



(11) **EP 3 485 115 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

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

21.12.2022 Bulletin 2022/51

(21) Application number: **17828564.9**

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

(51) International Patent Classification (IPC):

E04H 9/14 ^(2006.01) **E06B 7/02** ^(2006.01)
E06B 7/14 ^(2006.01) **E21F 1/08** ^(2006.01)
E21F 1/16 ^(2006.01) **E21F 17/103** ^(2006.01)
E21F 17/12 ^(2006.01)

(52) Cooperative Patent Classification (CPC):

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

(86) International application number:

PCT/US2017/042220

(87) International publication number:

WO 2018/013974 (18.01.2018 Gazette 2018/03)

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

HOCHWASSERSCHUTZ FÜR UNTERIRDISCHE BELÜFTUNGSÖFFNUNGEN

PROTECTION CONTRE L'INONDATION DESTINÉE AUX BOUCHES D'AIR SOUTERRAINES

(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 sidewalk 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.

[0006] 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

[0007]

FIG. 1 is an isometric top view of a panel assembly with panels in lowered position.

FIG. 2A is an isometric view of the top side of an embodiment of a panel on the right side of the embodiment of FIG. 1, from the same perspective as in FIG. 1.

FIG. 2B is an isometric view of the bottom side of the embodiment of the panel of FIG. 6A.

FIG. 3A is an isometric view of the top side of an embodiment of a panel on the left side of the embodiment of FIG. 1, from the same perspective of the panel as in FIG. 1.

FIG. 3B is an isometric view of the bottom side of an embodiment of a panel of FIG. 6A.

FIG. 4 is an isometric view of a quadrilateral (four sided) support structure for receiving the embodiment of FIG. 5

FIG. 5 is a top plan view of the quadrilateral embod-

iment of FIG. 1.

FIG. 5A is a cross section view of the quadrilateral embodiment of FIG. 1 taken along the lines 2A-2A of FIG. 2.

FIG. 6 is an isometric view of the panel assembly of FIG. 1 received in the a quadrilateral support viewed in this perspective from a left side.

FIG. 7 is an isometric view of the panel assembly of FIG. 1 received in a quadrilateral support rotated 180 degrees from the view of FIG. 6, that is, it is a view of the opposite side of FIG. 4 (the right side).

FIG. 8 is a top plan view of the panel of FIG. 2A.

FIG. 9 is a cross sectional view of the panel of FIG. 8 taken along the line 9-9 of FIG. 8.

FIG. 10 is an enlargement of the area indicated by "10" in FIG. 8.

FIG. 11 is a side elevational view of the panel of FIG. 8 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. 12 is an isomeric view of a plug assembly part of the panel of FIG. 8.

FIG. 13 is a top plan view of the plug assembly of FIG. 12.

FIG. 13A is a cross section of the plug assembly of FIG. 12 taken along the line 13A-13A of FIG. 13.

FIG. 13B is a top plan and side view of a top plate component of the plug assembly of FIG. 12 better seen in the cross section view of FIG. 13A.

FIG. 13C is a top plan and side view of a bottom plate component of the plug assembly of FIG. 12 better seen in the cross section view of FIG. 13A.

FIG. 13D is a top plan and side view of a concave sealing gasket of the plug assembly of FIG. 12 better seen in the cross section view of FIG. 13A.

FIG. 14 is a top plan and side elevational view of a plug arm of the plug assembly of FIG. 12 also seen in the top plan view of FIG. 13 and the cross sectional view of FIG. 13A.

FIG. 15 is a cross sectional view of a variation of a plug assembly in place on a panel.

FIG. 16 is a cross sectional view of the plug arm portion of the plug assembly of FIG. 15.

FIGS. 17A, 17B and 17C are respectively side, frontal and perspective views of a tool for manual raising of components of embodiments of the invention.

FIG. 18 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. 18A is a cross sectional view of the embodiment of FIG. 18 taken along the line 18A-18A of FIG. 18.

FIG. 19 is a top plan view of a single panel assembly received in a quadrilateral support showing the panel completely raised to home position

FIG. 19A is a cross sectional view of the embodiment of FIG. 19 taken along the line 19A-19A of FIG. 19.

DESCRIPTION OF EMBODIMENTS

[0008] 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 treat 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.

[0009] The concepts embodied in the exemplary embodiments of such apparatus described herein have application 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.

[0010] 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.

[0011] 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.

[0012] 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.

[0013] 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.

[0014] 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 comma, 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.

[0015] 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.

[0016] 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.

[0017] 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.

[0018] 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 exemplary 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.

[0019] 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.

[0020] 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.

[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] 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. 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 for panels.

[0024] In an exemplary embodiment, the suspension member is 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 in which the atmospheric opening is rectilinear and said support is quadrilateral, such centrally supported suspension member comprises a beam having vertically hung straps holding the horizontal hinge and the panels connected with said horizontal hinge. In such exemplary embodiment, 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 bars connecting to and standing upright on a horizontal bar for receiving and supporting the beam within such vertical bars and on the horizontal bar.

[0025] In an exemplary embodiment, a panel holder for holding each the panel in the upright home position comprises a latch carried by the suspension member below the suspension member, and a latch catch carried by the panel, the latch capturing and holding the latch catch 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 panel holder carried by the suspension member, the linkage being vertically moveable relative to the suspension member to translate the latch to cause it to lose capture of the catch and release the panel from the upright home position, allowing the panel to gravitationally rotationally fall to the lower passage closing position.

[0026] 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 passing through the panel. The conduit has an aperture 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 conduit 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.

[0027] 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.

[0028] In an exemplary embodiment a panel containing a self actuating drain closure has a pair of 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 for 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.

[0029] 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. 1-7 show exemplary embodiments having a pair of panels. FIGS. 18-19A 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.

[0030] Although an exemplary 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.

[0031] 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.

[0032] Referring now to FIGS. 6 and 7, 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.

[0033] Although an exemplary 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.

[0034] Referring particularly to FIG. 1, 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.

[0035] 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 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 re-

spective 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 counterclockwise) 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, 230d and 230e. Each panel has a profile that closes the passage when the panels gravitationally rotate to the passage closing position.

[0036] 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.

[0037] In the exemplary embodiment illustrated in FIG. 1 each panel 234, 236 topside 238 includes a recess 233 or 233'. 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. 1 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. 1 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 horizontally 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.

[0038] 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 vertically 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.

[0039] 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.

[0040] Panel 236 as in the depicted exemplary embodiment in FIGS. 2A, 2B, 8 and 11 is fitted with a drain 270 intermediate the proximate and distal ends of the panel. Drain 270 comprises a hollow conduit 271 passing through panel 236 and has an opening 272 open at panel top side 238. Referring particularly to FIGS. 8-16, 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 opening 272.

[0041] 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.

[0042] Plug arm 277 comprises an attachment projection 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.

[0043] 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 opening 270 to drain box 210 while panel 236 is in passage closing position 215.

[0044] Referring to FIGS. 15 and 16, the same reference numerals are used as in FIGS. 8-12 where applicable for a variation of the plug 274. The variant plug is indicated generally by reference numeral 310. FIG. 15 compares to FIG. 11. 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

[0045] 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 po-

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

[0046] Referring now to FIGS. 18-191A, 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 18-19A but are understood from the prior embodiments). Support box sidewalls 224b, 224c and 224d are visible in the sectional views FIGS 18A and 19 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. 4-5A where they do not obstruct passage 225. Adjacent sidewalls include a base 227 having rounded corners 227a, 127d above respective stops 230a, 230d.

[0047] 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.

[0048] Referring now to FIGS. 18-19A, 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.

[0049] Referring particularly to FIG. 19A, 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. 18A and 19A). 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. 19A, only moveable member 243a is referenced to avoid obfuscation of elements,

[0050] 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.

[0051] In the embodiment illustrated in FIGS. 18-19A, 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.

[0052] 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.

[0053] As shown in FIGS. 18-19A 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.

[0054] 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 sidewalls (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 and a bottom side, 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,

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 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) pivoting rotatable on a drain plug axis (275) positioned between said drain conduit (271) and said distal end of each said panel, said drain plug axis (275) paralleling said horizontal hinge axis, said plug (274) being manually pivotable upwardly on said drain plug axis (275) to remove said plug from said drain opening (272) to drain water contained above said one or more panels when each said panel is in said passage closing position, said plug (274) by gravitational impetus of its own weight automatically pivoting downward to place said plug (274) in said conduit opening when said panel (234;

236) 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 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.

