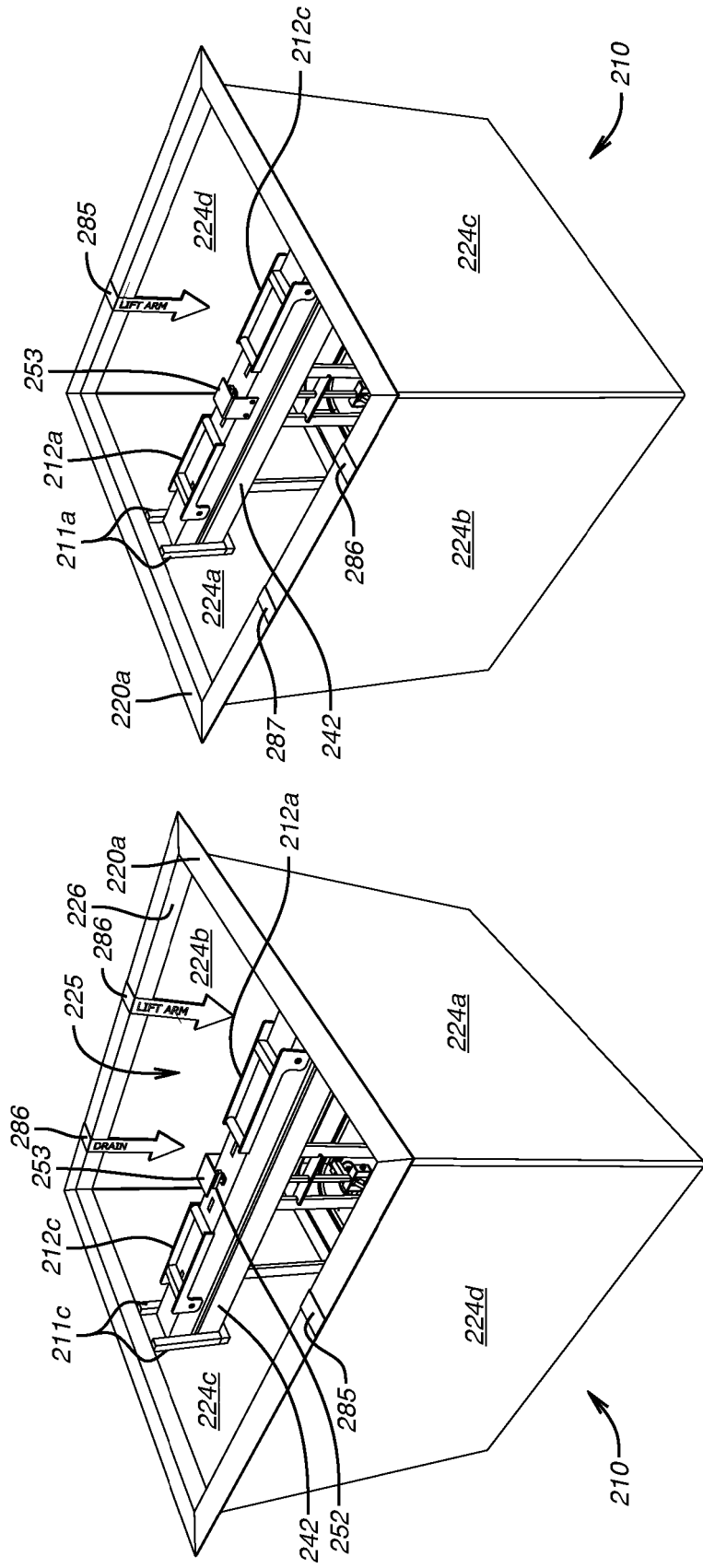


FIG. 4

FIG. 3

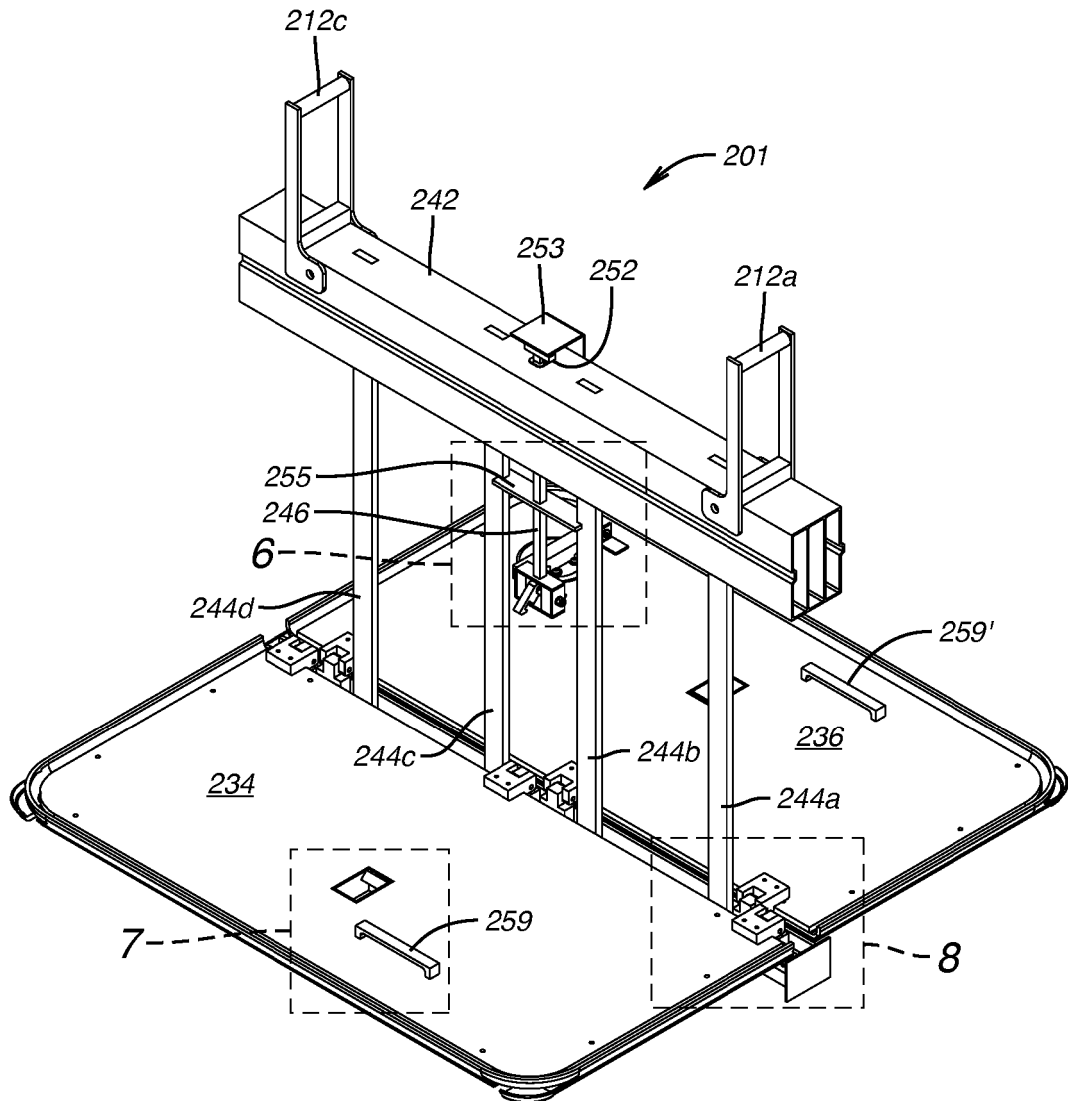


FIG. 5

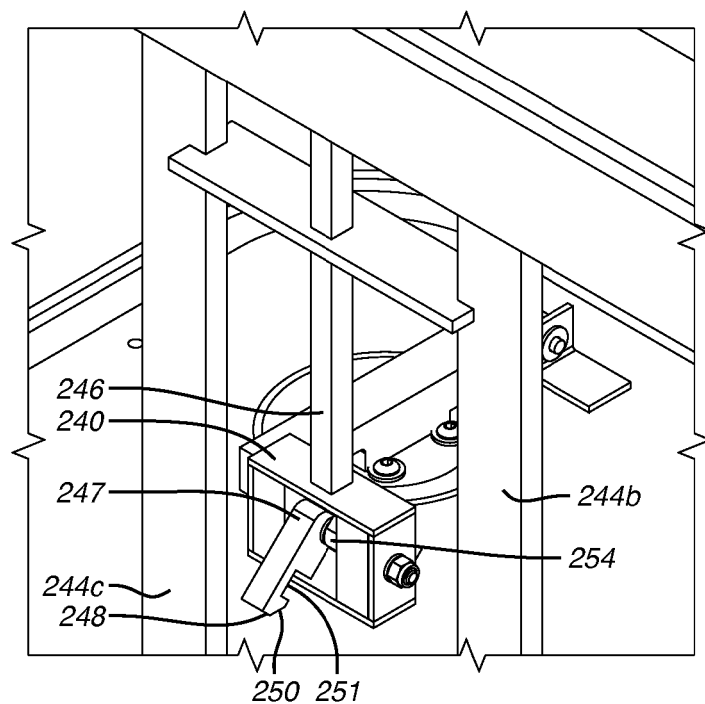


FIG. 6

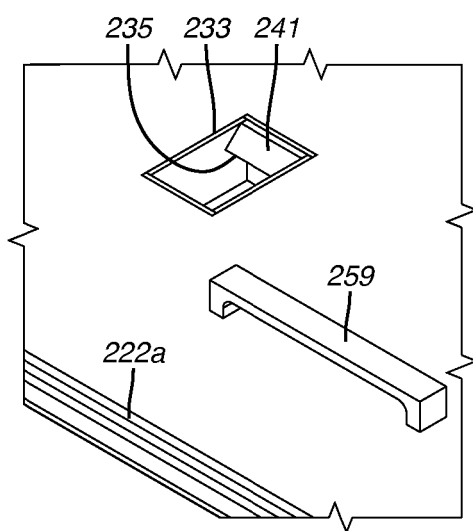


FIG. 7

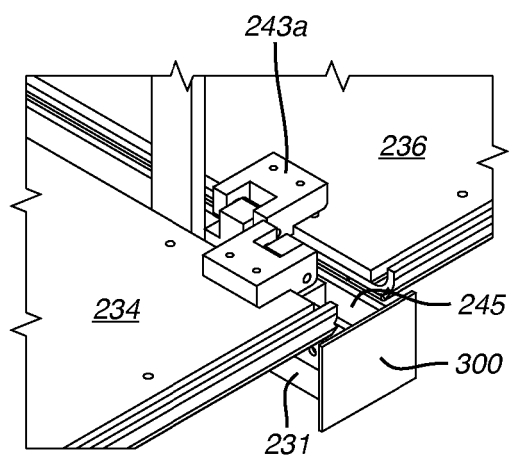


FIG. 8

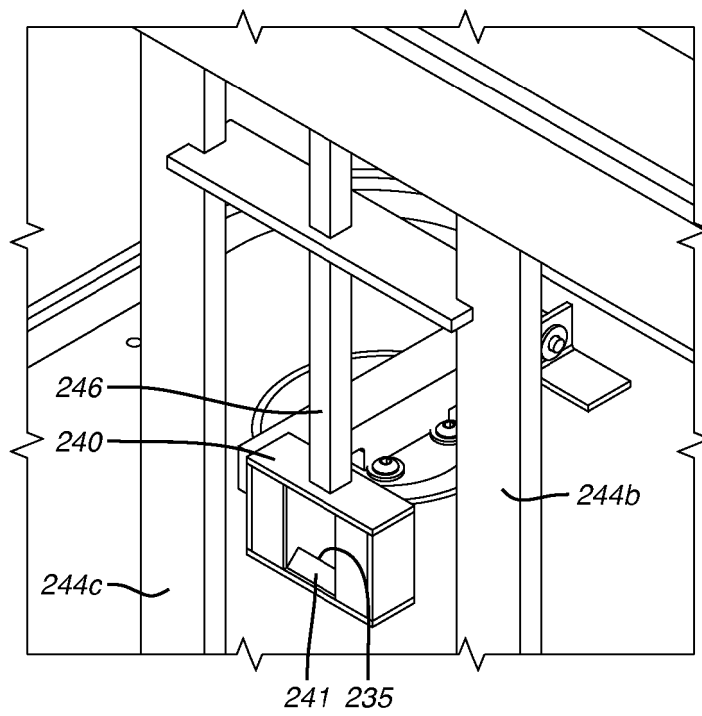


FIG. 9

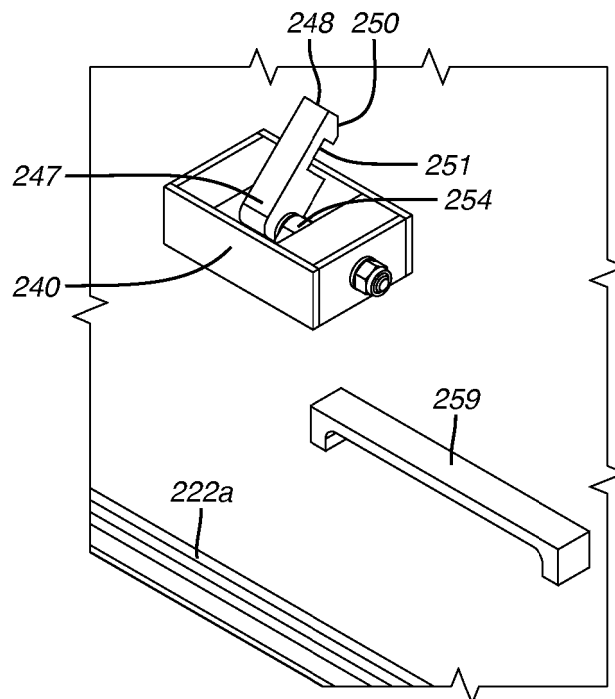


