



(11) **EP 3 485 116 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

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

**25.10.2023 Bulletin 2023/43**

(21) Application number: **17828567.2**

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

(51) International Patent Classification (IPC):

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

(52) Cooperative Patent Classification (CPC):

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

(86) International application number:

**PCT/US2017/042226**

(87) International publication number:

**WO 2018/013977 (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 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 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 enlargement of the portion of FIG. 1 shown in dashed lines indicated by the reference numeral 4.

FIG. 5 is an enlargement of the portion of FIG. 1

shown in dashed lines indicated by the reference numeral 5.

FIG. 6 is an enlargement of the portion of FIG. 1 shown in dashed lines indicated by the reference numeral 6.

FIG. 7 is an alternative embodiment to FIG. 4.

FIG. 8 is an alternative embodiment to FIG. 5.

FIG. 9 is a frontal graphic showing the panels of FIG. 1 in lowered position in place in the support of FIG. 11. FIG. 10 is a side elevational view of the panel assembly of FIG. 1 with the panels in raised home position.

FIG. 11 is an isometric view of a quadrilateral (four sided) support structure for receiving the embodiment of FIG. 1

FIG. 12 is a top plan view of the quadrilateral embodiment of FIG. 11

FIG. 12A is a cross section view of the quadrilateral embodiment of FIG. 11 taken along the lines 12A-12A of FIG. 12.

FIG. 13 is an isometric view of the panel assembly of FIG. 1 received in the quadrilateral support of FIGS. 11, 12 and 12A viewed in this perspective from a left side.

FIG. 14 is an isometric view of the panel assembly of FIG. 1 received in the quadrilateral support of FIGS. 11, 12 and 12A rotated 180 degrees from the view of FIG. 13, that is, it is a view of the opposite side of FIG. 13 (the right side).

FIG. 15 is a cutaway isometric view of the panel assembly of FIG. 1 in place in the quadrilateral support of FIGS. 11, 12 and 12A illustrating the panels of FIG. 1 in raised home position.

FIG. 16 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. 16A is a cross sectional view of the embodiment of FIG. 16 taken along the line 16A-16A of FIG. 16.

FIG. 17 is a top plan view of a single panel assembly received in a quadrilateral support showing the panel completely raised to home position

FIG. 17A is a cross sectional view of the embodiment of FIG. 17 taken along the line 17A-17A of FIG. 17.

## 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 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.

**[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 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.

**[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. Restraints 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 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.

**[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]** 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.

**[0021]** 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 pas-

sage closing position.

**[0022]** 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.

**[0023]** 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 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 arms connecting to and standing upright on a horizontal bar for receiving and supporting the beam within such vertical bars and on the horizontal bar.

**[0024]** In an exemplary embodiment, a panel holder for holding each the panel in the upright home position comprises a moveable member carried either by a the 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 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 gravitationally rotationally fall to the lower passage closing position.

**[0025]** In an exemplary embodiment the non-moveable 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. In an exemplary embodiment, the panel holder is a slam latch. In an exemplary embodiment, the panel holder is a gravity latch.

**[0026]** Referring 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. 1-15 show exemplary embodiments having a pair of panels. FIGS. 16-17A show exemplary embodiments having a single panel. Referring to FIGS. 11, 12 and 12A initially, 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 214. 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.

**[0027]** Although an embodiment as described herein employs a quadrilateral (four sided) 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.

**[0028]** 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.

**[0029]** Referring now to FIGS. 13 and 14, 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 assembly unit 201 can be removed from box 210 for servicing by withdrawing beam 242 from channels 211a, 211c by means of handles 212a, 212c.

**[0030]** 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. 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.

**[0031]** Referring particularly to FIGS. 1, 6 and 9-10, a hinge mounting member 245 unobstructively horizontally spans across passage 225 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. Hinge mounting member 245 includes a stiffener bar 231 affixed lengthwise along to the inferior surface of hinge mounting member 245.

**[0032]** 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 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 under beam 242 (indicated generally by reference numeral 213). Rotation of the panels upwardly (one clockwise, the other counterclockwise) to home position 213 is effected manually as further described below. The home position of the panels tucked under beam 242 does not occlude passage 225. Rotation of the panels downwardly (one clockwise, the other counterclockwise) is by gravity acting solely on the mass of the panel when the panels are released from the home position, as further

described below. 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.

**[0033]** 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 may be fitted with a drain 270 intermediate the proximate and distal ends of the panel, as shown in FIGS. 2A and 2B. Drain 270 comprises a conduit such as a hollow tube 271 passing through panel 236 and has an opening 272 at panel top side 238 and a drain closure indicated generally by reference numeral 273.

**[0034]** Referring particularly to FIGS. 1, 4-5, and 7-8 a panel holder 240 for holding each panel in said upright home position comprises a moveable member carried either by a panel 234, 236 or by suspension member 242 below suspension member 242. A non-moveable member is carried by the other of the panel or the suspension member not carrying the moveable member. The moveable member captures and holds the nonmoving member when the panel is rotated upwardly to the home position. In an exemplary embodiment the nonmoveable member of the panel holder 240 comprises a latch catch and the moveable member of the panel holder comprises a latch engageable with the latch catch.

**[0035]** In the embodiment illustrated in FIGS 1, 4-5, each panel 234, 236 topside 238 includes a recess 233 or 233'. The recess contains a panel holder latch catch, and a panel holder latch is carried by the suspension member 242. Panel holder 240 moveable members 247, 249 carried by the suspension member 242 each comprise a latch engageable with latch catch 235, 235' carried by panel 234, 236. Latches 247, 249 are vertically pivotal on a horizontal axis 254 at a proximate end of the latches. Horizontal axis 254 resides inside the panel holder 240 that includes the latches 247, 249. Horizontal 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 248, 248' having

a sloped surface 250, 250' 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 248, 248' of latch 247, 249 carried by the suspension member 242 is brought into sliding contact with ramp 241, 241' carried by the panel, whereupon sloped surface 250, 250' slides on ramp 241, 241' until inset notch 251, 251' passes over latch catch edge 235, 235', capturing latch 247, 249, which holds panel 234, 236 as the panel completes upward rotation to home position 213.

**[0036]** Referring particularly to FIGS. 1 and 7-8, in an alternative configuration, the panel 234, 236 topside 238 includes the panel holder latch and the panel holder latch catch is carried by the suspension member 242. The same panel holding action occurs as described above. The moveable members 247, 249 in panel 234, 236 each comprise a latch engageable with latch catch 235, 235' carried by suspension member 242. Latches 247, 249 are vertically pivotal on a horizontal axis 254 at a proximate end of the latches. Horizontal axis 254 resides inside a panel holder 240 that includes the latches and 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 248, 248' having a sloped surface 250, 250' ending at an inset notch 251, 251'. Recesses 233, 233' and panel holder 240 are horizontally and vertically aligned with each other such that when panel 234, 236 is rotated vertically upward, the inferior return 248, 248' of latch 247, 249 carried by the panel is brought into sliding contact with ramp 241, 241' carried by the suspension member 242, whereupon sloped surface 250, 250' slides on ramp 241, 241' until inset notch 251, 251' passes over latch catch edge 235, 235', capturing latch 247, 249, which holds panel 234, 236 as the panel completes upward rotation to home position 213.