3. 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 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 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 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 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 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 panel (234; 236), placing at least said bottom plate (282) in said conduit opening thereby closing said opening with said outer upwardly concave gasket portion (280)

sealing space between said plates and said opening.

4. The apparatus of claim 3 in which said plug arm (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. 5
5. The apparatus of claim 3 in which said plug arm (277) includes a recess on an end of the arm distal from said rod (275) for capture of the arm by an arm lifting reach tool. 10
6. The apparatus of claim 3 in which said drain conduit is a hollow cylinder, said top and bottom plates (281; 282) are circular discs and said concave gasket (280) is circular. 15
7. The apparatus of claim 3 in which bottom plate (282) is an inverted frustoconical plate. 20
8. The apparatus of claim 3 in which said rod (275) is fixed to said posts (276; 276') and said plug arm rotates on said rod (275). 25
9. The apparatus of claim 3 in which said rod (275) rotates in said posts (276; 276') and said plug arm (277) is fixed to said pivot axis rod (275). 30
10. The apparatus of claim 1 in which said support (210) inclusive of said lateral sidewalls (224) is sized to internally fit in said vertical shaft between said ventilation duct and said atmospheric opening, said support further comprising horizontal flanges (220) transverse to said sidewalls for projecting across a top of said shaft to hang said support in said shaft. 35
11. The apparatus of claim 1 in which said atmospheric opening is rectilinear and said support (210) is quadrilateral. 40
12. The apparatus of claim 1 wherein said suspension member comprises a beam (242) having vertically hung straps (244) holding said horizontal hinge (243) and said panels (234; 236) connected to said horizontal hinge. 45
13. The apparatus of claim 12 in which said horizontal hinge (243) comprises a hinge mounting member (245) held by said suspension member (242; 244) and a plurality of hinge members (243) mounted on said hinge mounting member (245). 50
14. The apparatus of claim 1 in which said shaft is vertical and said support (210) inclusive of sidewalls is sized to internally fit in said shaft between said ventilation duct and said atmospheric opening, said support (210) further comprising flanges (220) transverse to

said sidewalls (224) for overlaying a top of said shaft to hang said support (210) in said shaft, said sidewalls supporting said suspension member (242; 244).

15. The apparatus of claim 14 comprising a pair of said panels (234; 236) in which said atmospheric opening is rectilinear, said support (210) is quadrilateral, said suspension member comprises a beam (242) supported centrally between said opposed lateral sidewalls (224) for mounting of said panels (234; 236) in said passage for rotation of the panels in directions opposite each other from or to said upright home position not obstructing said passage, said beam (242) having vertically hung straps (244) holding said horizontal hinge (243) and said panels connected with said horizontal hinge.

20 Patentansprüche

1. Vorrichtung zum Ermöglichen von Belüftung durch einen vertikalen Belüftungsschacht zu einem unterirdischen Belüftungskanal, der durch den Belüftungsschacht mit einer atmosphärischen Öffnung des Schachts in Fluidverbindung steht und bei drohender Überflutung manuell betätigbar ist, um das Abwärtsfließen von Oberflächenwasser in den unterirdischen Belüftungskanal zu verhindern, die Folgendes umfasst:

ein Auflager (210) mit gegenüberliegenden lateralen Seitenwänden (224) zur Anordnung in dem genannten Schacht, das einen Durchgang zwischen einer oberen (226) und einer unteren (220) Öffnung des Auflagers für eine Fluidverbindung des genannten Belüftungskanals durch das genannte Auflager nach oben zu der genannten atmosphärischen Öffnung definiert, ein oder mehrere Paneele (234; 236) mit proximalen und distalen Enden (234a; 234b; 236a; 236b), einer Oberseite und einer Unterseite, wobei das genannte proximale Ende mit einem horizontalen Scharnier (243) mit einer Scharnierachse lotrecht zu den gegenüberliegenden lateralen Seitenwänden (224) zum Drehen jedes genannten Paneels (234; 236) nach oben in eine aufrechte Ausgangsposition, die den genannten Durchgang nicht versperrt, und zum Drehen aus der genannten Ausgangsposition nach unten durch die Schwerkraft seines eigenen Gewichts verbunden ist, um eine untere Durchgangsverschlussposition zu erreichen, wobei die genannten ein oder mehreren Paneele ein Profil haben, das den genannten Durchgang verschließt, wenn sich jedes genannte Paneel unter Schwerkraft in die genannte Durchgangsverschlussposition dreht,

- ein Aufhängungselement (242; 244), das den genannten Durchgang (225) ungehindert horizontal überspannt, der auf den genannten gegenüberliegenden lateralen Seitenwänden (224) in der Nähe der genannten oberen Öffnung (226) getragen wird und die genannten ein oder mehreren gelenkig verbundenen Paneele (234; 236) in dem genannten Durchgang in der Nähe der genannten unteren Öffnung hält, einen Abfluss (270) in mindestens einem der genannten ein oder mehreren Paneele (234; 236) zwischen dem genannten proximalen und distalen Ende davon, wobei der genannte Abfluss (270) eine Leitung (271) umfasst, die durch das genannte Paneel (234; 236) verläuft; wobei die genannte Leitung (271) eine Öffnung (272) an der genannten Paneelenoberseite (231) und einen selbsttätigen Abflussverschluss (273) an jedem genannten Paneel mit einem Abfluss aufweist, wobei der genannte Verschluss einen Stopfen (274) umfasst, der um eine Abflusstopfenachse (275) drehbar ist, die zwischen der genannten Abflussleitung (271) und dem genannten distalen Ende jedes genannten Paneels angeordnet ist, wobei die genannte Abflusstopfenachse (275) parallel zu der genannten horizontalen Gelenkachse verläuft, wobei der genannte Stopfen (274) manuell auf der genannten Abflusstopfenachse (275) nach oben schwenkbar ist, um den genannten Stopfen aus der genannten Ablassöffnung (272) zu entfernen, um oberhalb der genannten ein oder mehreren Paneele enthaltenes Wasser abzulassen, wenn jedes genannte Paneel in der genannten Durchgangsverschlussposition ist, wobei der genannte Stopfen (274) durch die Schwerkraft seines eigenen Gewichts automatisch nach unten schwenkt, um den genannten Stopfen (274) in der genannten Leitungsöffnung zu platzieren, wenn das den genannten Abfluss enthaltende genannte Paneel (234; 236) schwenkbar nach oben in die genannte Ausgangsposition angehoben wird, so dass die Leitungsöffnung bereits geschlossen ist, wenn sich das Paneel durch Schwerkraft nach unten in die genannte Durchgangsverschlussposition dreht.
2. Vorrichtung nach Anspruch 1, wobei der genannte Stopfen (274) ferner eine nach oben konkave Dichtung (280) um den genannten Stopfenumfang herum umfasst, um jeglichen Raum zwischen dem genannten Stopfenumfang und der genannten Leitungsöffnung abzudichten, wenn sich das genannte, den genannten Stopfen (274) enthaltende Paneel in der genannten Durchgangsverschlussposition befindet.
3. Vorrichtung nach Anspruch 1, wobei jedes genannte, einen genannten Abfluss (270) enthaltende Pa-

neel (234; 236) beabstandete Pfosten (276; 276') aufweist, die fest an der genannten Oberseite jedes genannten Paneels (234; 236) zwischen dem genannten Abfluss (270) und dem genannten distalen Ende jedes genannten Paneels (234; 236) montiert sind, und wobei die genannte Abflusstopfenachse einen Stab (275) umfasst, der parallel zu der genannten horizontalen Scharnierachse von den genannten Pfosten (276; 276') getragen wird und sich zwischen den genannten Pfosten oberhalb der genannten Paneeloberseite erstreckt, wobei jeder genannte Abflussverschluss Folgendes umfasst:

einen Stopfenarm (277), der an einem proximalen Ende des genannten Arms mit oder auf dem genannten Stab (275) für eine Bewegung des genannten Arms in eine angehobene Abflussöffnungsposition und in eine abgesenkte Abflussverschlussposition schwenkbar ist, wobei der genannte Stopfenarm einen von dem genannten Stab (275) entfernten Befestigungsvorsprung aufweist, eine nach oben konkave Dichtung (280), eine obere Platte (281) und eine untere Platte (282), die beide kleiner als die genannte Dichtung (280) sind, wobei die genannte konkave Dichtung (280) zwischen der genannten oberen und unteren Platte (281; 282) befestigt ist, wobei zumindest die genannte untere Platte (282) eine Größe hat, die zum Eintreten in die und Verschließen der genannte(n) Leitungsöffnung konfiguriert ist, wobei die genannten Platten (281; 282) einen äußeren, nach oben konkaven Dichtungsabschnitt exponieren, der sich über die genannte untere Platte (282) erstreckt, wobei die genannten Platten fest mit dem genannten Arm an dem genannten Befestigungsvorsprung verbunden sind, der einen Schwerpunkt des genannten Arms hinter der genannten Schwenkachse des genannten Stabs (275) in der genannten Richtung des genannten Abflusses (270) anordnet, so dass, nachdem ein den genannten Abfluss (270) enthaltendes Paneel (234; 236) einen genannten Stopfenarm (277) in der genannten angehobenen Position hat, um Wasser oberhalb des Paneels abzulassen, während das genannte Paneel in der genannten Durchgangsverschlussposition ist, wenn das genannte Paneel, das den genannten Abfluss (270) mit dem genannten Stopfenarm (277) in der angehobenen Position enthält, nach oben in Richtung der genannten Ausgangsposition gedreht wird, der genannte Stopfenarm (277) aufgrund der genannten, auf den genannten Schwerpunkt des genannten angehobenen Stopfenarms (277) wirkenden Schwerkraft den genannten Stopfenarm von der angehobenen Position nach unten

- in eine Position parallel zu dem genannten Paneel (234; 236) dreht, wodurch zumindest die genannte Bodenplatte (282) in der genannten Leitungsöffnung platziert wird, wodurch die genannte Öffnung mit dem äußeren, nach oben konkaven Dichtungsabschnitt (280) verschlossen wird, der den Raum zwischen den genannten Platten und der genannten Öffnung abdichtet.
4. Vorrichtung nach Anspruch 3, wobei der genannte Stopfenarm (277) ein Relief an einer Unterseite des Arms distal von dem genannten Stab (275) zum Erfassen des Arms durch ein Armhebegreifwerkzeug aufweist.
 5. Vorrichtung nach Anspruch 3, wobei der genannte Stopfenarm (277) eine Aussparung an einem Ende des Arms entfernt von dem genannten Stab (275) zum Erfassen des Arms durch ein Armhebegreifwerkzeug aufweist.
 6. Vorrichtung nach Anspruch 3, wobei die genannte Abflussleitung ein Hohlzylinder ist, die genannte obere und untere Platte (281; 282) kreisförmige Scheiben sind und die genannte konkave Dichtung (280) kreisförmig ist.
 7. Vorrichtung nach Anspruch 3, wobei die Bodenplatte (282) eine umgekehrte kegelstumpfförmige Platte ist.
 8. Vorrichtung nach Anspruch 3, wobei der genannte Stab (275) an den genannten Pfosten (276; 276') befestigt ist und der genannte Stopfenarm sich auf dem genannten Stab (275) dreht.
 9. Vorrichtung nach Anspruch 3, wobei sich der genannte Stab (275) in die genannten Pfosten (276; 276') dreht und der genannte Stopfenarm (277) an der Schwenkachse des genannten Stabs (275) befestigt ist.
 10. Vorrichtung nach Anspruch 1, wobei das genannte Auflager (210) einschließlich der genannten lateralen Seitenwände (224) so bemessen ist, dass es innen in den genannten vertikalen Schacht zwischen dem genannten Lüftungskanal und der genannten atmosphärischen Öffnung passt, wobei das genannte Auflager ferner horizontale Flansche (220) quer zu den genannten Seitenwänden umfasst, die über eine Oberseite des Schachts vorstehen, um das genannte Auflager in dem genannten Schacht aufzuhängen.
 11. Vorrichtung nach Anspruch 1, wobei die genannte atmosphärische Öffnung geradlinig und das genannte Auflager (210) viereckig ist.
 12. Vorrichtung nach Anspruch 1, wobei das genannte Aufhängungselement einen Träger (242) mit vertikal hängenden Bändern (244) umfasst, die das genannte horizontale Scharnier (243) und die mit dem genannten horizontalen Scharnier verbundenen genannten Paneelen (234; 236) halten.
 13. Vorrichtung nach Anspruch 12, wobei das genannte horizontale Scharnier (243) ein von dem genannten Aufhängungselement (242; 244) gehaltenes Scharniermontageelement (245) und mehrere an dem genannten Scharniermontageelement (245) montierte Scharnierelemente (243) umfasst.
 14. Vorrichtung nach Anspruch 1, wobei der genannte Schacht vertikal ist und das genannte Auflager (210) einschließlich der Seitenwände so bemessen ist, dass er innen in den genannten Schacht zwischen dem genannten Lüftungskanal und der genannten atmosphärischen Öffnung passt, wobei das genannte Auflager (210) ferner Flansche (220) quer zu den genannten Seitenwänden (224) zum Überlagern einer Oberseite des genannten Schachts umfasst, um das genannte Auflager (210) in dem genannten Schacht aufzuhängen, wobei die genannten Seitenwände das genannte Aufhängungselement (242; 244) tragen.
 15. Vorrichtung nach Anspruch 14, die ein Paar der genannten Paneele (234; 236) umfasst, in denen die genannte atmosphärische Öffnung geradlinig ist, wobei das genannte Auflager (210) vierseitig ist, das genannte Aufhängungselement einen Träger (242) umfasst, der mittig zwischen den genannten gegenüberliegenden lateralen Seitenwänden (224) zum Montieren der genannten Paneele (234; 236) in dem genannten Durchgang zur Drehung der Paneele in einander entgegengesetzten Richtungen von oder zu der genannten aufrechten Ausgangsposition getragen wird, die den genannten Durchgang nicht behindert, wobei der genannte Träger (242) vertikal aufgehängte Bänder (244) aufweist, die das genannte horizontale Scharnier (243) und die mit dem genannten horizontalen Scharnier verbundenen genannten Paneele halten.

Revendications

1. Appareil pour permettre une ventilation à travers un puits de ventilation vertical vers une gaine de ventilation souterraine communiquant de manière fluide 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 fluide 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 et un côté inférieur, ladite extrémité proximale étant raccordée à une articulation horizontale (243) avec 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,

un élément de suspension (242; 244) s'étendant 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 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 (271) et ladite extrémité distale dudit chaque panneau, ledit axe d'obturateur de drain (275) étant en parallèle auxdits axes d'articulation horizontaux, ledit obturateur (274) étant apte à pivoter manuellement vers le haut sur ledit axe d'obturateur de drain (275) afin d'enlever ledit obturateur de ladite ouverture de drain (272) 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, l'obturateur (274) en vertu de l'impulsion gravi-