FIG. 10

+

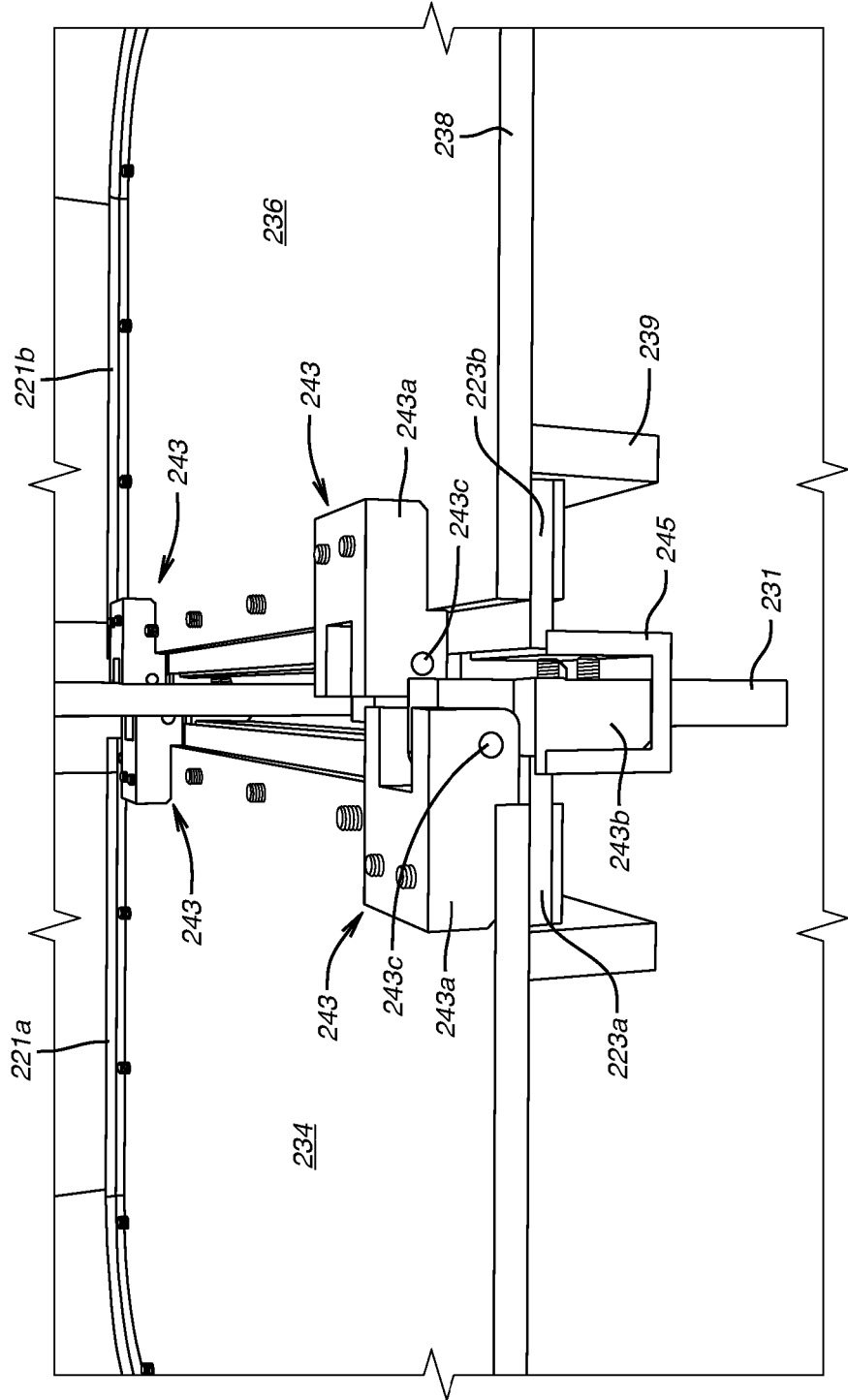


FIG. 11

+

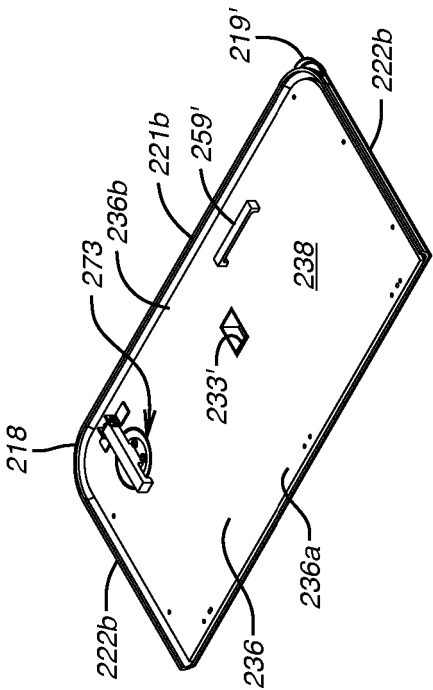


FIG. 12A

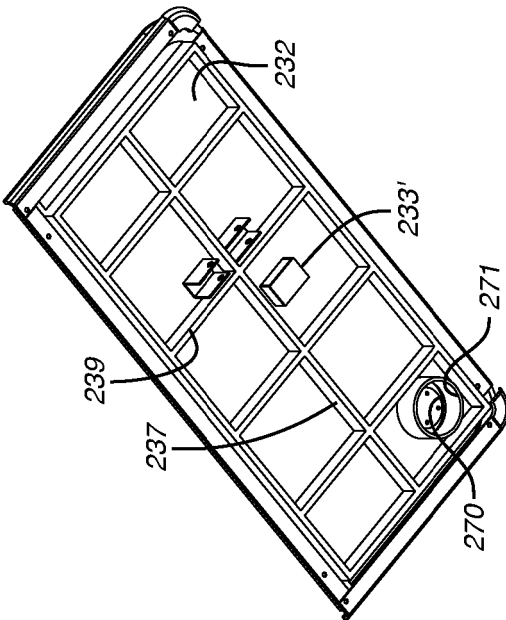


FIG. 12B

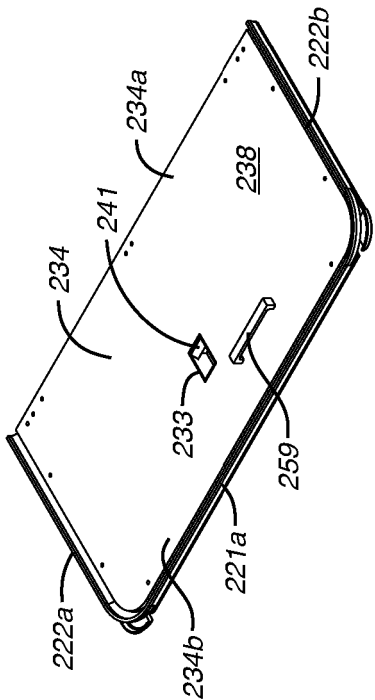


FIG. 13A

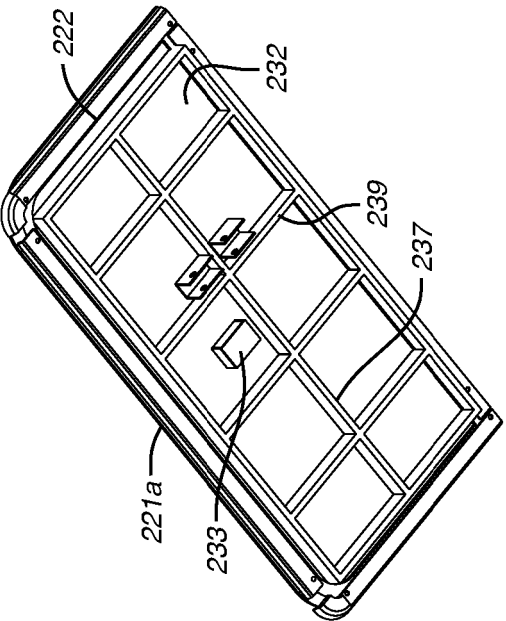


FIG. 13B

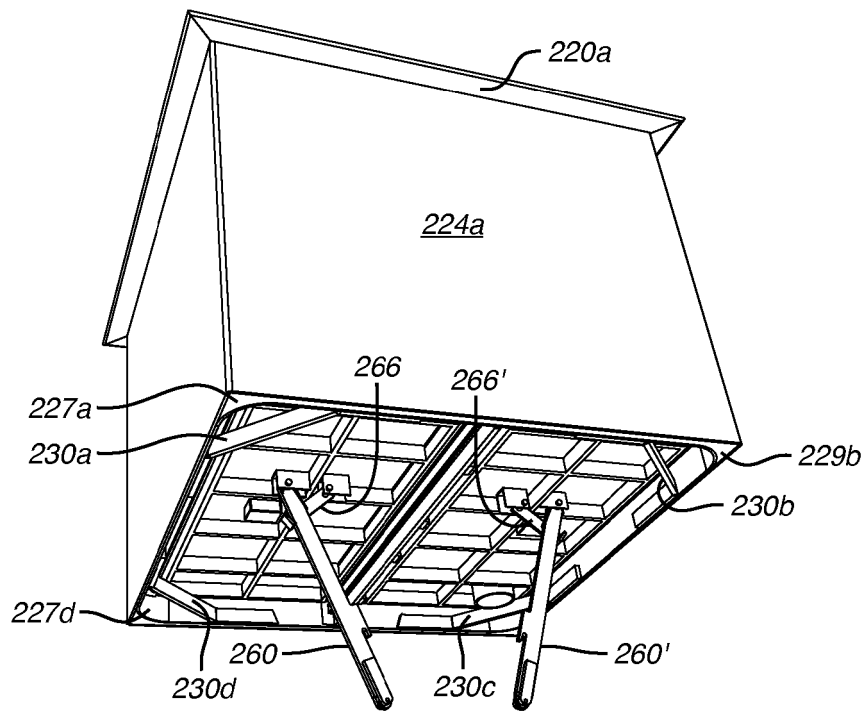


FIG. 14

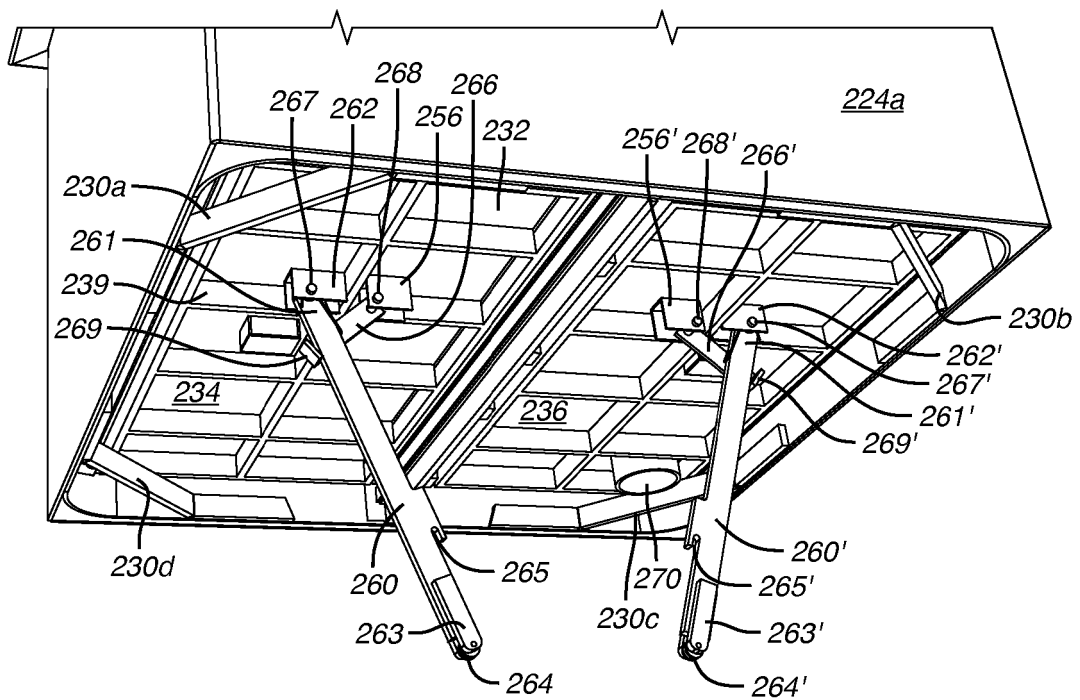