**[0037]** 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. Cover 253 reduces if not avoiding gratuitous tampering with the apparatus and unwanted deployment of the panels by mischief makers.

**[0038]** In the embodiment of Figs. 1, 4 and 5, panel holder 240 includes moveable member 247 on a side facing panel 234 and a moveable member 249 on a side facing panel 236. It is the moveable member components 247, 249 of panels holder 240 that catch and hold panels 234, 236 in the upright home position 213. 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 over 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 release held panels 234, 236 and allow the panels to rotationally gravitationally fall solely by impetus of their own weight from the upright home position 213 to the lower passage closing position 215.

**[0039]** In the embodiment of Figs. 1, 7 and 8, panel holder 240 includes non-moveable member 241 on a side facing panel 234 and a non-moveable member 241' on a side facing panel 236. It is the moveable member components 247, 249 of panel 234 and 236 that catch and hold non-moveable members 241, 241' in the upright home position 213. Rod 246 and T-handle 252 comprise a panel releaser. The T-handle provides convenient push platform, such as by a projection or horizontal flat of a reach tool that can be vertically inserted through a small opening in a grating over support 210 to reach under cover 253 and push down T-handle 252 to push down panel holder 240. Pushing down rod 246 by T-handle 252 moves panel holder 240 downwardly to cause non-moveable members 241, 241' to release held panels 234, 236 and allow the panels 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]** 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 reach tool with a terminal projection can be used by an operator and inserted through a grating over box 210 to grasp handle 259, 259' to lift panel 234, 236. A lift arm 260 for panel 234 and a lift arm 260' for panel 236 manipulated by a second reach tool to provide a mechanical assist giving lateral thrust against the bottom side of a panel to complete rotation of the panel to upright home position.

**[0041]** Referring now to FIGS. 16-17A, another exemplary embodiment employs a single panel. Components in the single panel exemplary 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 16-17A but are understood from the prior exemplary embodiments). Support box sidewalls 224b, 224c and 224d are visible in the sectional views FIGS 16A and 17 A (sidewall 224a will be understood from descriptions of the exemplary 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. 11-12A where they do not obstruct passage 225. Adjacent sidewalls include a base 227 having rounded corners 227a, 127d above respective stops 230a, 230d.

**[0042]** 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.

**[0043]** Referring now to FIGS. 16-17A, 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.

**[0044]** Referring particularly to FIG. 17A, 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. 16A and 17A). 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. 17A, only moveable member 243a is referenced to avoid obfuscation of elements,

**[0045]** 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 show) 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.

**[0046]** In the exemplary embodiment illustrated in FIGS. 16-17A, 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. 4 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.

**[0047]** 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.

[0048] As shown in FIG. 17, 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.

[0049] As shown in FIGS. 16-17A, the single panel exemplary embodiment includes a drain 270 in panel 236 intermediate the proximate and distal ends thereof.

[0050] 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 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 (225) 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 (238) and a bottom side (232), 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 supported on said opposed lateral sidewalls (224) proximate said top opening 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, the panel holder comprising, for each said panel, a moveable member (242; 244) and a non-moveable member (235; 235'), one of the moveable member (242; 244) and the non-moveable member being carried by the panel on said top side of the panel and the other of the moveable member (242; 244) and the non-moveable member (235; 235') being translatably suspended below said suspension member,  
said moveable member (242; 244) capturing and holding said non-moveable member (235; 235') when said panel is rotated upwardly to said home position, and  
a panel releaser (246, 252) for said panel holder (240), comprising linkage connected to said moveable or non-moveable panel holder member suspended by said suspension member (242; 244), said linkage being manually moveable relative to said suspension member (242; 244) to translate said suspended moveable or non-moveable member to release the panel from said upright home position and allow said panel to gravitationally rotationally fall to said lower passage closing position.

2. The apparatus of claim 1 wherein said panel holder (240) is a slam latch.
3. The apparatus of claim 1 in which said panel holder (240) is a gravity latch.
4. The apparatus of claim 1 in which said non-moveable member of said panel holder comprises a latch catch (235; 235') and said moveable member of said panel holder comprises a rotatable latch (247; 249) rotatable on a horizontal axis parallel to said panel axis and engageable with said latch catch (235; 235').
5. The apparatus of claim 4 in which said panel top side includes said latch catch (235; 235') and said latch (247; 249) is slideably translatably carried by said suspension member (242; 244).
6. The apparatus of claim 5 in which said latch catch (235; 235') resides in a recess in said top side of the panel and comprises a ramp (241; 241') originating

- at an entrance to said recess (233; 233') and declining in a direction toward said distal end of said panel to terminate in a latch catch (235; 235') edge, and in which each said latch (247; 249) is pivotally vertically rotatable on a horizontal axis at a proximate end of the latch parallel to said panel axis, said latch extending from said axis distally to an inferior return (248; 248') having a sloped surface (250; 250') ending at an inset notch (251; 251'), said latch catch (235; 235') and said latch (247; 249) being horizontally and vertically aligned with each other such that when a said panel containing said latch catch (235; 235') is rotated upwardly, the rotation brings said inferior return (248; 248') of said latch (247; 249) into sliding contact with said ramp (241; 241'), said sloped surface slideable on said ramp (241; 241') until said latch (247; 249) inset passes over said latch catch (235; 235') edge, capturing said latch (247; 249), said latch holding said panel in said home position.
7. The apparatus of claim 4 in which said panel top side includes said latch (247; 249) and said latch catch (235; 235') is slideably translatably carried by said suspension member.
8. The apparatus of claim 7 in which said latch (247; 249) resides in a recess in said top side of the panel and is pivotally vertically rotatable on a horizontal axis at a proximate end of the latch (247; 249) parallel to said panel axis, said latch (247; 249) extending distally to an inferior return (248; 248') having a sloped surface ending at an inset notch, and wherein said latch catch (235; 235') comprises a ramp (241; 241') declining in a direction toward said suspension member to terminate in a latch catch (235; 235') edge, and wherein each said latch (247; 249) and latch catch (235; 235') are horizontally and vertically aligned with each other such that when a said panel containing said latch (247; 249) is rotated vertically, the rotation brings said inferior return (248; 248') of said latch (247; 249) into sliding contact with said ramp (241; 241'), said sloped surface slideable on said ramp (241; 241') until said latch (247; 249) inset passes over said latch catch (235; 235') edge, capturing said latch (247; 249), said latch (247; 249) holding said panel in said home position.
9. The apparatus of claim 1 further comprising at least one restraint (230) limiting said downward rotation of each panel (234; 236) to said lower passage closing position.
10. The apparatus of claim 9 in which said restraint comprises stops (230) within and connected to said support (210) proximate said bottom opening and not obstructing said passage.
11. The apparatus of claim 1 in which said atmospheric opening is rectilinear and said support (210) is quadrilateral.
12. The apparatus of claim 1 wherein said suspension member (242; 244) comprises a beam (242) having vertically hung straps (244) holding said horizontal hinge and said panels connected to said horizontal hinge.
13. The apparatus of claim 12 in which said horizontal hinge comprises a hinge mounting member (245) held by said suspension member and a plurality of hinge members (243) mounted on said hinge mounting member.
14. The apparatus of claim 13 wherein each hinge member comprises a stationary member (243b), a moveable member (243a) and a hinge pin (243c) interconnecting the stationary (243b) and moveable members (243a), said stationary member (243b) connecting to said hinge mounting member (245), said moveable hinge member connecting to said proximal end of a said panel.
15. The apparatus of claim 14 in which said atmospheric opening is rectilinear and said support (210) is quadrilateral and comprising a pair of said panels (234; 236) and wherein said suspension member (242; 244) is supported centrally between said opposed lateral sidewalls (224) for mounting of said panels (234; 236) in said passage for rotation of the panels (234; 236) in directions opposite each other from or to said upright home position not obstructing said passage.