tationnelle sous son propre poids pivotant vers le bas afin de placer ledit obturateur (274) dans ladite ouverture de conduit lorsque ledit panneau (234; 236) contenant ledit drain est relevée de manière pivotante vers le haut jusqu'à ladite position de repos, assurant ainsi que 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 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.
3. 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 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.
4. Appareil de la revendication 3 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.
 5. Appareil de la revendication 3 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.
 6. Appareil de la revendication 3 dans lequel ledit conduit de drain est un cylindre creux, lesdites plaques supérieure et inférieure (281; 282) sont des disques circulaires et ladite garniture concave (280) est circulaire.
 7. Appareil de la revendication 3 dans lequel la plaque inférieure (282) est une plaque frustoconique inversée.
 8. Appareil de la revendication 3 dans lequel ladite tige (275) est fixée auxdits montants (276; 276') et ledit bras d'obturateur tourne sur ladite tige (275).
 9. Appareil de la revendication 3 dans lequel ladite tige (275) tourne dans lesdits montants (276; 276') et ledit bras d'obturateur (277) est fixé à ladite tige d'axe-pivot (275).
 10. Appareil de la revendication 1 dans lequel ledit support (210) incluant lesdites parois latérales (224) est dimensionné de façon à s'adapter de manière interne dans ledit puits vertical entre ladite gaine de ventilation et ladite ouverture à l'atmosphère, ledit support comprenant en outre des brides horizontales (220) transversalement par rapport auxdites parois latérales pour faire saillie en travers d'une face supérieure dudit puits afin de suspendre ledit support dans ledit puits.
 11. Appareil de la revendication 1 dans lequel ladite ouverture à l'atmosphère est rectiligne et ledit support (210) est quadrilatéral.
 12. Appareil de la revendication 1 dans lequel ledit élément de suspension comprend une poutrelle (242) ayant des armatures suspendues verticalement (244) qui maintiennent ladite articulation horizontale (243) et lesdits panneaux (234; 236) raccordés à ladite articulation horizontale.
 13. Appareil de la revendication 12 dans lequel ladite articulation horizontale (243) comprend un élément de montage d'articulation (245) maintenu par ledit élément de suspension (242; 244) et une pluralité d'éléments d'articulation (243) montés sur ledit élément de montage d'articulation (245).
 14. Appareil de la revendication 1 dans lequel ledit puits est vertical et ledit support (210) incluant les parois latérales est dimensionné de façon à s'adapter de manière interne dans ledit puits entre ladite gaine de ventilation et ladite ouverture à l'atmosphère, ledit support (210) comprenant en outre des brides (220) transversalement par rapport auxdites parois latérales (224) pour se superposer une face supérieure dudit puits afin de suspendre ledit support (210) dans ledit puits, lesdites parois latérales soutenant ledit élément de suspension (242; 244).
 15. Appareil de la revendication 14 comprenant une paire desdits panneaux (234; 236) dans lequel ladite ouverture à l'atmosphère est rectiligne, ledit support (210) étant quadrilatéral, ledit élément de suspension comprend une poutrelle (242) soutenue centralement entre lesdites parois latérales opposées (224) pour le montage desdits panneaux (234; 236) dans ledit passage pour une rotation des panneaux dans des directions opposées l'une à l'autre à partir de ou vers ladite position de repos dressée n'obstruant pas ledit passage, ladite poutrelle (242) ayant des armatures suspendues verticalement (244) qui maintiennent ladite articulation horizontale (243) et lesdits panneaux raccordés à ladite articulation horizontale.