FIG. 14A

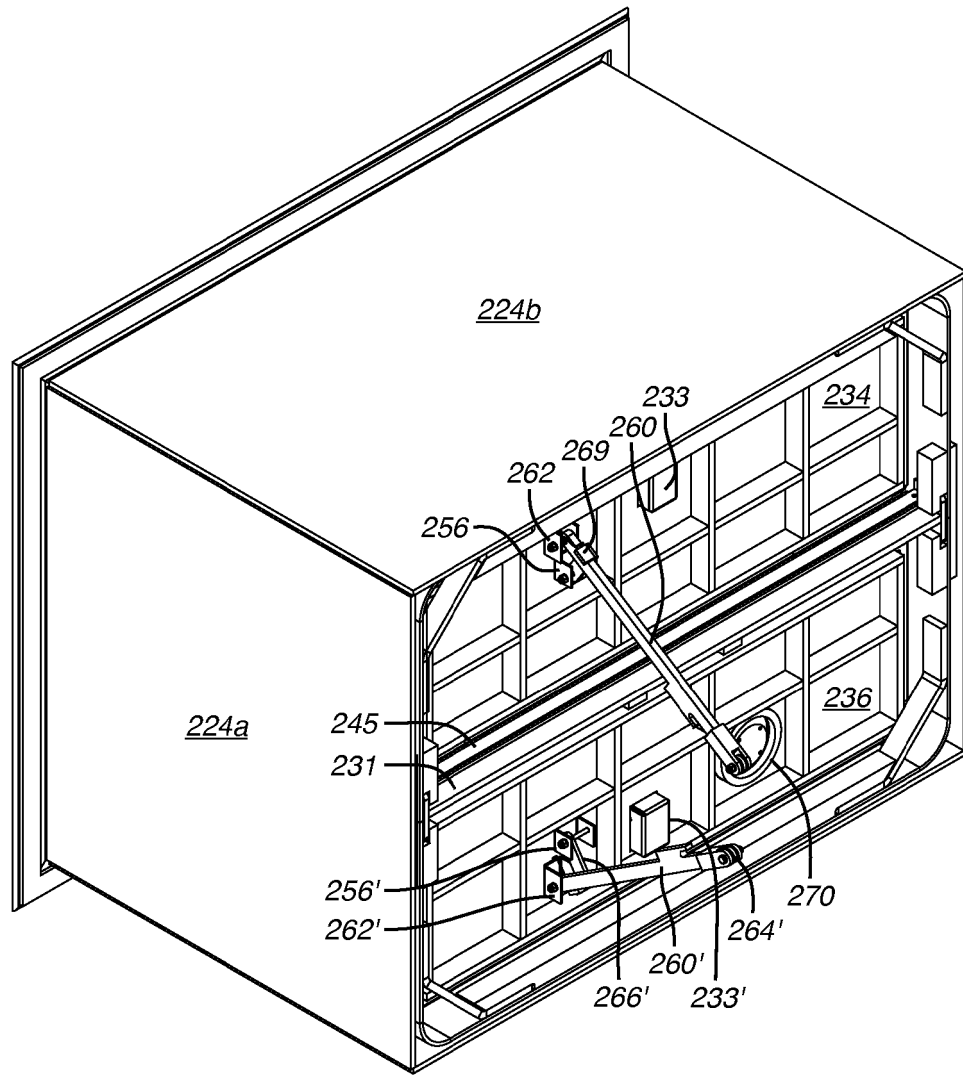


FIG. 15

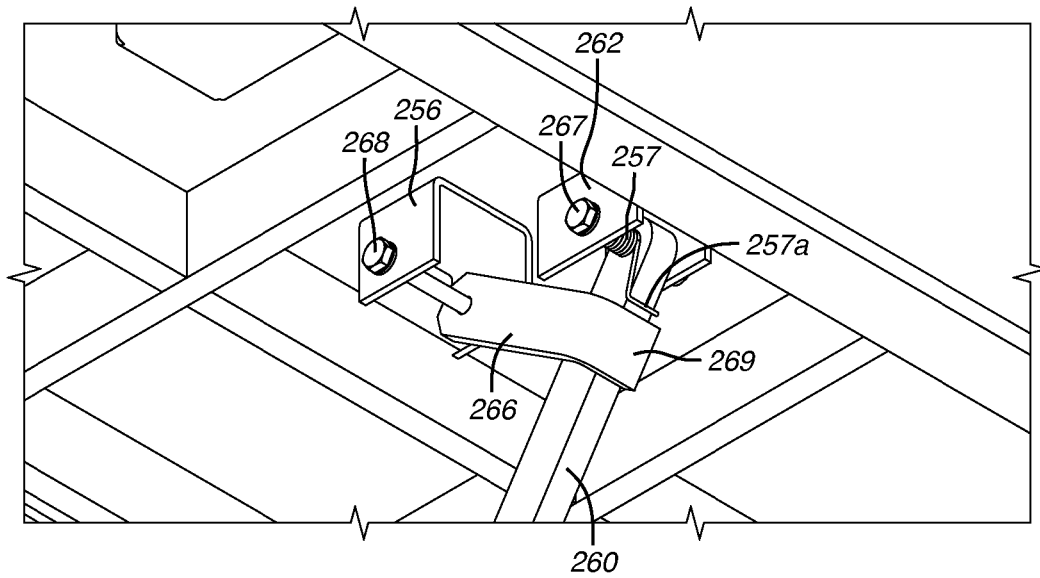


FIG. 16

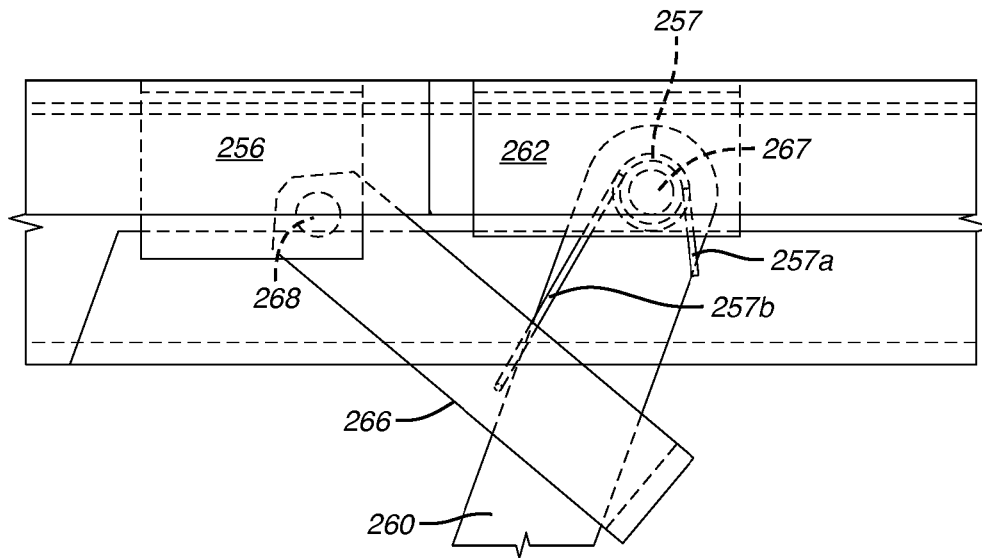


FIG. 17

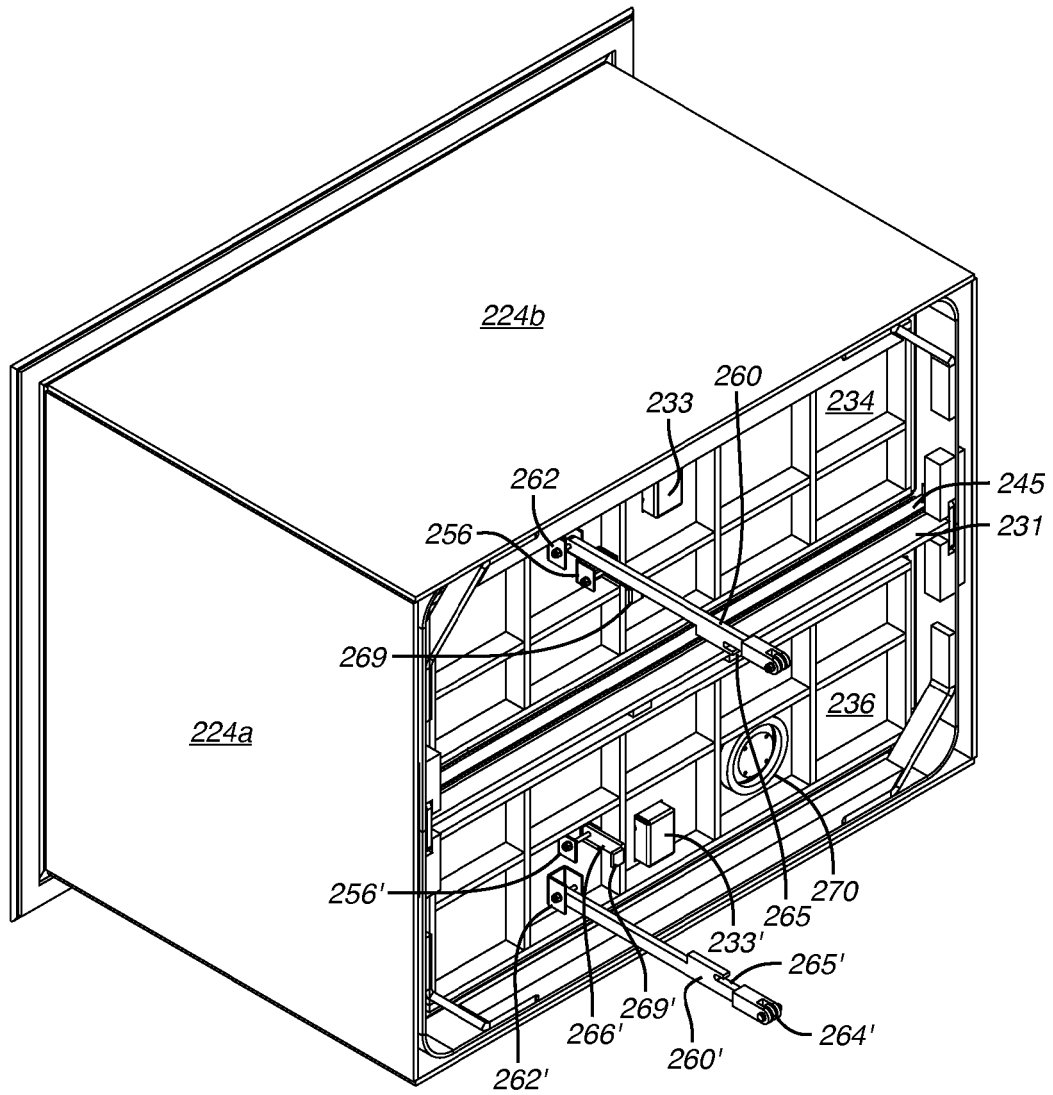


FIG. 18

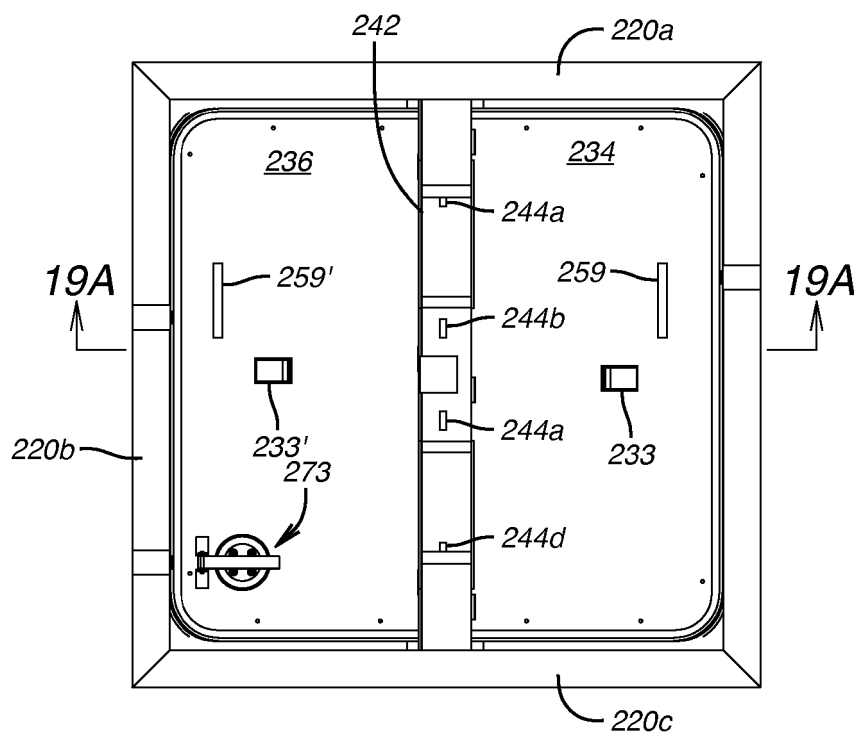


FIG. 19

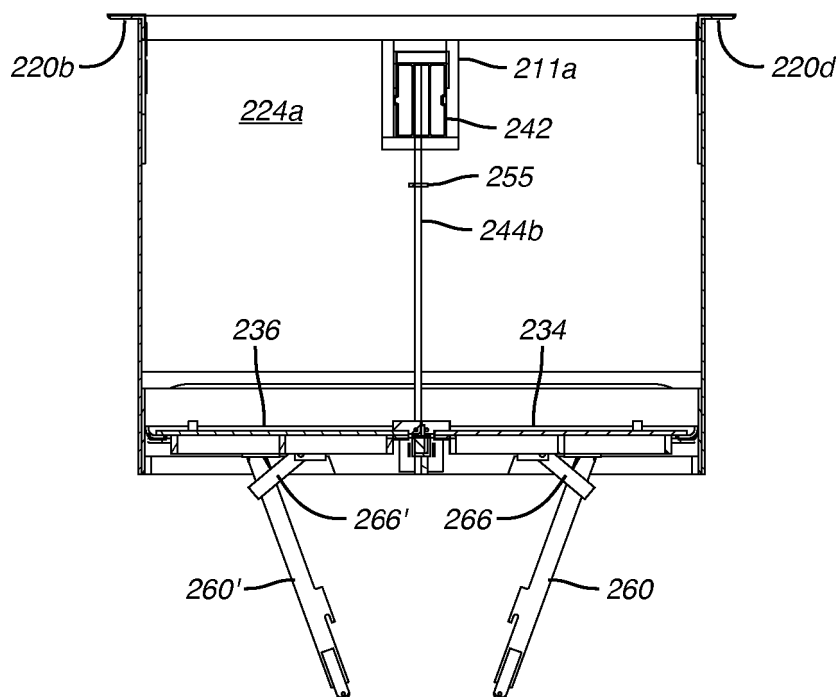


FIG. 19A