## Patentansprüche

1. Eine Vorrichtung zum Ermöglichen einer Lüftung 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 betätigt werden kann, um einen Abwärtsfluss von Oberflächenwasser in den unterirdischen Lüftungskanal zu verhindern, umfassend:
- eine Abstützung (210), umfassend entgegengesetzte laterale Seitenwände (224), zur Anordnung in dem genannten Schacht, die einen Durchgang (225) 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 (238) und eine untere Seite (232) 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;

ein Aufhängungsglied (242; 244), das sich unblockierend horizontal über den genannten Durchgang spannt, auf den genannten entgegengesetzten lateralen Seitenwänden (224) proximal zu der genannten oberen Öffnung abgestützt ist und die genannte/n eine oder mehreren scharnierverbundenen Platten (234; 236) in dem genannten Durchgang proximal zu der genannten unteren Öffnung hält,

einen Plattenhalter (240) zum Halten von jeder genannten Platte in der genannten aufrechten Grundposition, wobei der Plattenhalter, für jede genannte Platte, ein bewegbares Glied (242; 244) und ein nicht bewegbares Glied umfasst (235; 235'), wobei eines des bewegbaren Glieds (242; 244) und des nicht bewegbaren Glieds von der Platte auf der genannten oberen Seite der Platte getragen werden und das andere des bewegbaren Glieds (242; 244) und des nicht bewegbaren Glieds (235; 235') unterhalb des genannten Aufhängungsglieds verschiebbar aufgehängt sind,

wobei das genannte bewegbare Glied (242; 244) das genannte nicht bewegbare Glied (235; 235') erfasst und hält, wenn die genannte Platte aufwärts zur genannten Grundposition gedreht wird, und

einen Plattenausrucker (246; 252) für den genannten Plattenhalter (240), umfassend ein Gestänge, das mit dem genannten bewegbaren oder nicht bewegbaren Plattenhalterglied, das an dem genannten Aufhängungsglied (242; 244) aufgehängt ist, verbunden ist, wobei das genannte Gestänge relativ zu dem genannten Aufhängungsglied (242; 244) bewegbar ist, um das genannte aufgehängte bewegbare oder nicht bewegbare Glied zu verschieben, um die Platte von der genannten aufrechten Grundpo-

sition auszurücken und der genannten Platte zu ermöglichen, gravitativ drehend auf die genannte untere den Durchgang schließende Position zu fallen.

2. Die Vorrichtung nach Anspruch 1, wobei der genannte Plattenhalter (240) ein Schnappriegel ist.
3. Die Vorrichtung nach Anspruch 1, bei der der genannte Plattenhalter (240) ein Schwerkraftriegel ist.
4. Die Vorrichtung nach Anspruch 1, bei der das genannte nicht bewegbare Glied des genannten Plattenhalters einen Riegelfänger (235; 235') umfasst und das genannte bewegbare Glied des genannten Plattenhalters einen drehbaren Riegel (247; 249) umfasst, der auf einer zur genannten Plattenachse parallelen horizontalen Achse drehbar ist und in dem genannten Riegelfänger (235; 235') eingreifbar ist.
5. Die Vorrichtung nach Anspruch 4, bei der die genannte obere Plattenseite den genannten Riegelfänger (235; 235') beinhaltet und der genannte Riegel (247; 249) von dem genannten Aufhängungsglied (242; 244) gleitbar verschiebbar getragen wird.
6. Die Vorrichtung nach Anspruch 5, bei der der genannte Riegelfänger (235; 235') in einer Aussparung in der genannten oberen Seite der Platte liegt und eine Rampe (241; 241') umfasst, die von einem Eintritt zu der genannten Aussparung (233; 233') ausgeht und in einer Richtung zu dem genannten distalen Ende der genannten Platte hin abfällt, um in einer Riegelfänger(235; 235')kante abzuschließen, und bei der jeder Riegel (247; 249) auf einer zu der genannten Plattenachse parallelen horizontalen Achse an einem proximalen Ende des Riegels gelenkig vertikal drehbar ist, wobei sich der genannte Riegel von der genannten Achse distal zu einer tieferliegenden Rückführung (248; 248') erstreckt, die eine geneigte Oberfläche (250; 250') aufweist, die an einer Einschnittkerbe (251; 251') endet, wobei der genannte Riegelfänger (235; 235') und der genannte Riegel (247; 249) horizontal und vertikal aufeinander ausgerichtet sind, sodass, wenn eine genannte Platte, die den genannten Riegelfänger (235; 235') enthält, aufwärts gedreht wird, die Drehung die genannte tieferliegende Rückführung (248; 248') des genannten Riegels (247; 249) mit der genannten Rampe (241; 241') in Gleitkontakt bringt, wobei die genannte geneigte Oberfläche auf der genannten Rampe (241; 241') gleitbar ist, bis der genannte Riegel(247; 249)einschnitt über die genannte Riegelfänger(235; 235')kante hinwegläuft, womit der genannte Riegel (247; 249) erfasst wird, wodurch der genannte Riegel die genannte Platte in der genannten Grundposition hält.