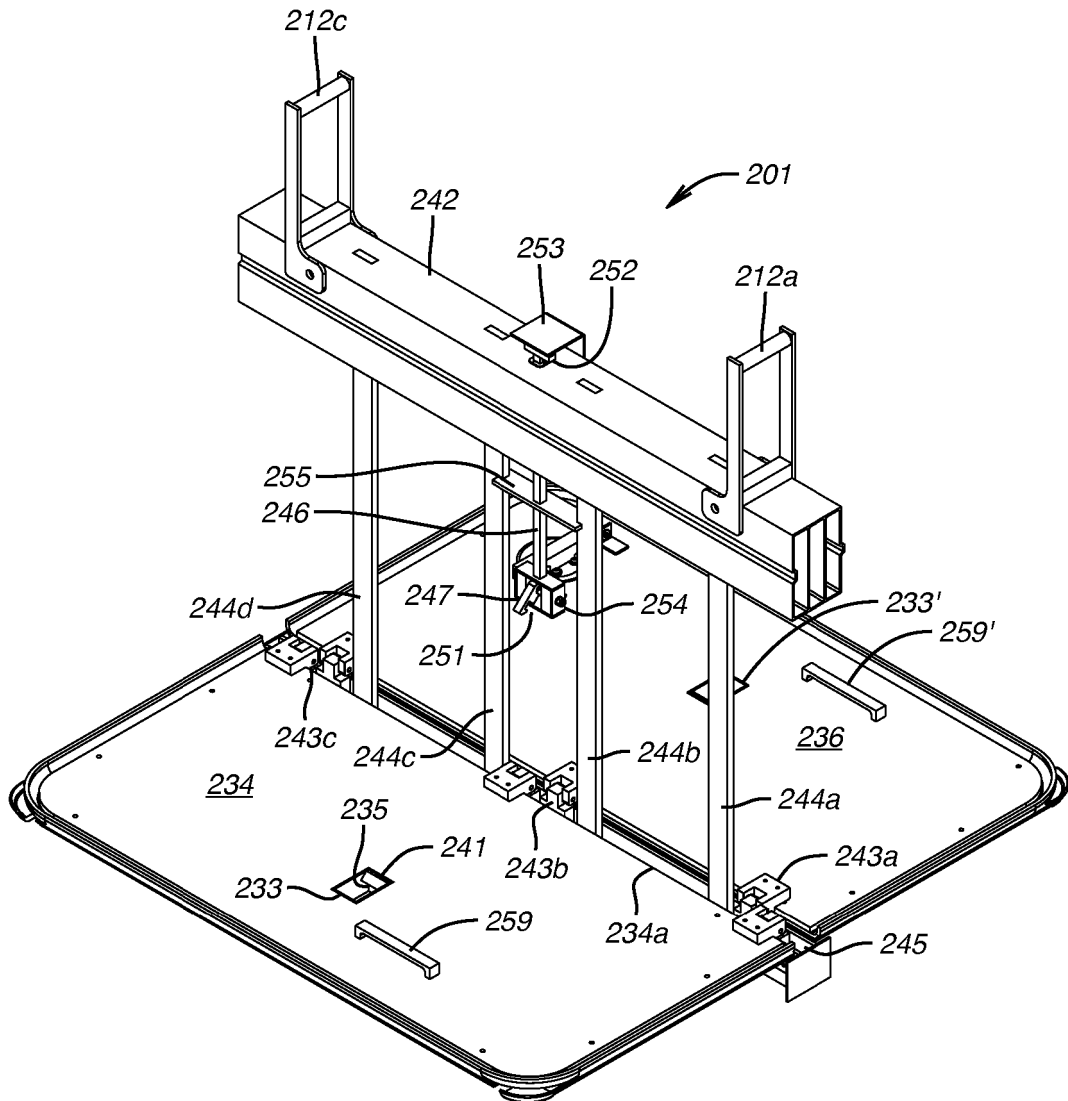


FIG. 1

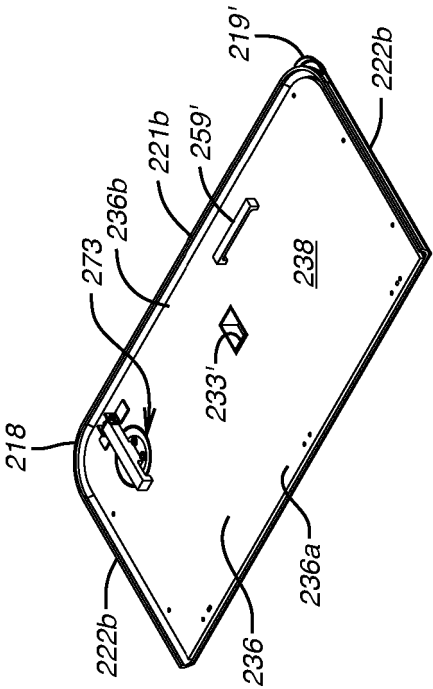


FIG. 2A

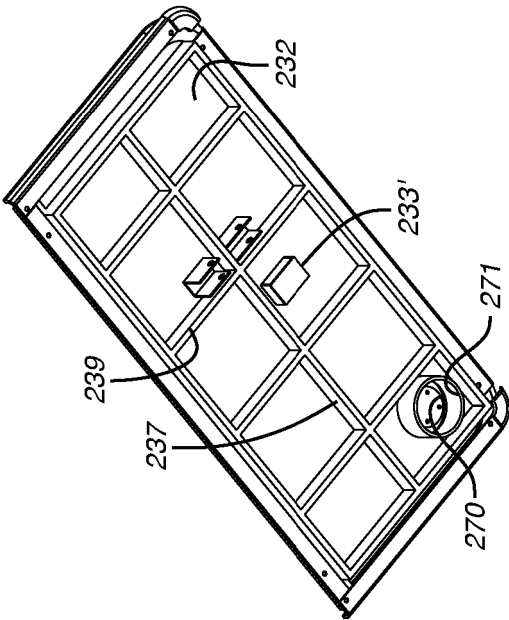


FIG. 2B

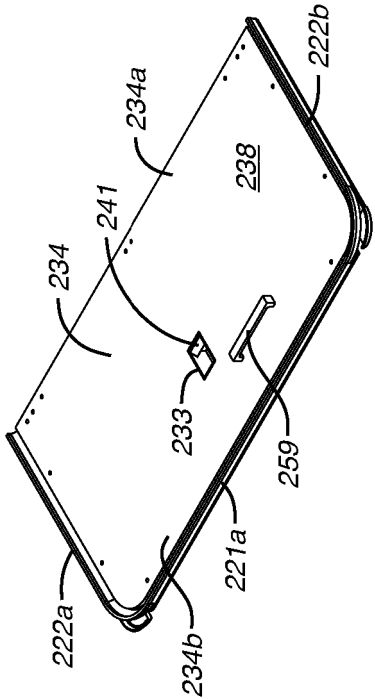


FIG. 3A

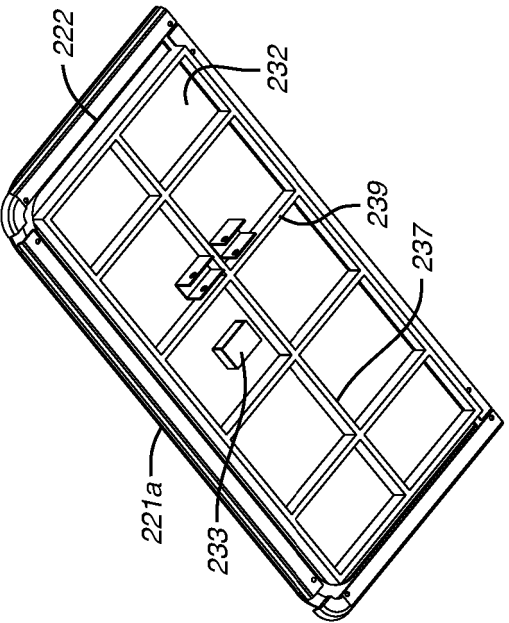