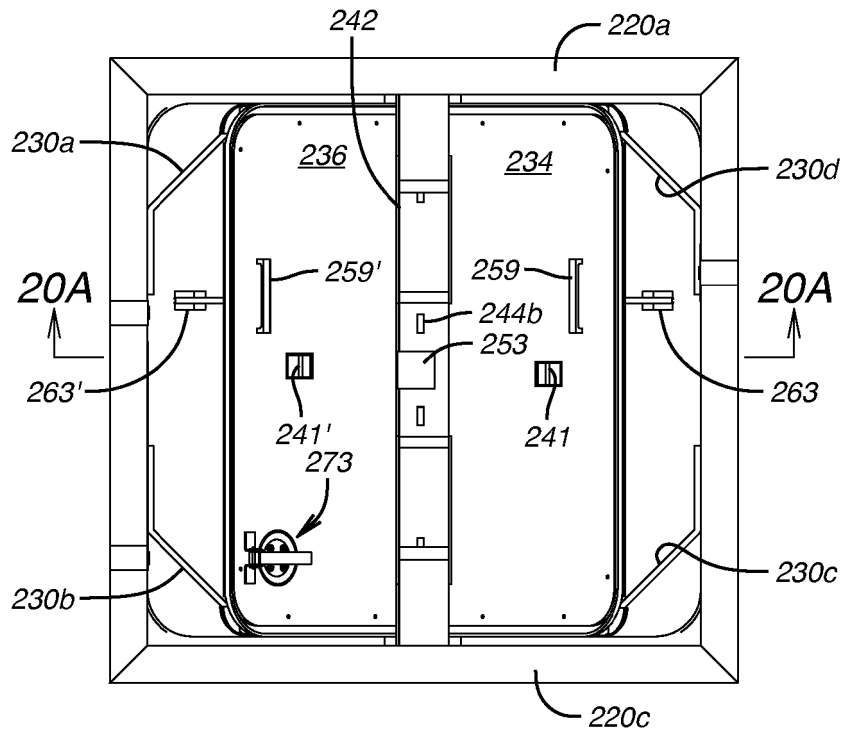


FIG. 20

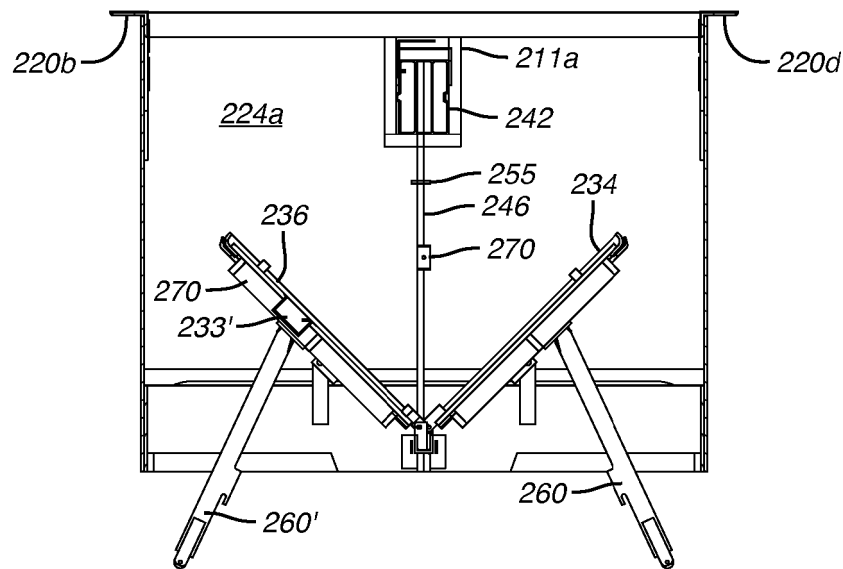


FIG. 20A

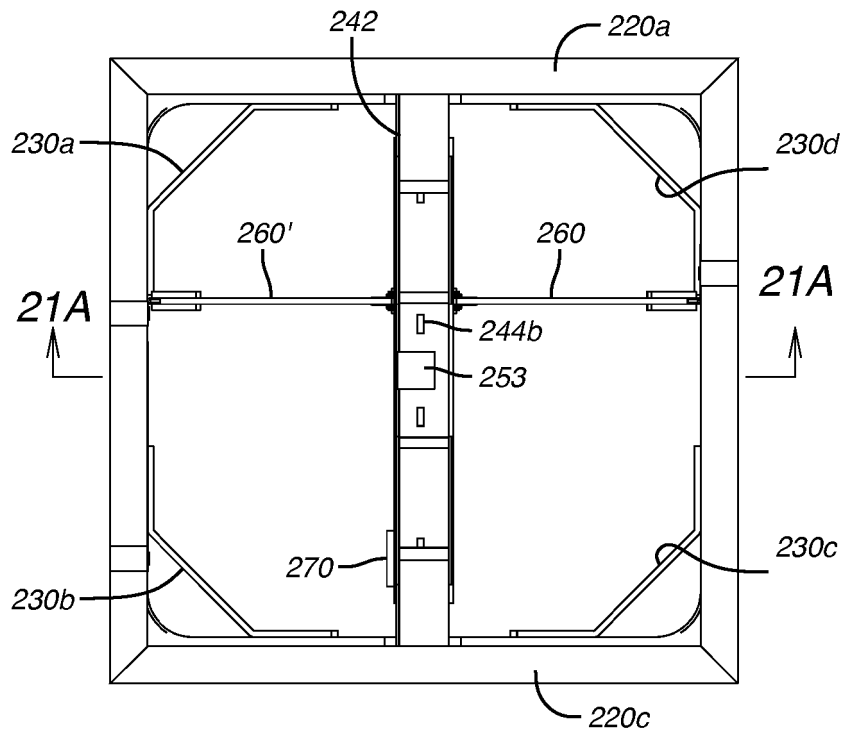


FIG. 21

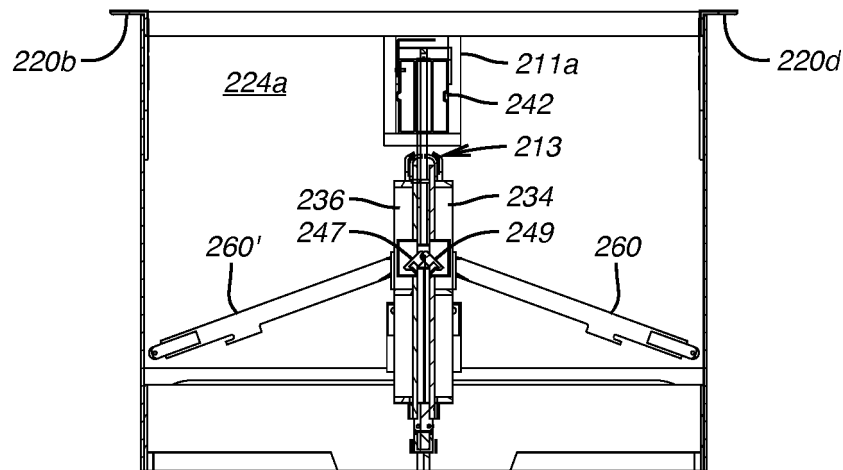


FIG. 21A

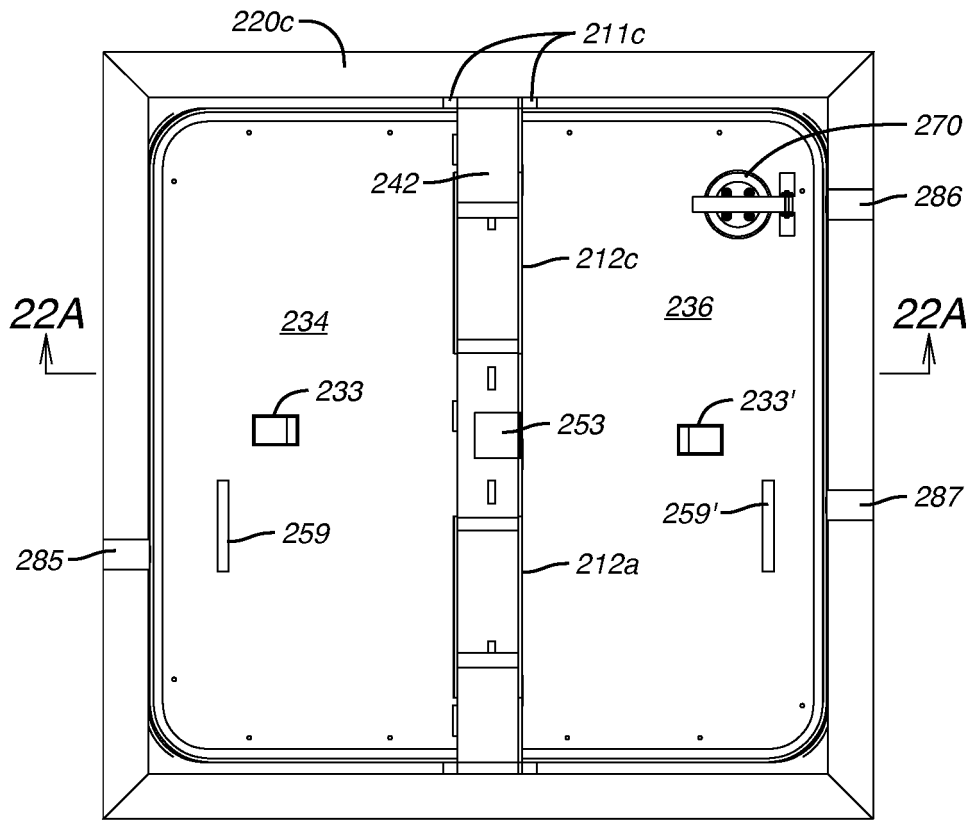


FIG. 22

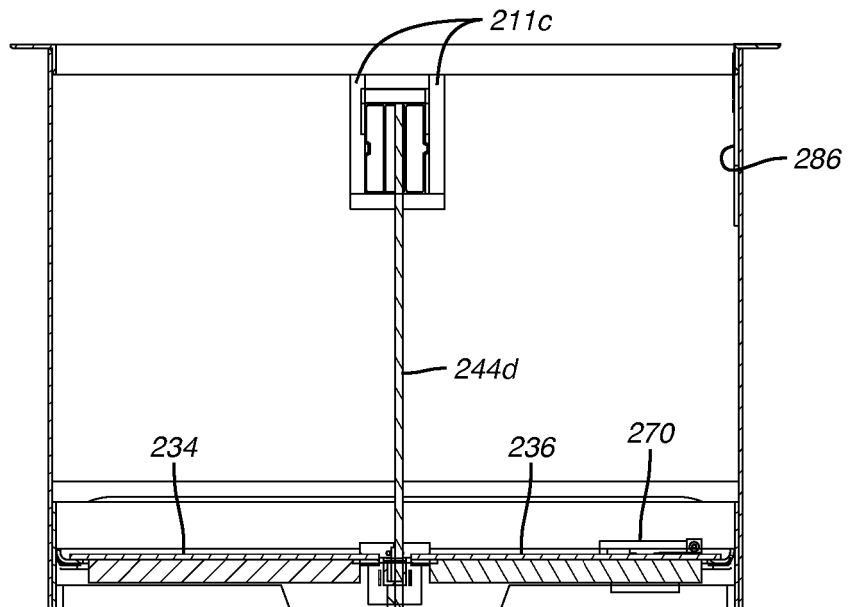


FIG. 22A

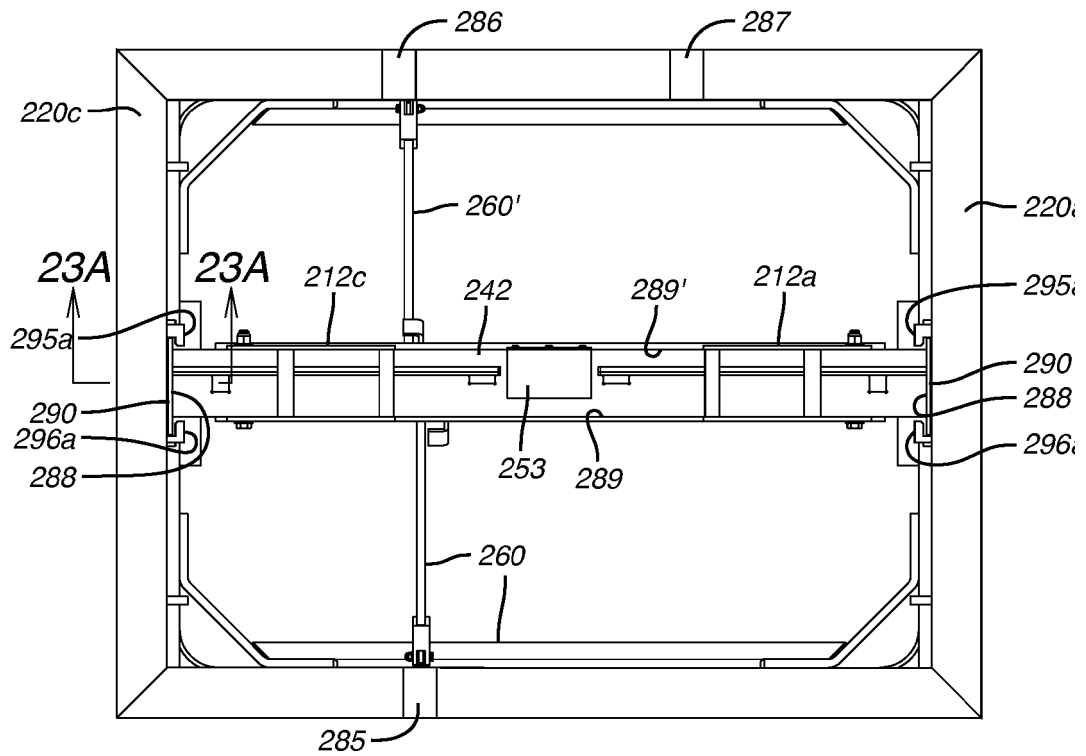


FIG. 23