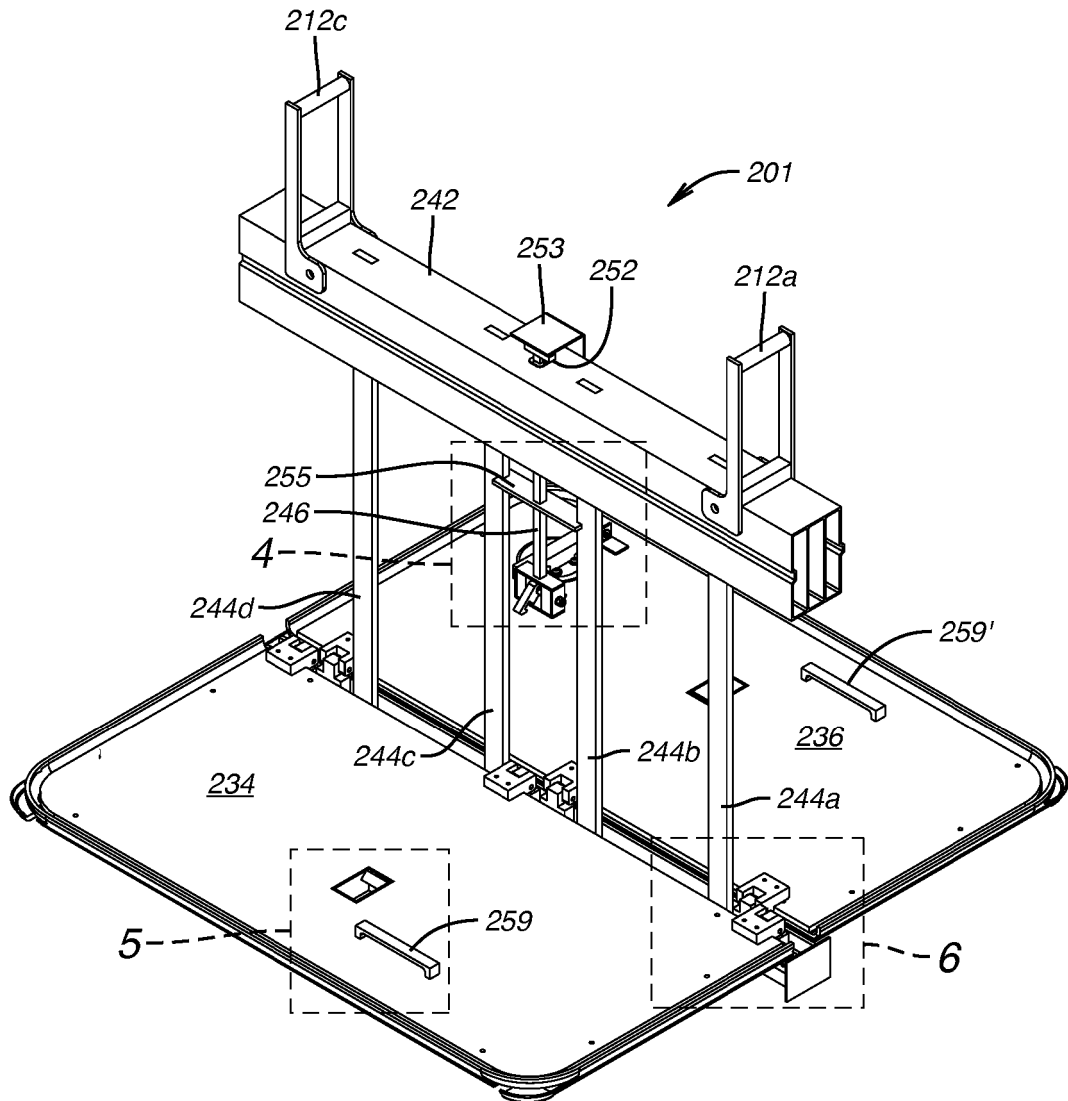
7. Die Vorrichtung nach Anspruch 4, bei der die genannte obere Plattenseite den genannten Riegel (247; 249) beinhaltet und der genannte Riegelfänger (235; 235') von dem genannten Aufhängungsglied gleitbar verschiebbar getragen wird.
8. Die Vorrichtung nach Anspruch 7, bei der der genannte Riegel (247; 249) in einer Aussparung in der genannten oberen Seite der Platte liegt und auf einer zu der genannten Plattenachse parallelen horizontalen Achse an einem proximalen Ende des Riegels (247; 249) gelenkig vertikal drehbar ist, wobei sich der Riegel (247; 249) distal zu einer tieferliegenden Rückführung (248; 248') erstreckt, die eine geneigte Oberfläche aufweist, die an einer Einschnittkerbe endet, und wobei der genannte Riegelfänger (235; 235') eine Rampe (241; 241') umfasst, die in einer Richtung zu dem genannten Aufhängungsglied hin abfällt, um an einer Riegelfänger(235; 235')kante abzuschließen, und wobei jeder Riegel (247; 249) und jeder Riegelfänger (235; 235') horizontal und vertikal aufeinander ausgerichtet sind, sodass, wenn eine genannte Platte, die den genannten Riegel (247; 249) enthält, vertikal gedreht wird, die Drehung die genannte tieferliegenden Rückführung (248; 248') des genannten Riegels (247; 249) der genannten Rampe (241; 241') in Gleitkontakt bringt, wobei die genannte geneigte Oberfläche auf der genannten Rampe (241; 241') gleitbar ist, bis der genannte Riegel(247; 249) einschnitt über die genannte Riegelfänger(235; 235')kante hinwegläuft, womit der genannte Riegel (247; 249) erfasst wird, wodurch der genannte Riegel (247; 249) die genannte Platte in der genannten Grundposition hält.
9. Die Vorrichtung nach Anspruch 1, die ferner mindestens eine Rückhaltung (230), die die genannte Abwärtsdrehung von jeder Platte (234; 236) zu der genannten unteren den Durchgang schließenden Position beschränkt, umfasst.
10. Die Vorrichtung nach Anspruch 9, bei der die genannte Rückhaltung Anschläge (230), die innerhalb der genannten Abstützung (210) und mit dieser verbunden proximal zu der genannten unteren Öffnung liegen und den genannten Durchgang nicht blockieren, umfasst.
11. Die Vorrichtung nach Anspruch 1, bei der die genannte atmosphärische Öffnung rechtlinig ist und die genannte Abstützung (210) vierseitig ist.
12. Die Vorrichtung nach Anspruch 1, bei der das genannte Aufhängungsglied (242; 244) einen Träger (242) umfasst, der vertikal herunterhängende Gurte (244) aufweist, die das genannte horizontale Scharnier und die genannten Platten mit dem genannten horizontalen Scharnier verbunden halten.
13. Die Vorrichtung nach Anspruch 12, bei der das genannte horizontale Scharnier ein Scharniermontageglied (245), das von dem genannten Aufhängungsglied gehalten wird, und eine Vielzahl von Scharniergliedern (243), die auf dem genannten Scharniermontageglied montiert sind, umfasst.
14. Die Vorrichtung nach Anspruch 13, bei der jedes Scharnierglied ein stationäres Glied (243b), ein bewegbares Glied (243a) und einen Scharnierstift (243c), der das stationäre (243b) und bewegbare Glied (243a) verbindet, umfasst, wobei das stationäre Glied (243b) mit dem genannten Scharniermontageglied (245) verbunden ist, wobei das genannte bewegbare Scharnierglied mit dem genannten proximalen Ende einer genannten Platte verbunden ist.
15. Die Vorrichtung nach Anspruch 14, bei der die genannte atmosphärische Öffnung rechtlinig ist und die genannte Abstützung (210) vierseitig ist und ein Paar der genannten Platten (234; 236) umfasst und wobei das genannte Aufhängungsglied (242; 244) mittig zwischen den genannten entgegengesetzten lateralen Seitenwänden (224) abgestützt ist, zum Montieren der genannten Platten (234; 236) in dem genannten Durchgang, zur Drehung der Platten (234; 236) in entgegengesetzte Richtungen voneinander von oder zu der genannten aufrechten Grundposition, die den genannten Durchgang nicht blockiert.