FIG. 3B

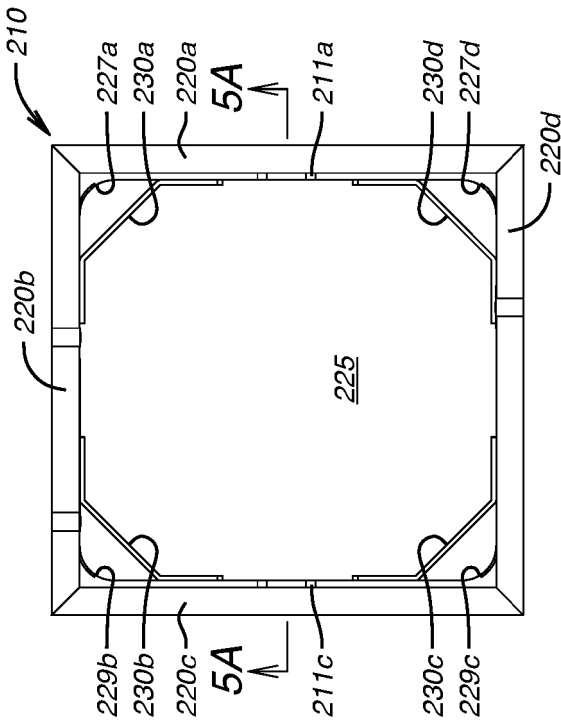


FIG. 5

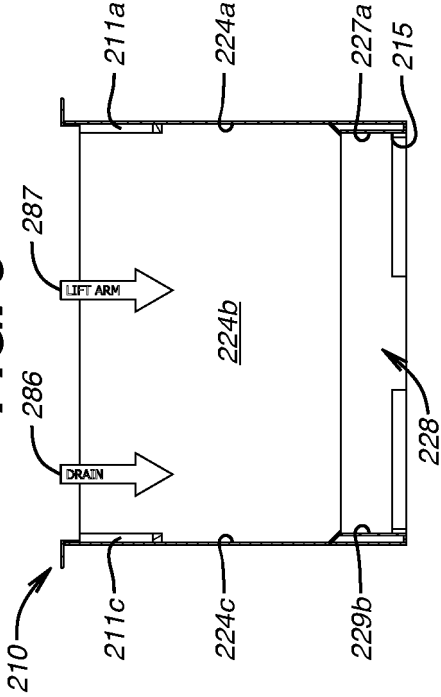


FIG. 5A

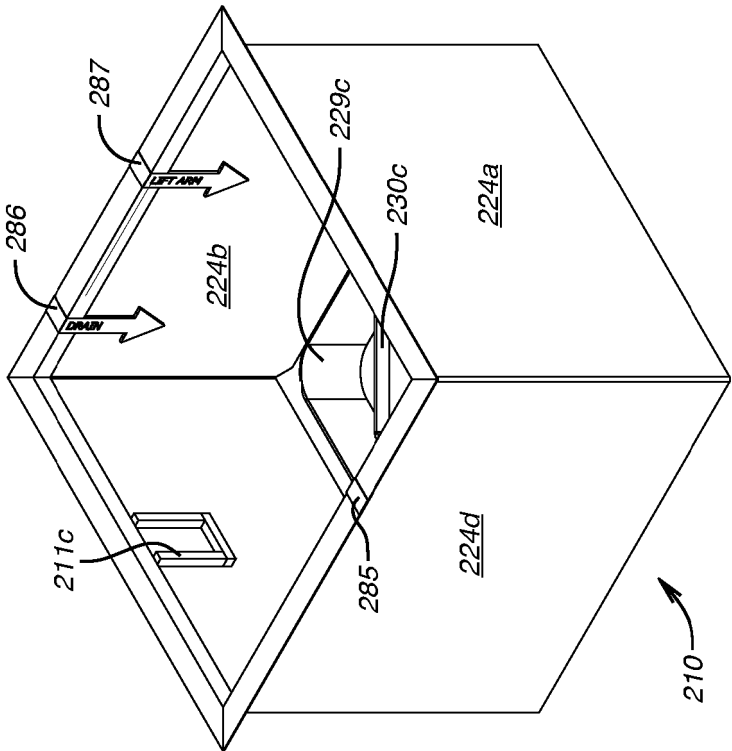


FIG. 4

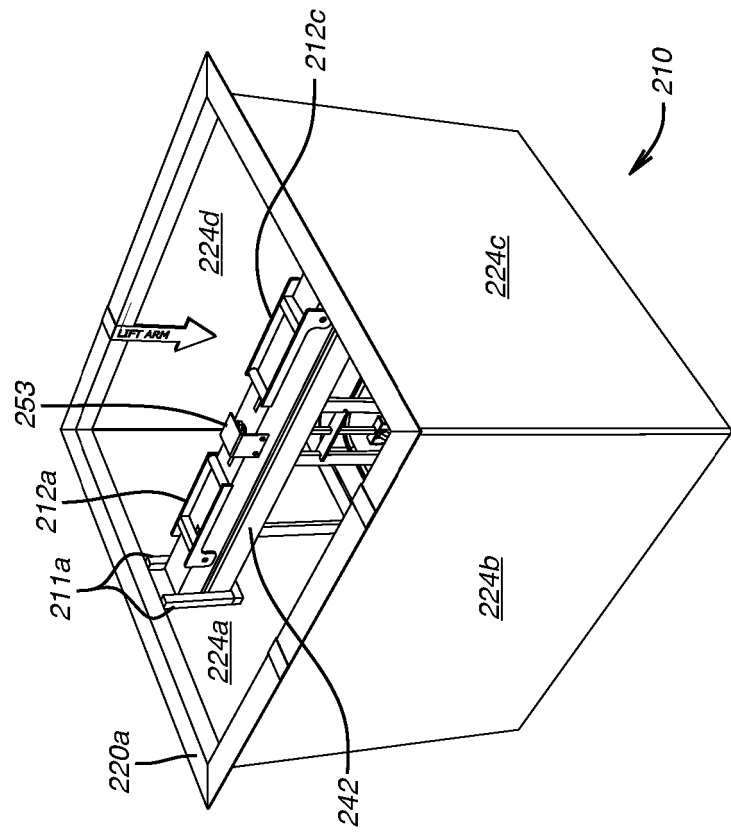


FIG. 6