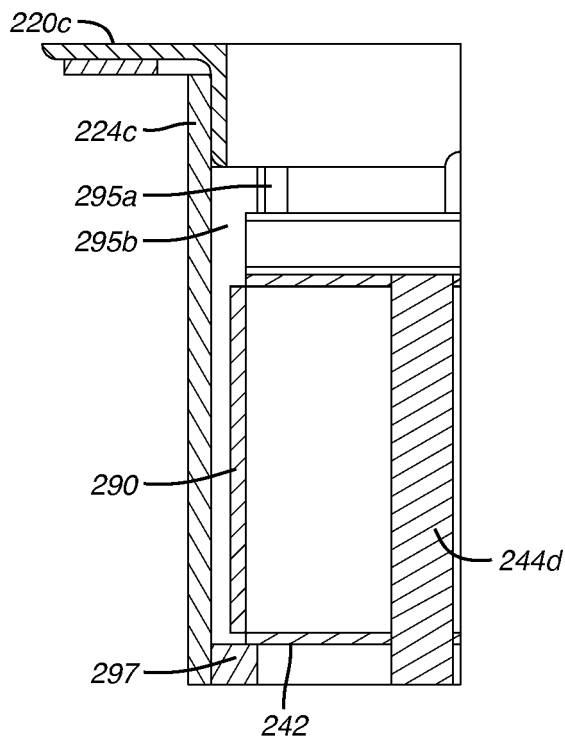


FIG. 23A

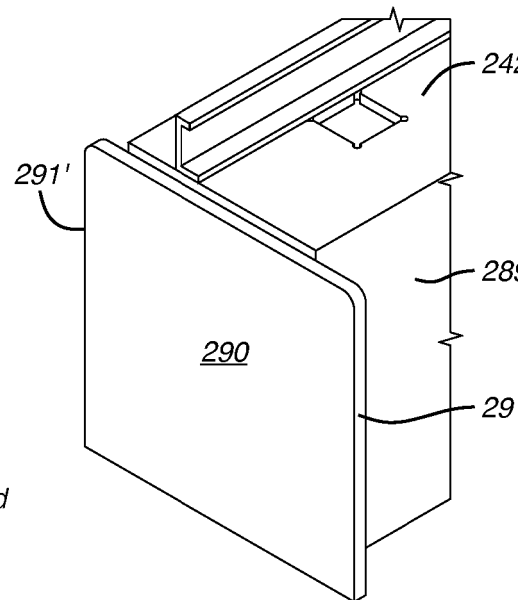


FIG. 24

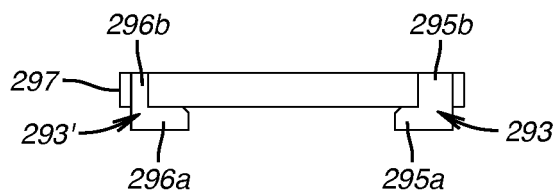


FIG. 28

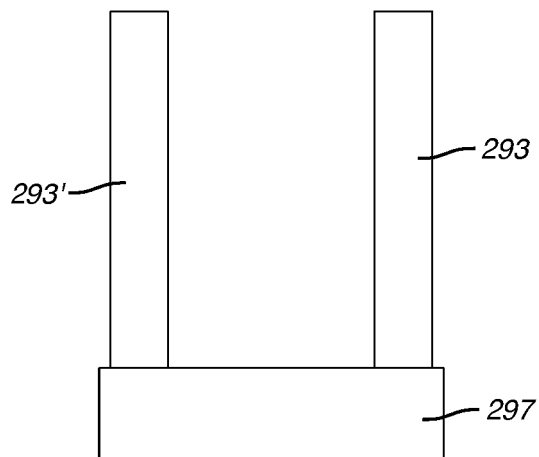


FIG. 25

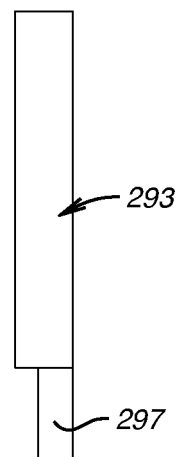


FIG. 27

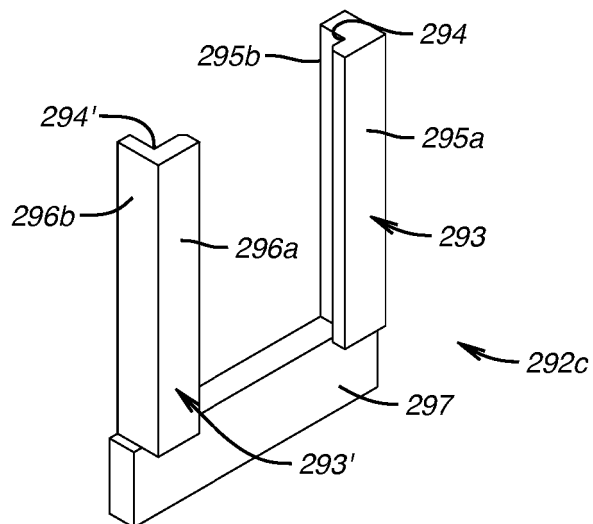


FIG. 26

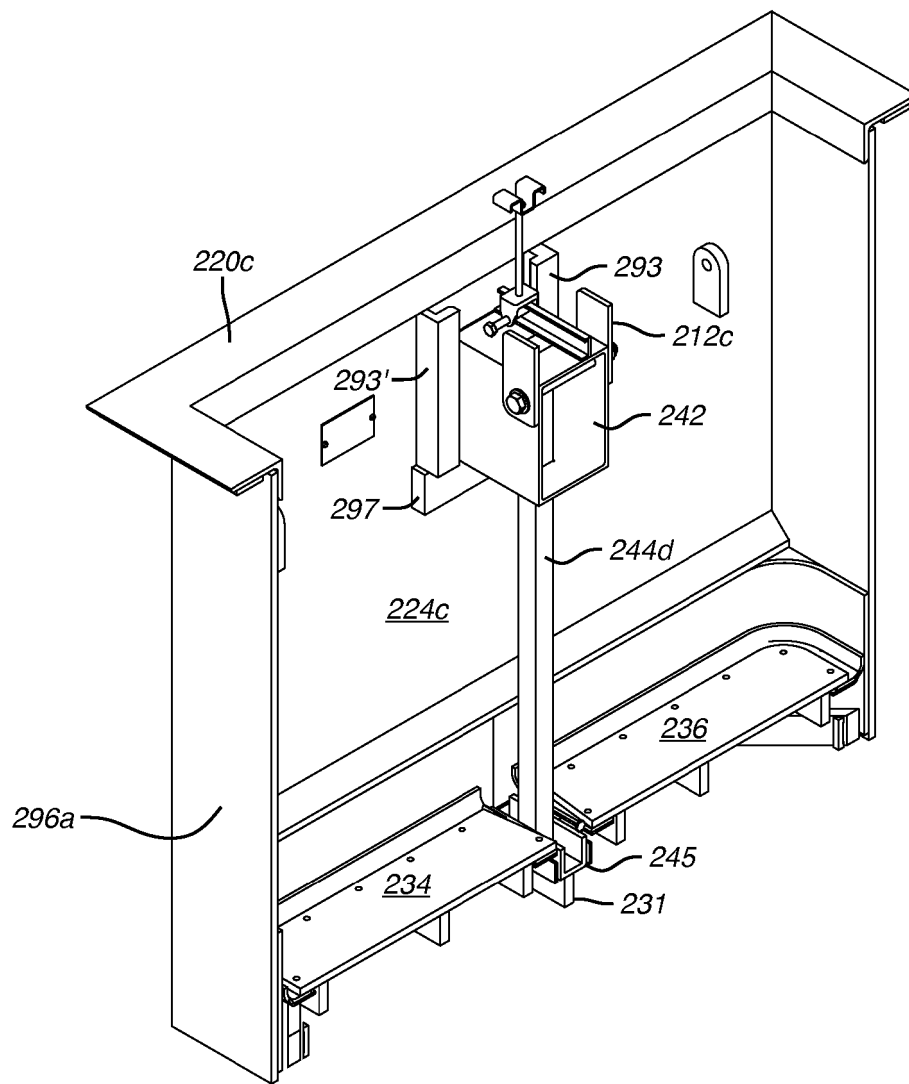