## Revendications

1. Appareil pour permettre une ventilation à travers un puits de ventilation vertical à 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 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 (225) 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 (238) et un côté inférieur (232), 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 ; un élément de suspension (242 ; 244) enjambant de manière non obstructive dans le plan horizontal ledit passage soutenu sur lesdites parois latérales opposées (224) à proximité de ladite ouverture supérieure 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, le dispositif de maintien de panneau comprenant, pour ledit chaque panneau, un élément mobile (242 ; 244) et un élément non mobile (235 ; 235'), un élément parmi l'élément mobile (242 ; 244) et l'élément non mobile étant porté par le panneau sur ledit côté supérieur du panneau et l'autre élément parmi l'élément mobile (242 ; 244) et l'élément non mobile (235 ; 235') étant suspendu par translation en dessous dudit élément de suspension, ledit élément mobile (242 ; 244) saisissant et maintenant ledit élément non mobile (235 ; 235') lorsque ledit panneau est tourné vers le haut jusqu'à ladite position de repos, et un dispositif de libération de panneau (246, 252) pour ledit dispositif de maintien de panneau (240), comprenant une tringlerie raccordée audit élément de maintien de panneau mobile ou non mobile suspendu par ledit élément de suspension (242 ; 244), ladite tringlerie étant mobile manuellement relativement audit élément de suspension (242 ; 244) afin d'effectuer la translation dudit élément mobile ou non mobile suspendu 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.
2. Appareil de la revendication 1 où ledit dispositif de maintien de panneau (240) est un verrou bec-de-cane.
  3. Appareil de la revendication 1 dans lequel ledit dispositif de maintien de panneau (240) est un verrou par gravité.
  4. Appareil de la revendication 1 dans lequel ledit élément non mobile dudit dispositif de maintien de panneau comprend un taquet de verrou (235 ; 235') et ledit élément mobile dudit dispositif de maintien de panneau comprend un verrou rotatif (247 ; 249) apte à tourner sur un axe horizontal parallèle audit axe de panneau et 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 inclut ledit taquet de verrou (235 ; 235') et ledit verrou (247 ; 249) est porté de manière coulissante en translation par ledit élément de suspension (242 ; 244).
  6. Appareil de la revendication 5 dans lequel ledit taquet de verrou (235 ; 235) réside dans un évidement dans ledit côté supérieur du panneau et comprend une rampe (241 ; 241') commençant au niveau d'une entrée vers ledit évidement (233 ; 233') et en déclivité dans une direction allant vers ladite extrémité distale dudit panneau pour se terminer dans un bord de taquet de verrou (235 ; 235'), et dans lequel ledit chaque verrou (247 ; 249) est apte à tourner de manière pivotante dans le plan vertical sur un axe horizontal au niveau d'une extrémité proche du verrou parallèlement audit axe de panneau, ledit verrou s'étendant à partir dudit axe de manière distale vers un retour inférieur (248 ; 248') ayant une surface inclinée (250 ; 250') finissant au niveau d'une encoche encastrée (251 ; 251'), ledit taquet de verrou (235 ; 235') et ledit verrou (247 ; 249) étant alignés horizontalement et verticalement l'un avec l'autre de telle sorte que lorsque ledit un panneau contenant ledit taquet de verrou (235 ; 235') est tourné vers le haut, la rotation amène ledit retour inférieur (248 ; 248') dudit verrou (247 ; 249) en contact coulissant avec ladite rampe (241 ; 241'), ladite surface inclinée étant apte à coulisser sur ladite rampe (241 ; 241') jusqu'à ce que ledit encastrement de verrou (247 ; 249) passe par-dessus ledit bord de taquet de verrou (235 ; 235'), saisissant ledit verrou (247 ; 249), ledit verrou maintenant ledit panneau dans ladite position de repos.
  7. Appareil de la revendication 4 dans lequel ledit côté supérieur de panneau inclut ledit verrou (247 ; 249) et ledit taquet de verrou (235 ; 235') est porté de manière coulissante par translation par ledit élément de suspension.
  8. Appareil de la revendication 7 dans lequel ledit verrou (247 ; 249) réside dans un évidement dans ledit côté supérieur du panneau et est apte à tourner de manière pivotante dans le plan vertical sur un axe horizontal au niveau d'une extrémité proche du verrou (247 ; 249) parallèlement audit axe de panneau, ledit verrou (247 ; 249) s'étendant de manière distale

- vers un retour inférieur (248 ; 248') ayant une surface inclinée finissant au niveau d'une encoche encastree, et dans lequel ledit taquet de verrou (235 ; 235') comprend une rampe (241 ; 214') en déclivité dans une direction allant vers ledit élément de suspension pour se terminer dans un bord de taquet de verrou (235 ; 235'), et dans lequel chaque élément parmi lesdits verrou (247 ; 249) et taquet de verrou (235 ; 235') sont alignés horizontalement et verticalement l'un avec l'autre de telle sorte que lorsque ledit un panneau contenant ledit verrou (247 ; 249) est tourné verticalement, la rotation amène ledit retour inférieur (248 ; 248') dudit verrou (247 ; 249) en contact coulissant avec ladite rampe (241 ; 241'), ladite surface inclinée étant apte à coulisser sur ladite rampe (241 ; 241') jusqu'à ce que ledit encastrement de verrou (247 ; 249) passe par-dessus ledit bord de taquet de verrou (235 ; 235'), saisissant ledit verrou (247 ; 249), ledit verrou (247 ; 249) maintenant ledit panneau dans ladite position de repos.
9. Appareil de la revendication 1 comprenant en outre au moins une retenue (230) qui limite ladite rotation vers le bas de chaque panneau (234 ; 236) vers ladite position de fermeture de passage inférieure.
10. Appareil de la revendication 9 dans lequel ladite retenue comprend des arrêts (230) au sein de et raccordés audit support (210) à proximité de ladite ouverture inférieure et n'obstruant pas ledit passage.
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 où ledit élément de suspension (242 ; 244) comprend une poutrelle (242) ayant des armatures suspendues verticalement (244) qui maintiennent ladite articulation horizontale et lesdits panneaux raccordés à ladite articulation horizontale.
13. Appareil de la revendication 12 dans lequel ladite articulation horizontale comprend un élément de montage d'articulation (245) maintenu par ledit élément de suspension et une pluralité d'éléments d'articulation (243) montés sur ledit élément de montage d'articulation.
14. Appareil de la revendication 13 où chaque élément d'articulation comprend un élément stationnaire (243b), un élément mobile (243a) et une broche d'articulation (243c) raccordant entre eux les éléments stationnaire (243b) et mobile (243a), ledit élément stationnaire (243b) se raccordant audit élément de montage d'articulation (245), ledit élément d'articulation mobile se raccordant à ladite extrémité proximale dudit un panneau.
15. Appareil de la revendication 14 dans lequel ladite ouverture à l'atmosphère est rectiligne et ledit support (210) est quadrilatéral et comprenant une paire desdits panneaux (234 ; 236) et où ledit élément de suspension (242 ; 244) est soutenu centralement entre lesdites parois latérales opposées (224) pour le montage desdits panneaux (234 ; 236) dans ledit passage pour une rotation des panneaux (234 ; 236) dans des directions opposées l'une à l'autre à partir de ou vers ladite position de repos dressée n'obstruant pas ledit passage.