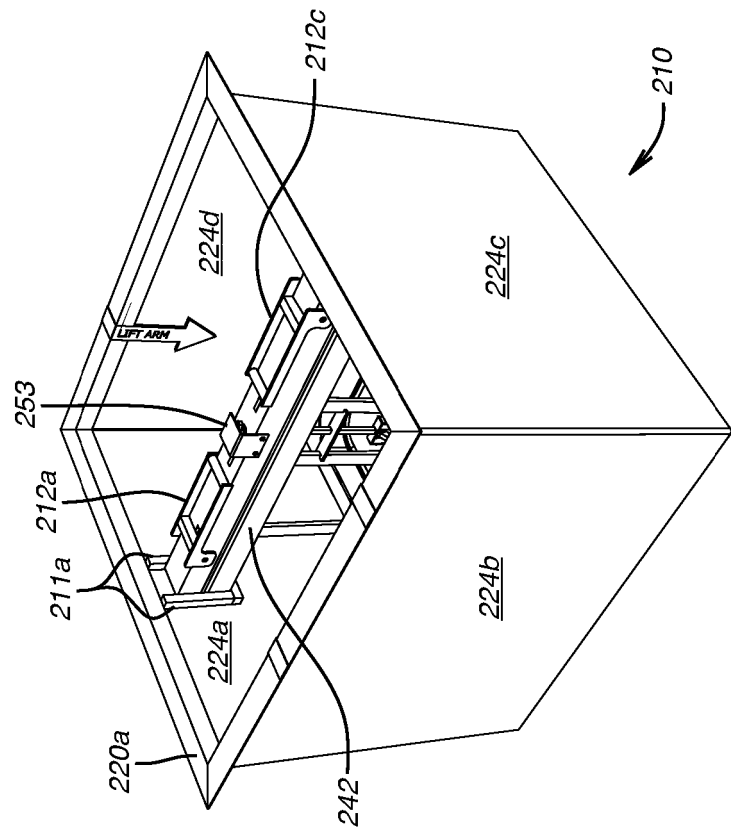


FIG. 7

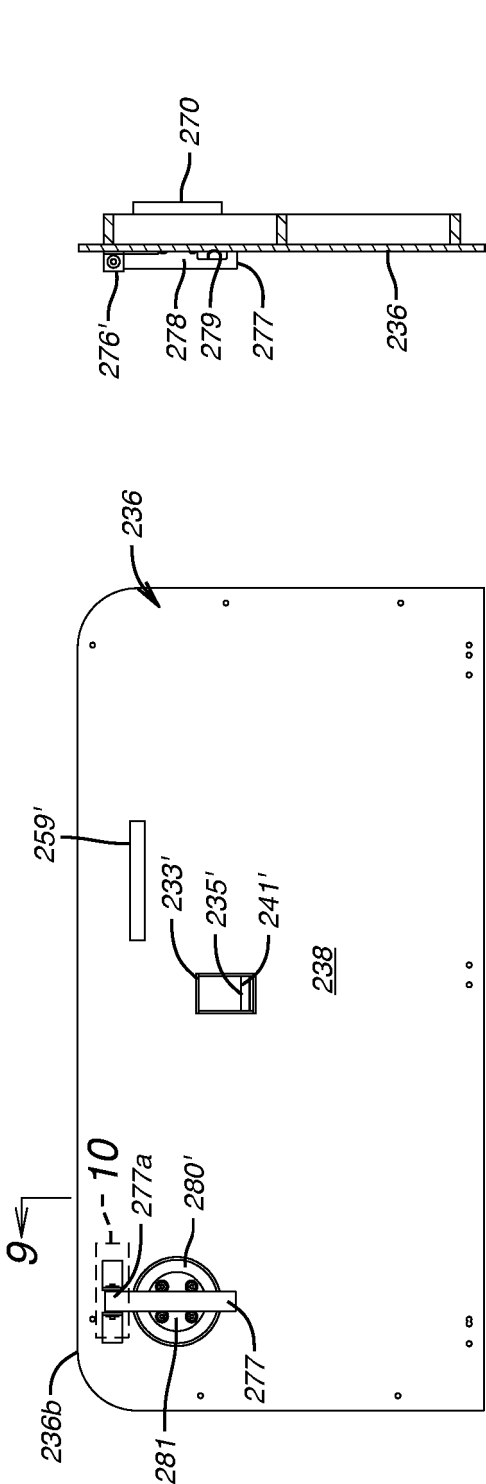


FIG. 8

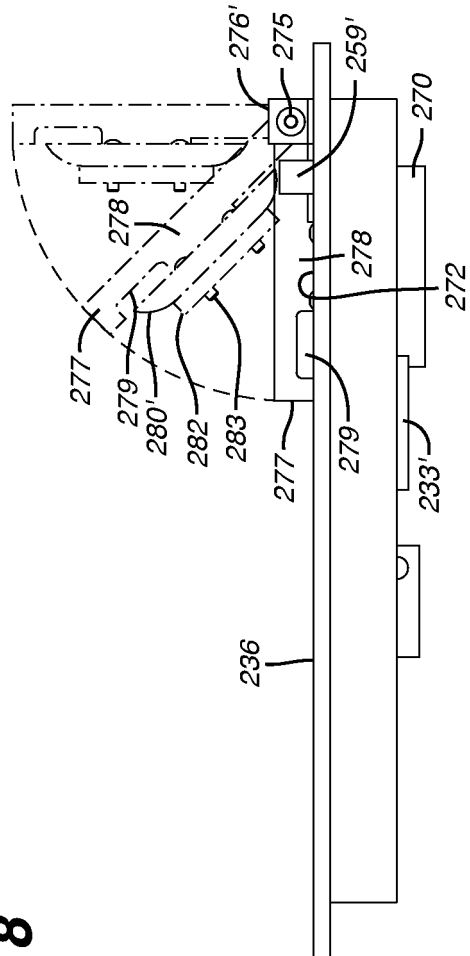


FIG. 9

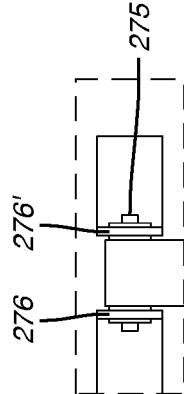
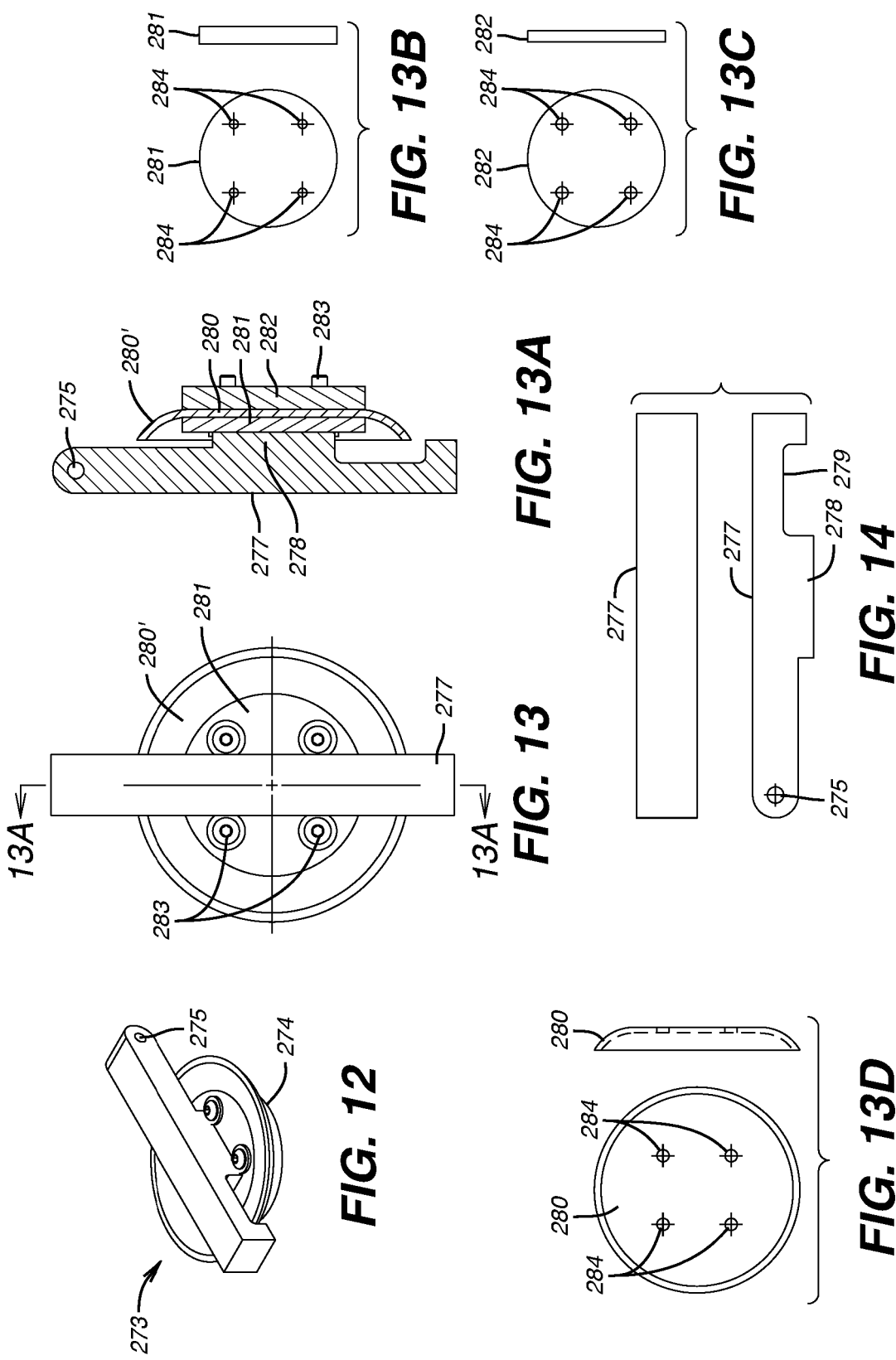