FIG. 29

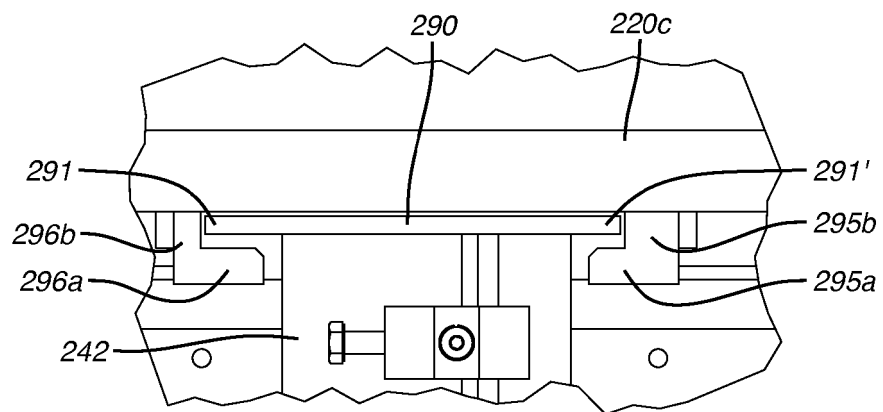


FIG. 30

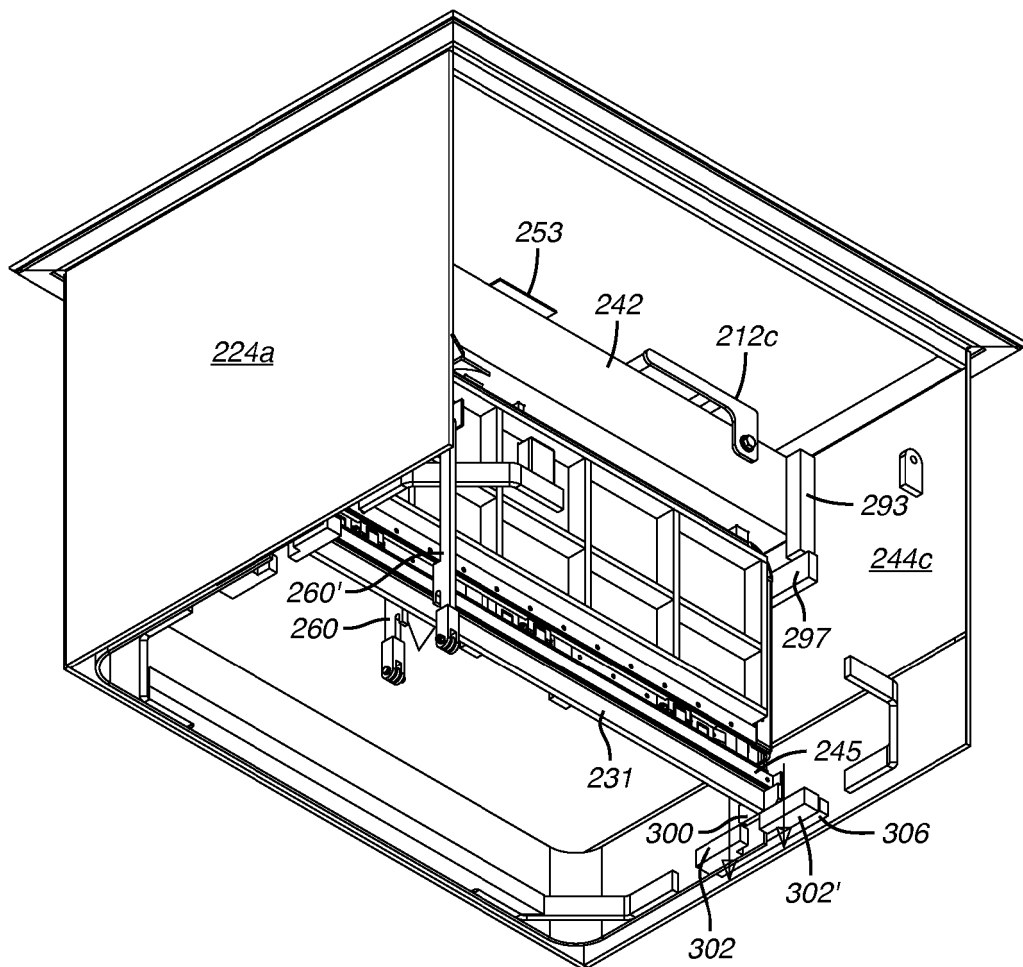


FIG. 31

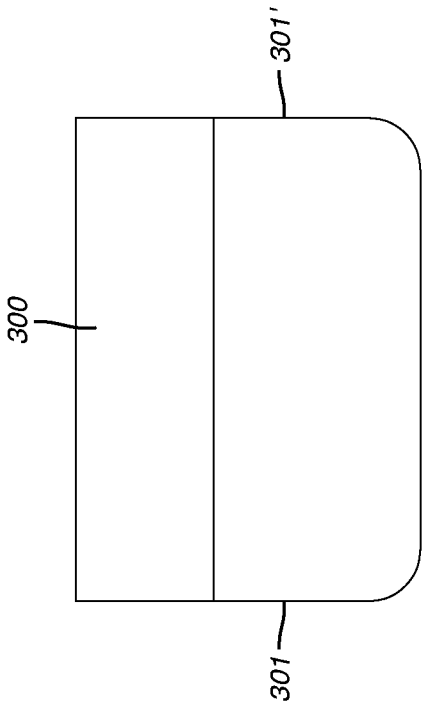


FIG. 32

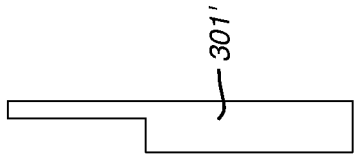


FIG. 33

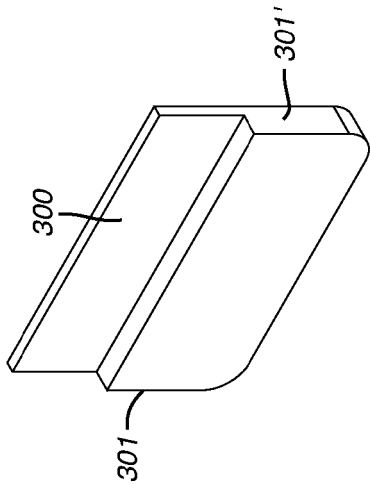


FIG. 34

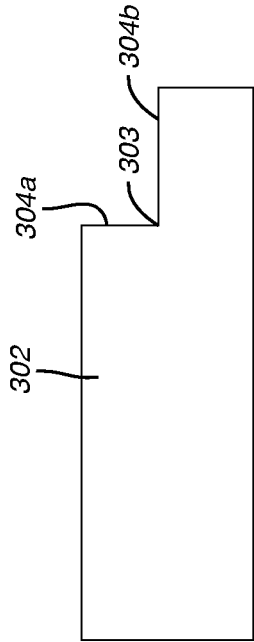


FIG. 35

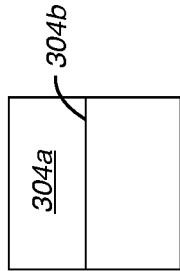