**FIG. 1**

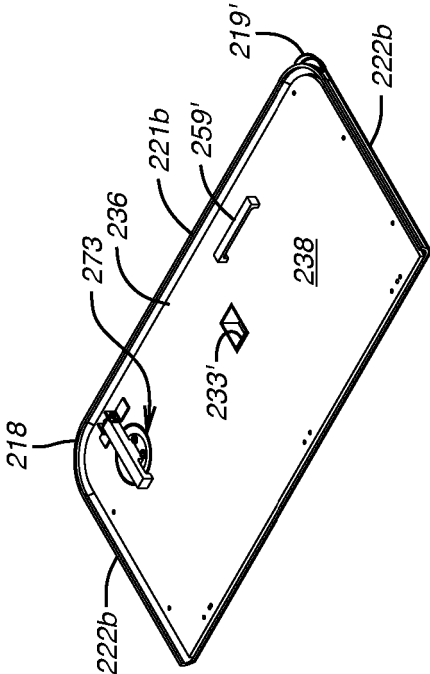


FIG. 2A

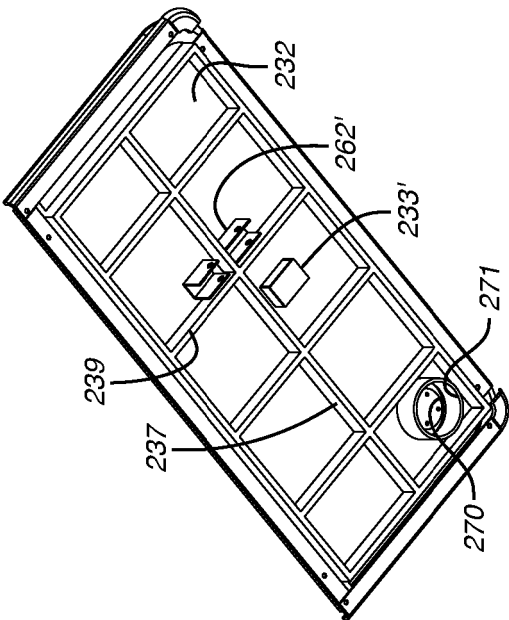


FIG. 2B

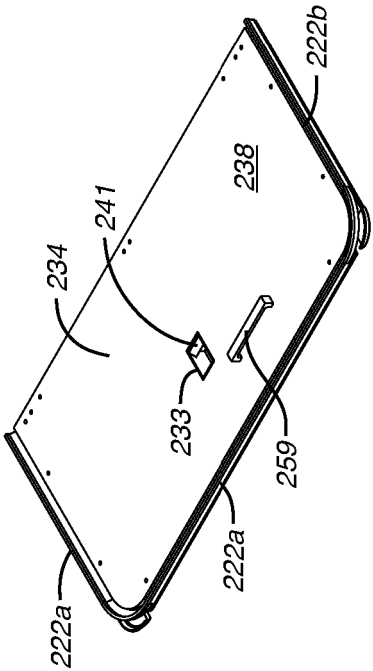


FIG. 3A

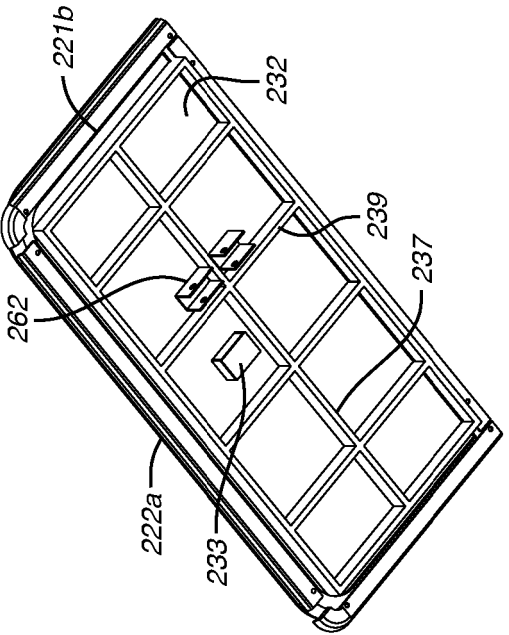
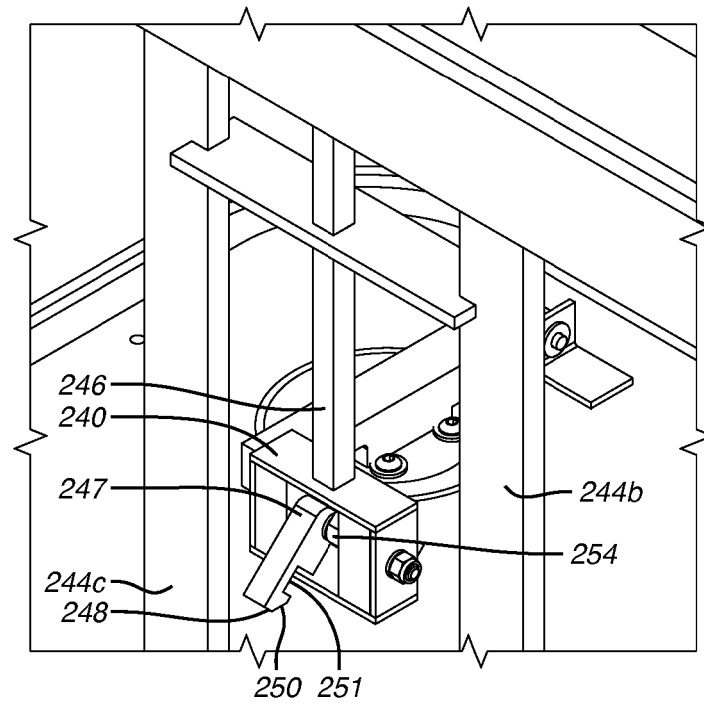
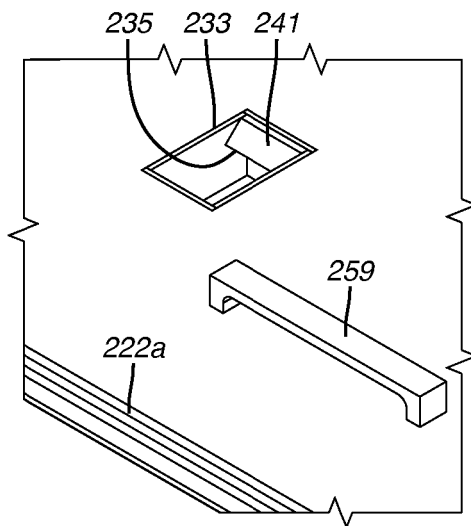