FIG. 10

FIG. 11



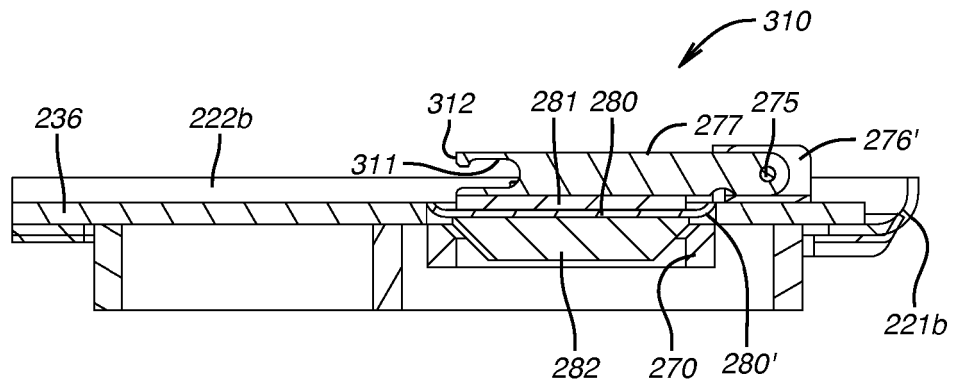


FIG. 15

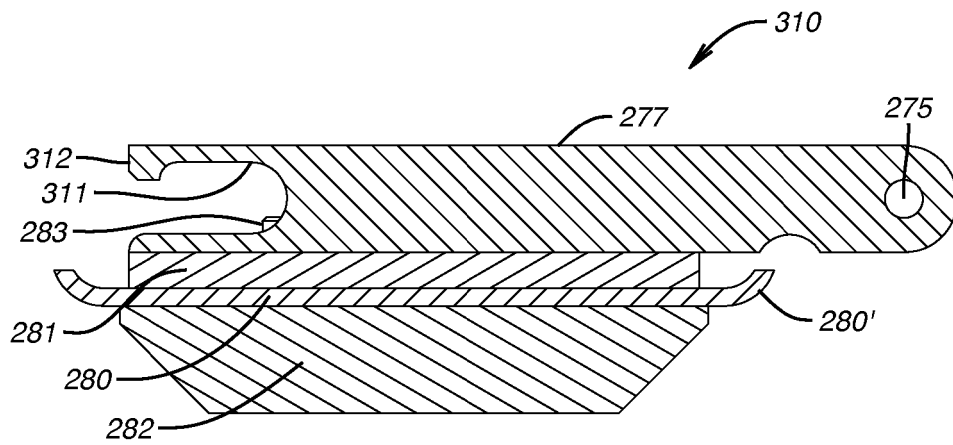


FIG. 16

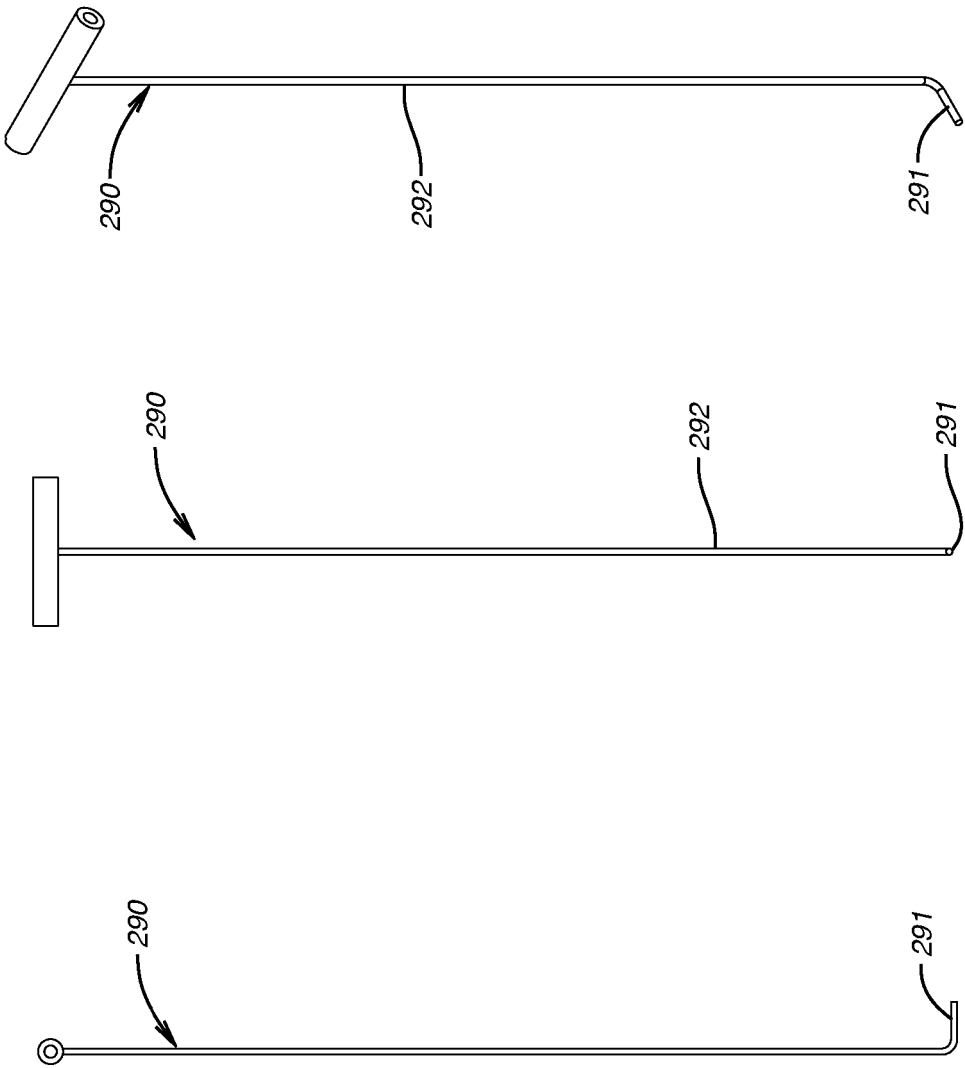


FIG. 17C

FIG. 17B

FIG. 17A

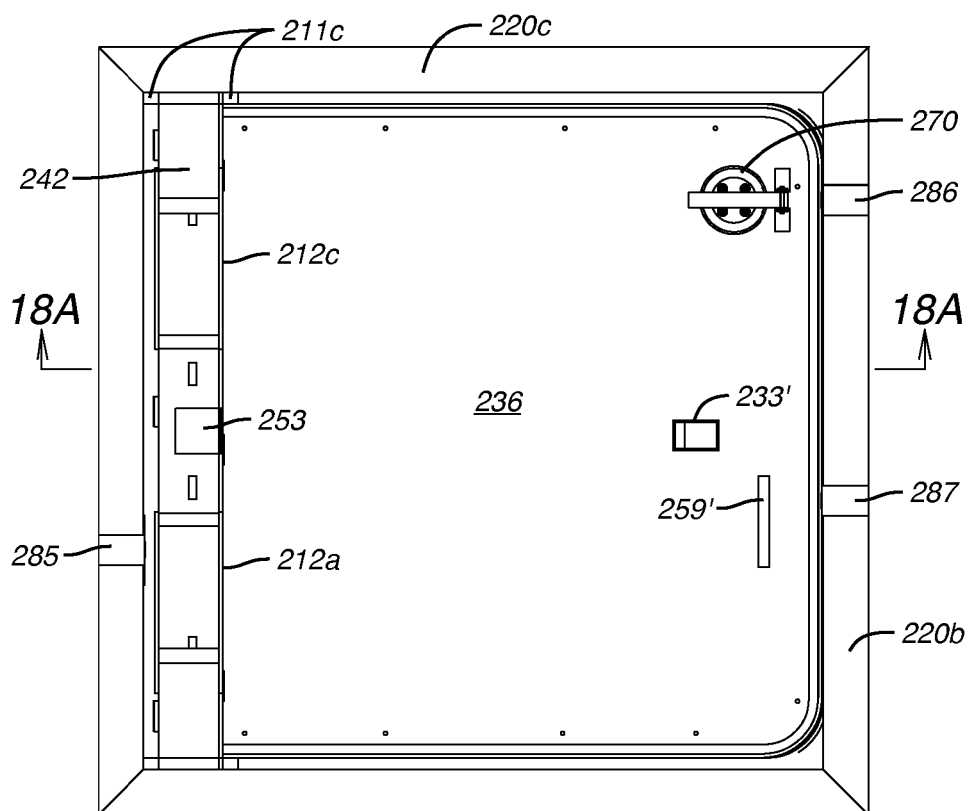


FIG. 18

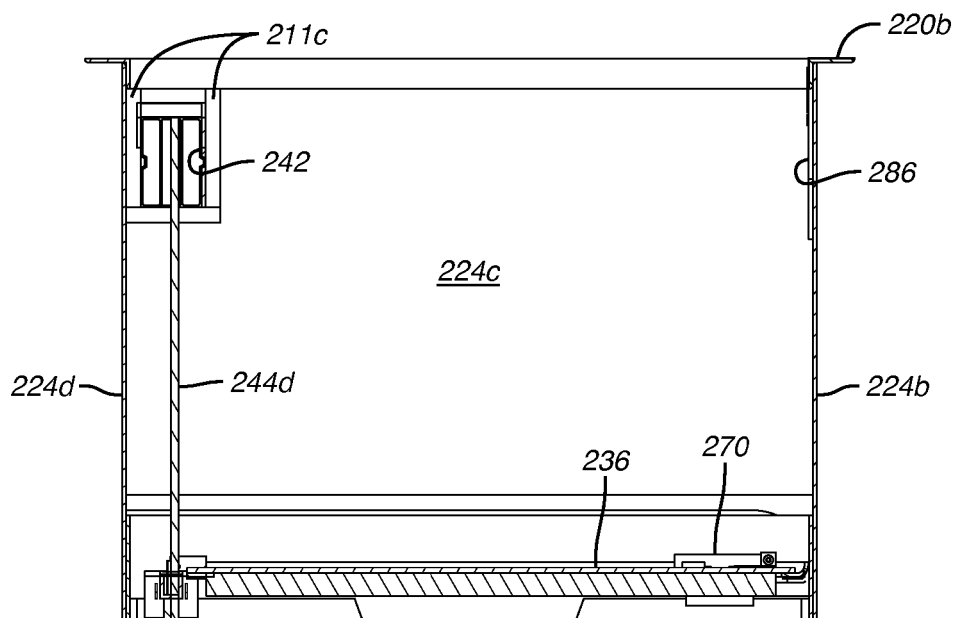


FIG. 18A

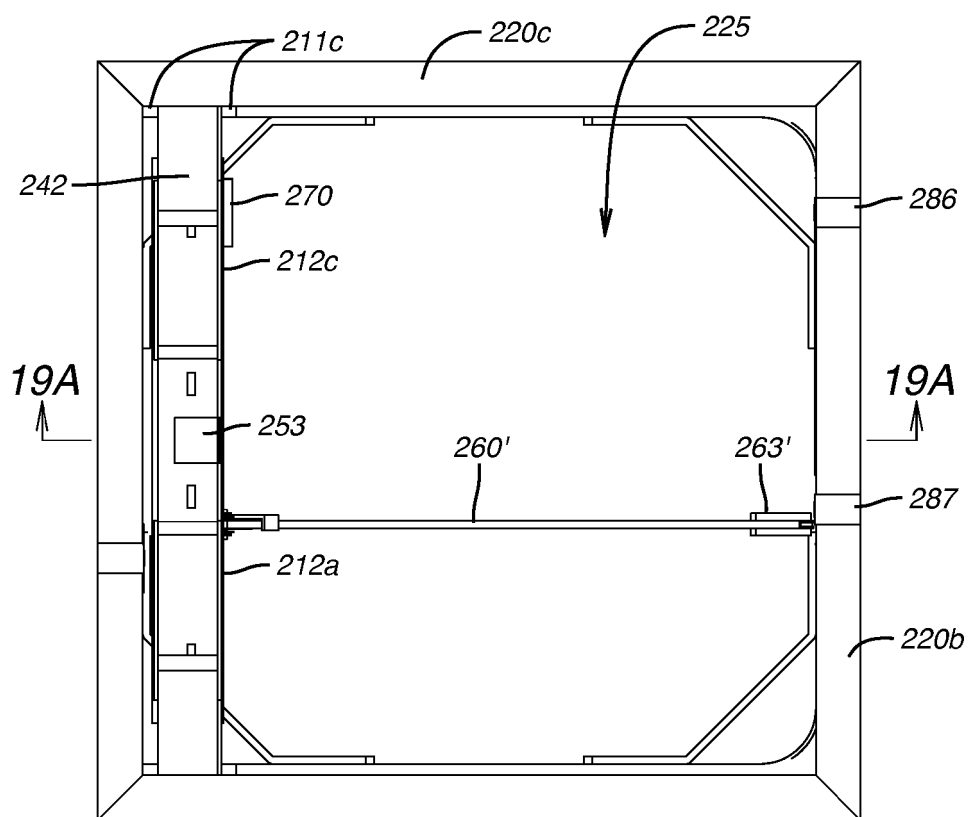


FIG. 19

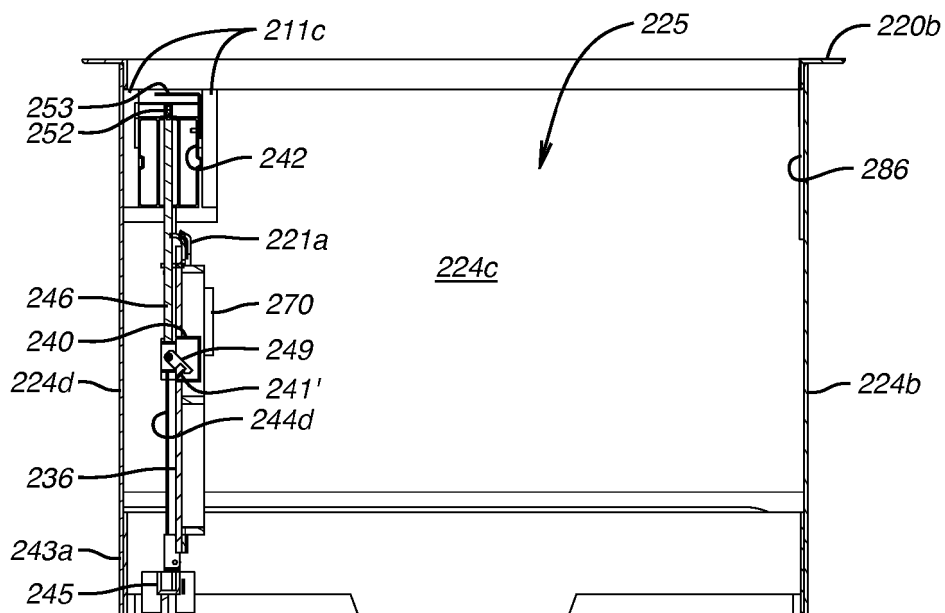


FIG. 19A

REFERENCES CITED IN THE DESCRIPTION

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