FIG. 36

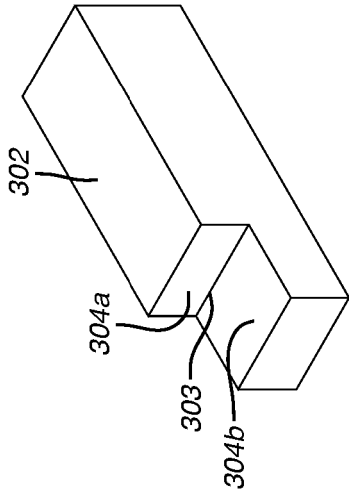


FIG. 37

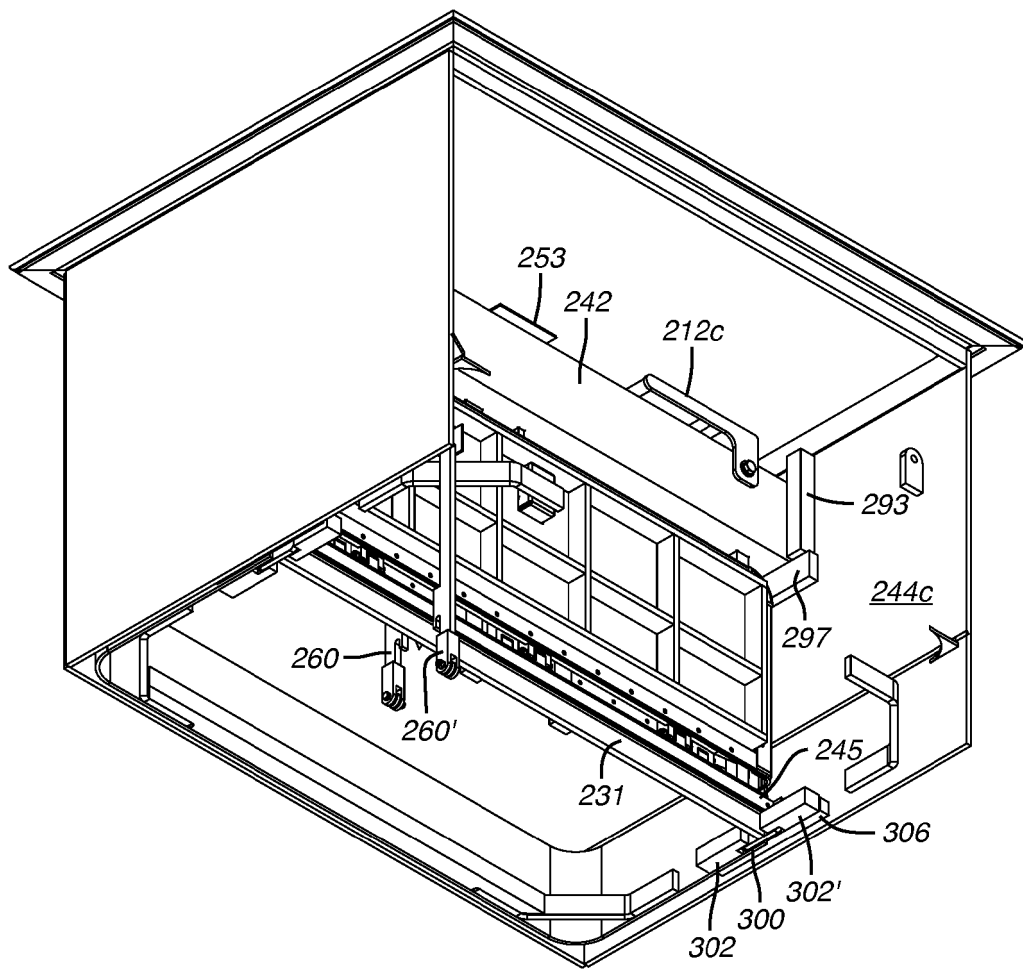


FIG. 38

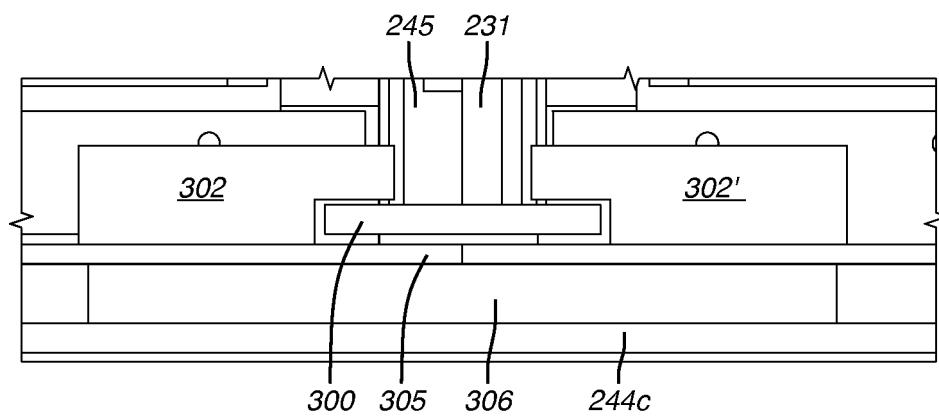


FIG. 39

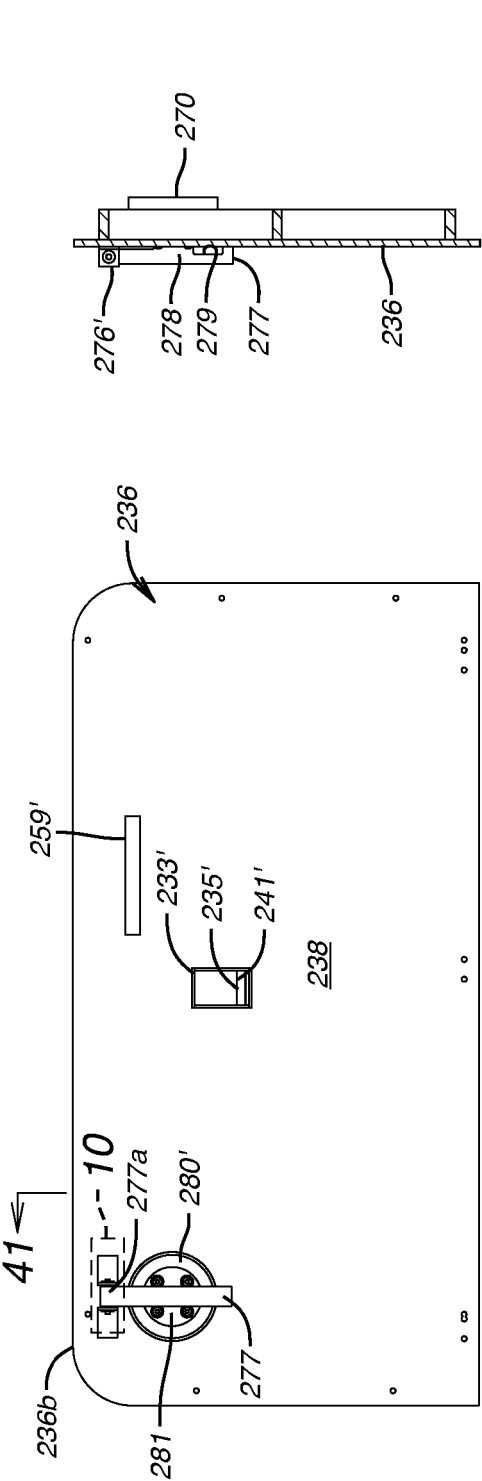


FIG. 40

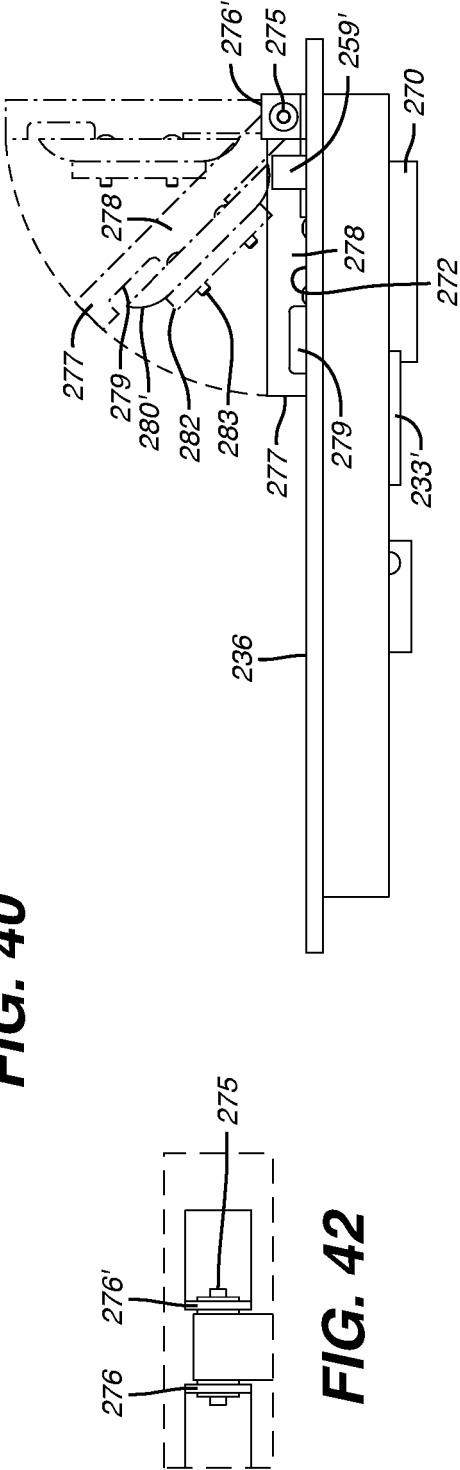


FIG. 41

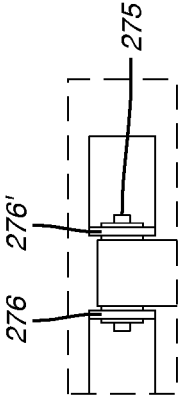
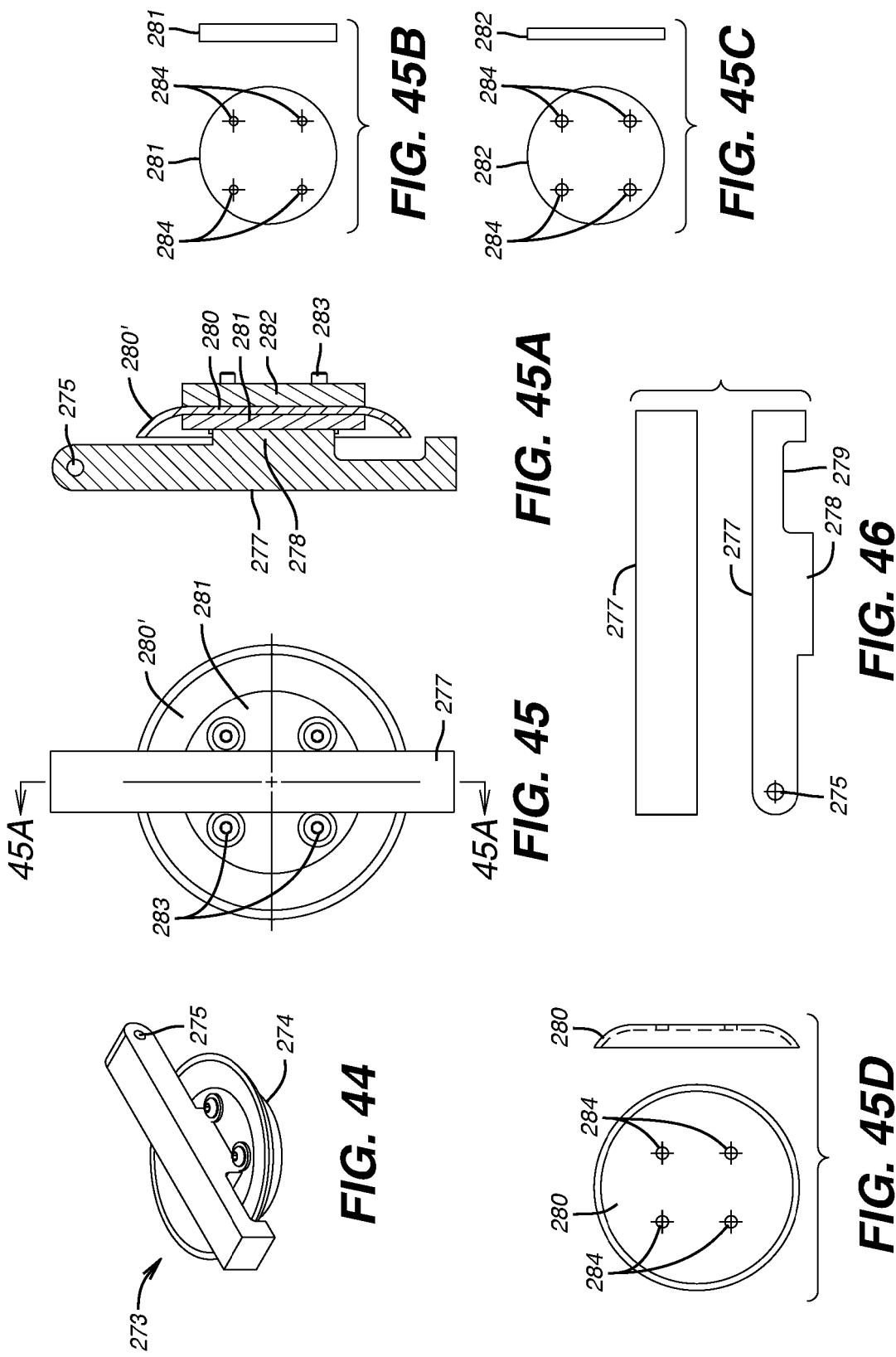