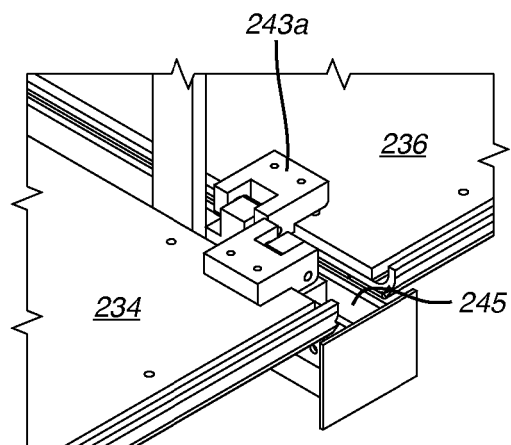
FIG. 3B



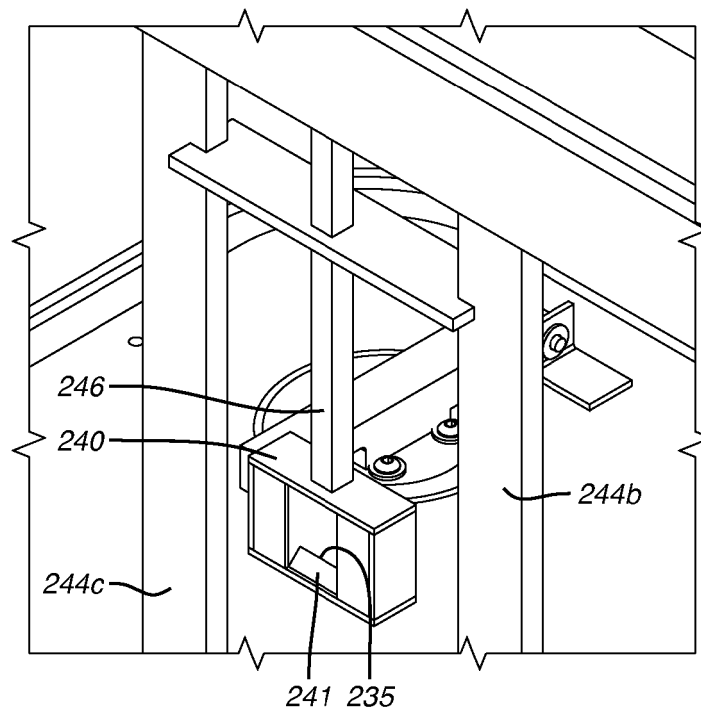
**FIG. 4**



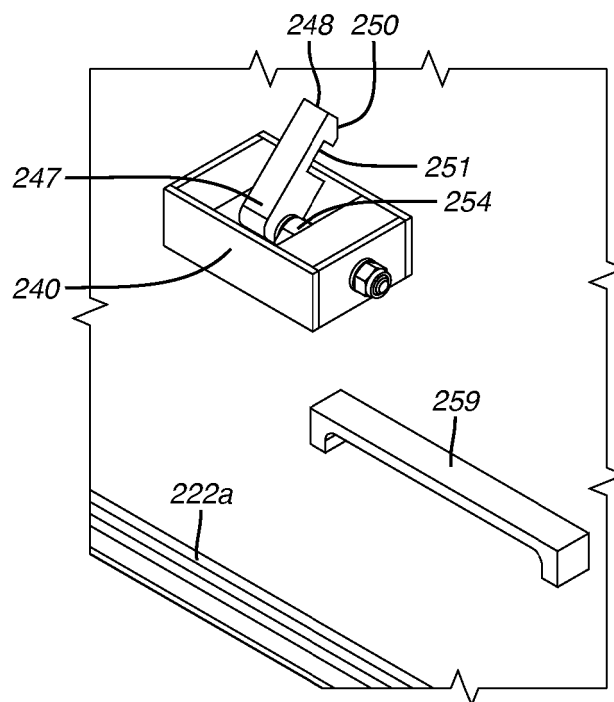
**FIG. 5**



**FIG. 6**



**FIG. 7**



**FIG. 8**

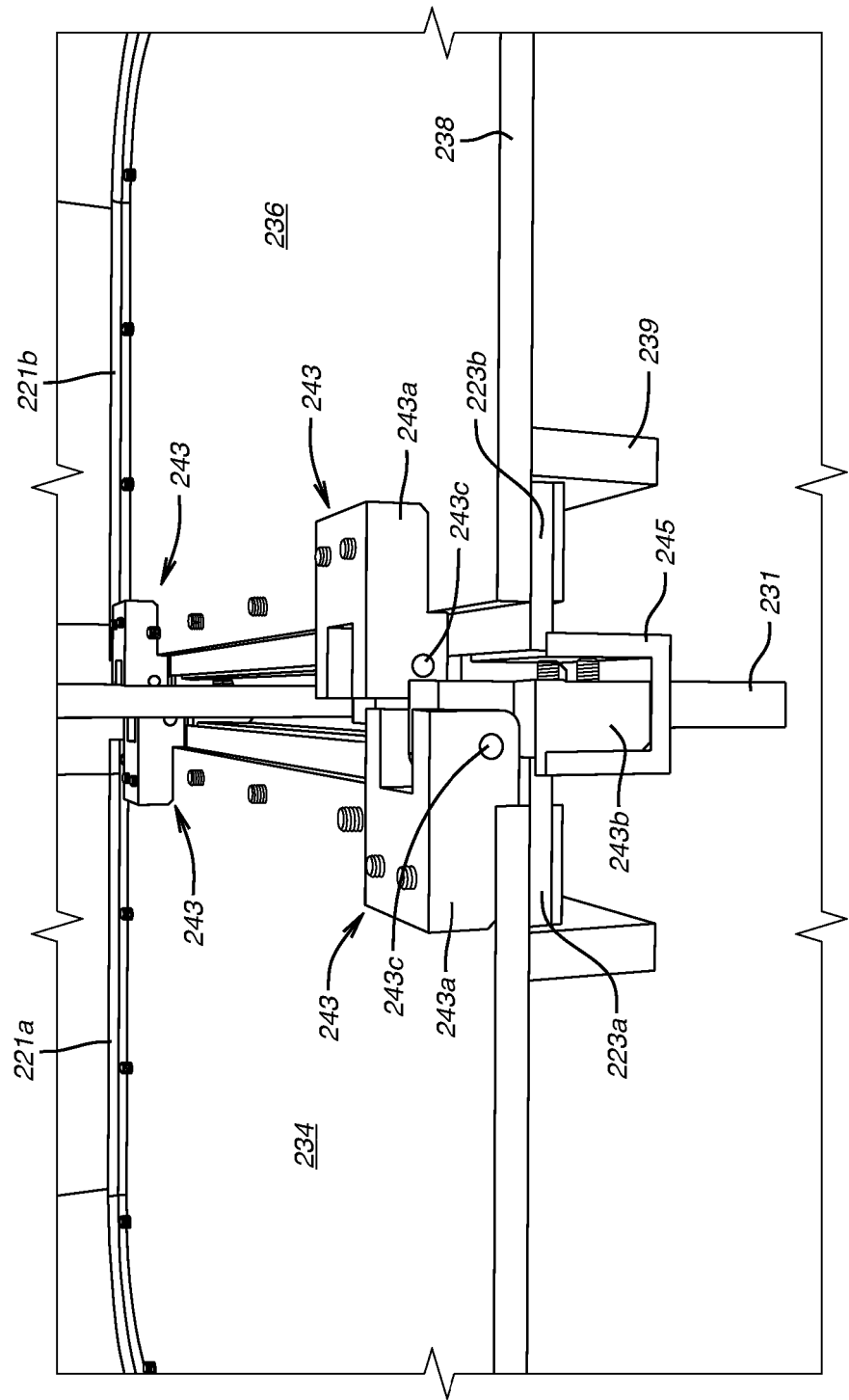
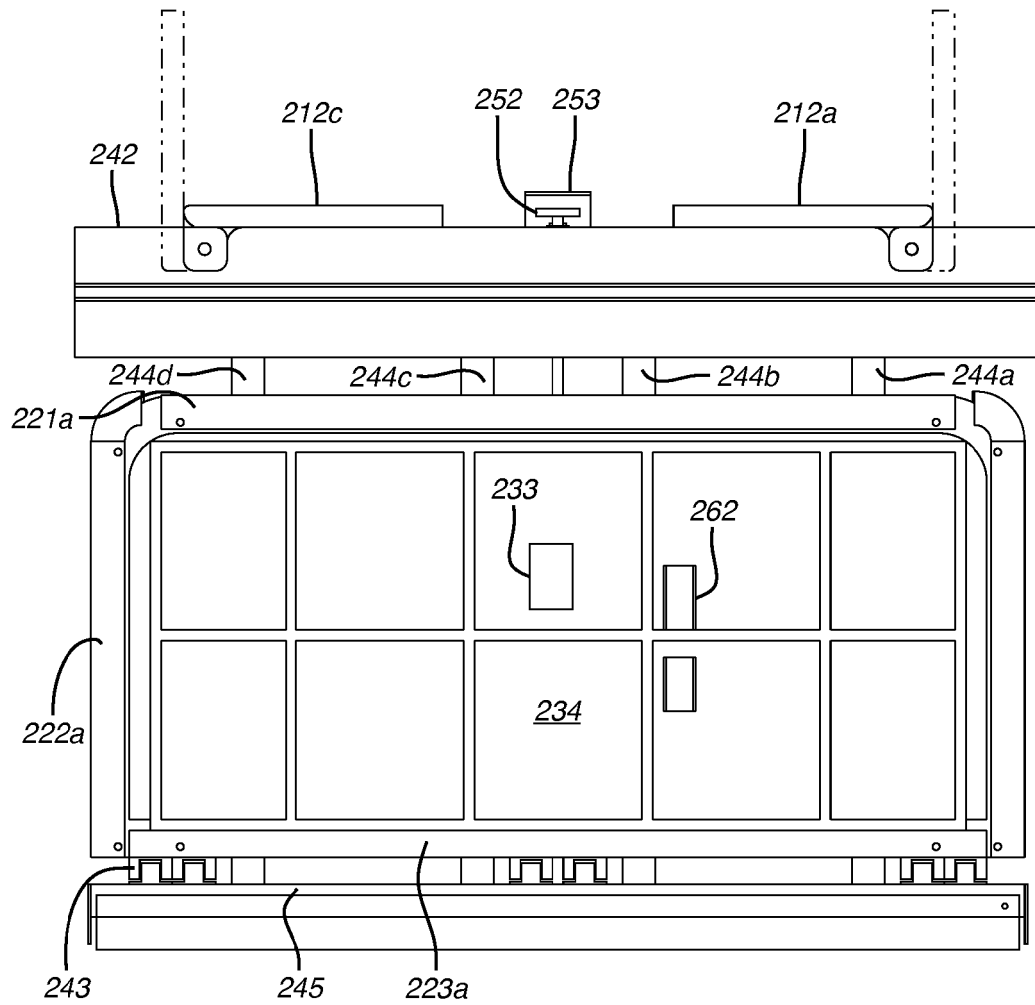