FIG. 42

FIG. 43



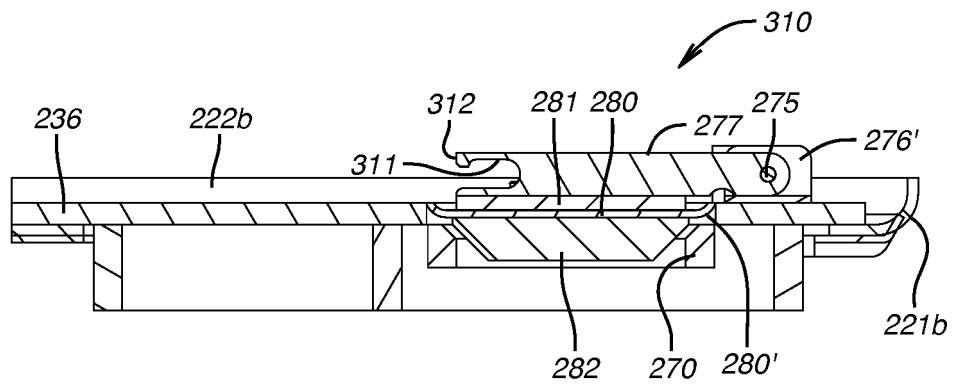


FIG. 47

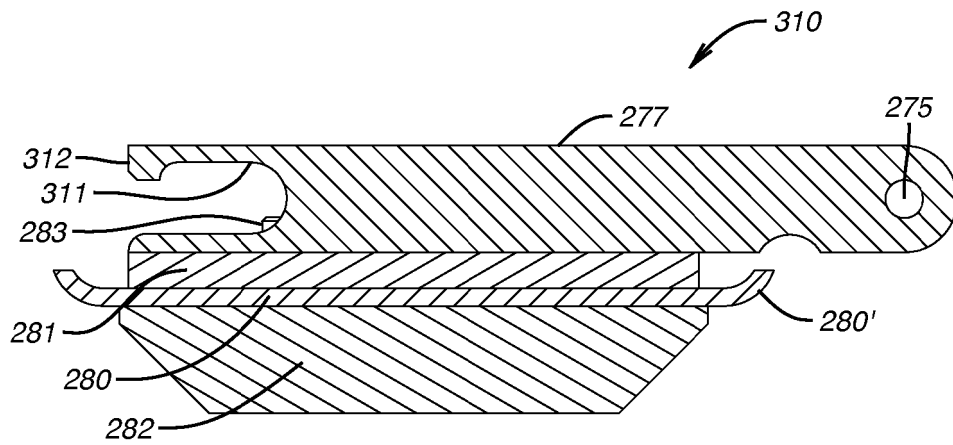


FIG. 48

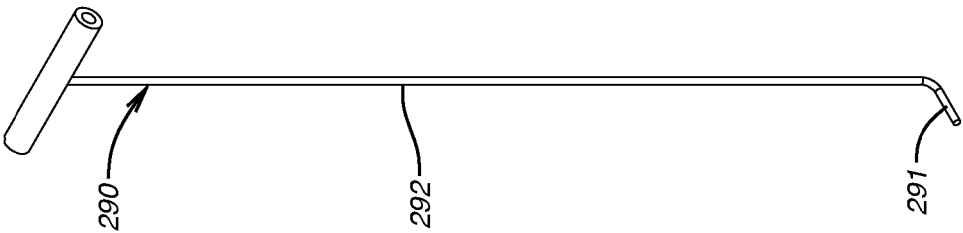


FIG. 49A



FIG. 49B



FIG. 49C

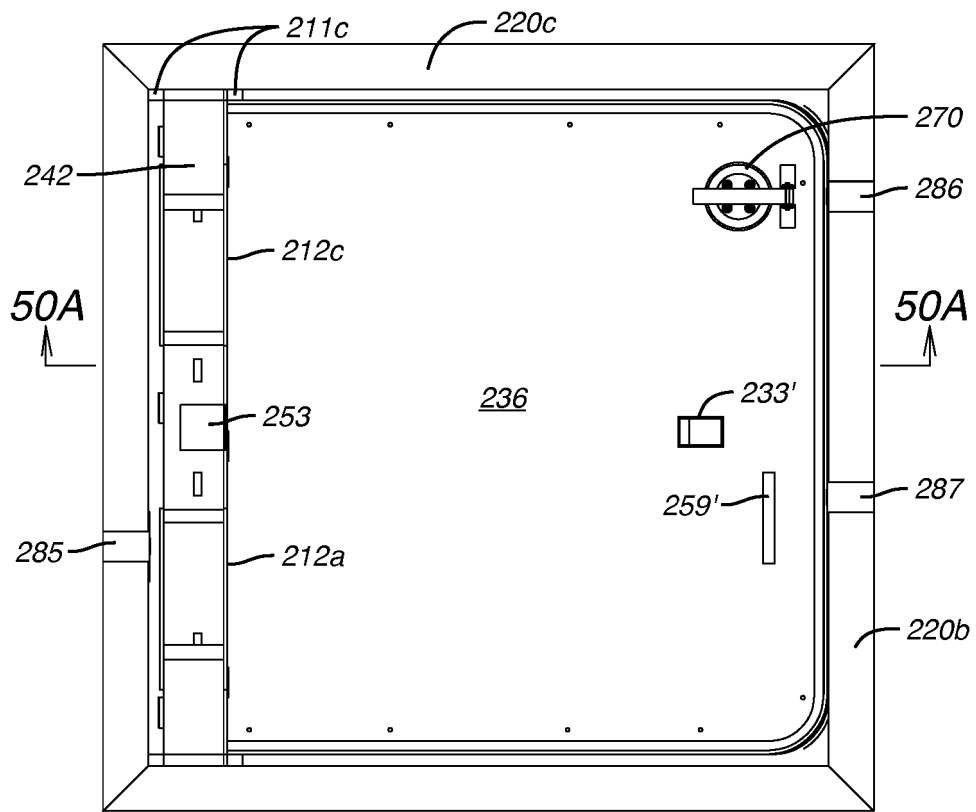


FIG. 50

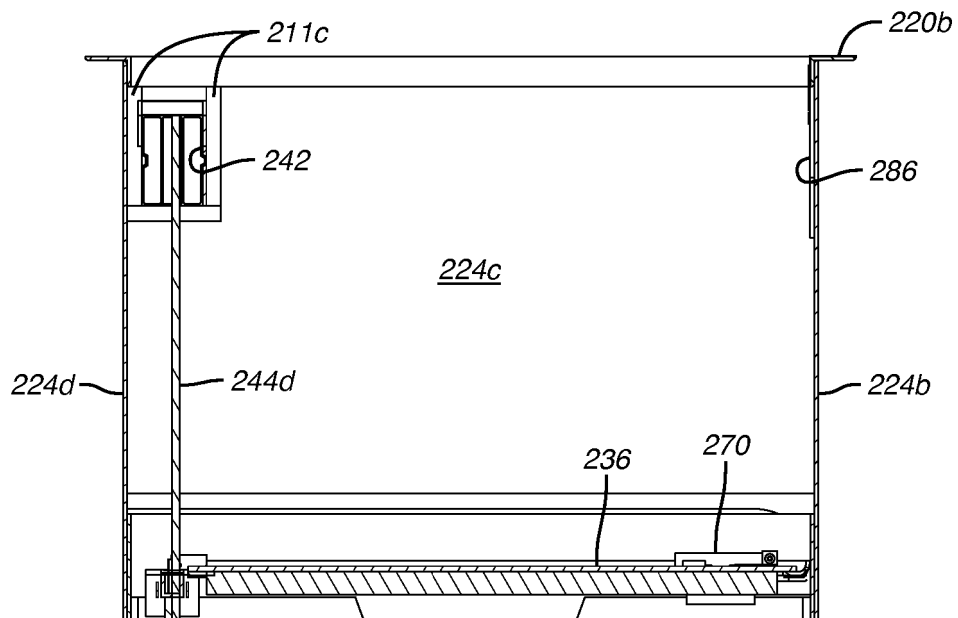


FIG. 50A

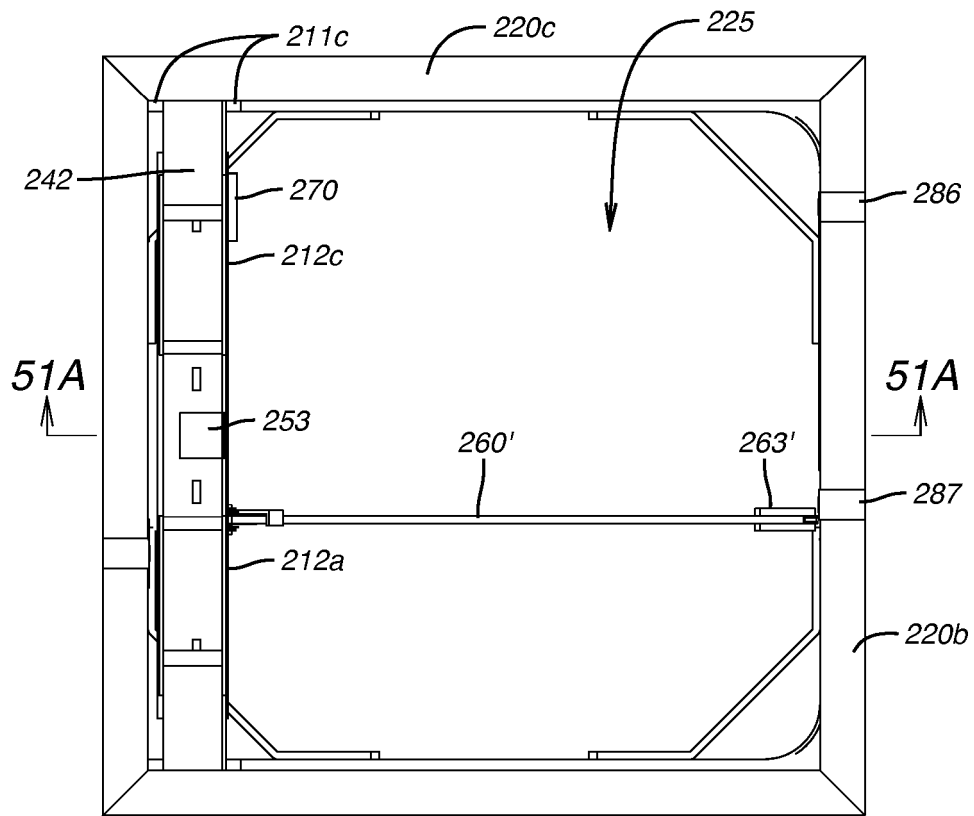


FIG. 51

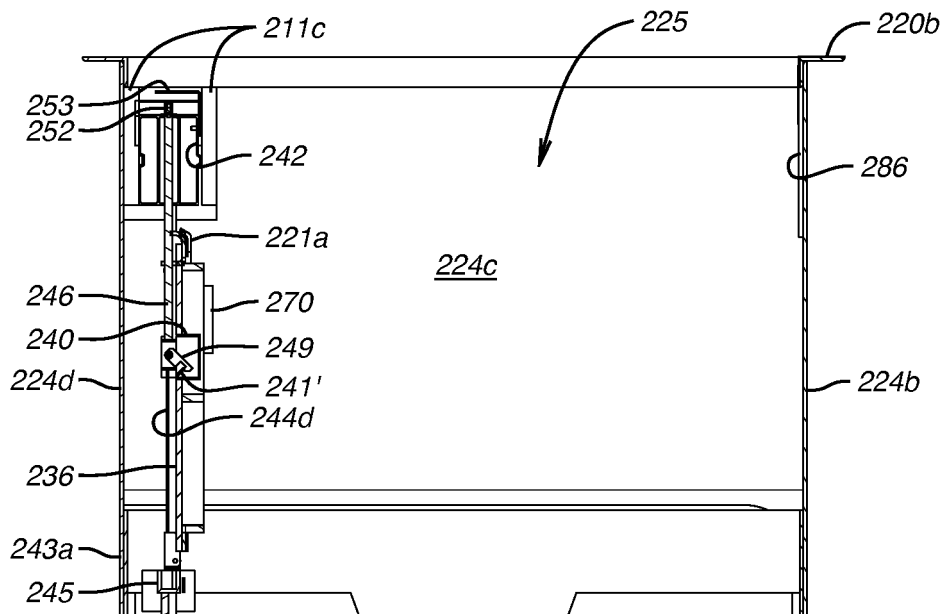


FIG. 51A

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2015051352 A [0005]