FIG. 9



**FIG. 10**

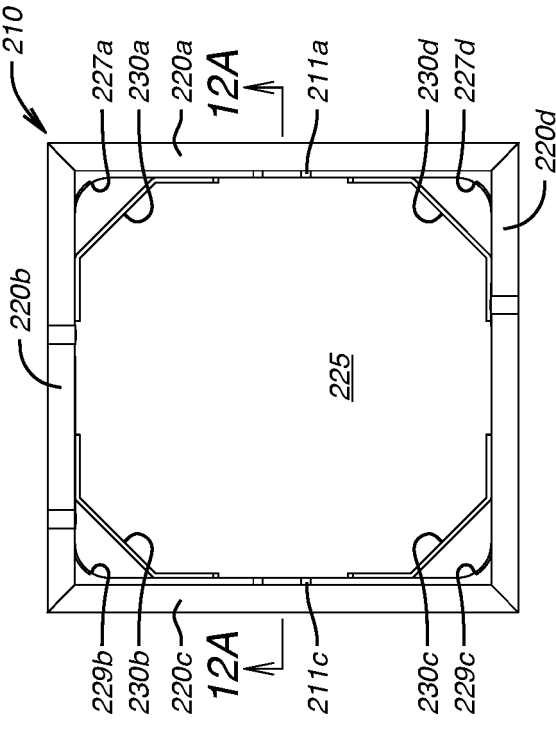


FIG. 12

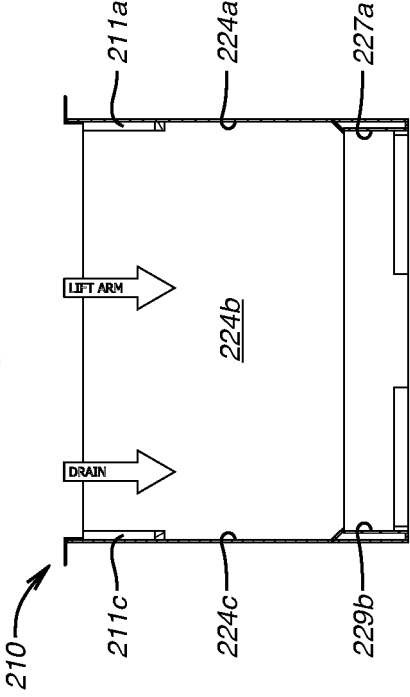


FIG. 12A

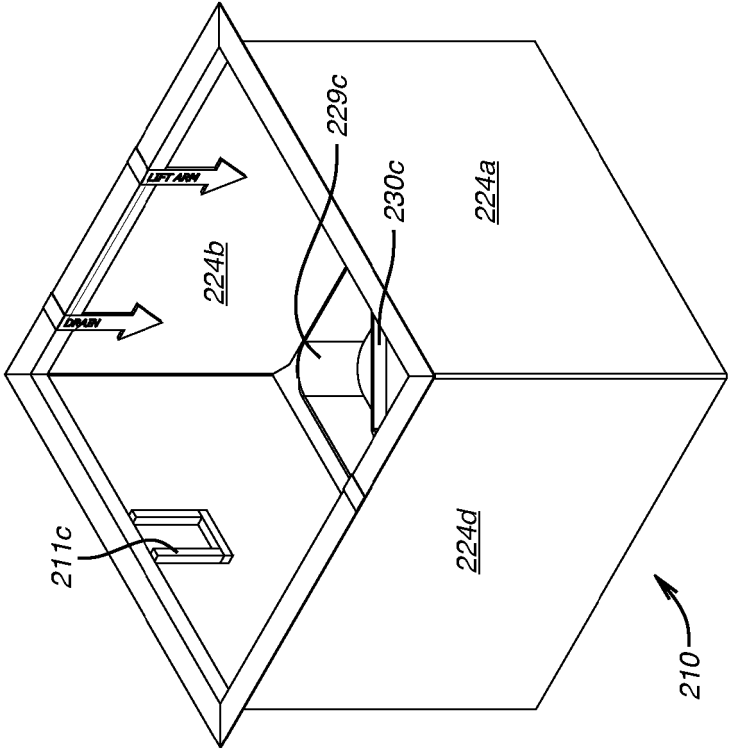


FIG. 11

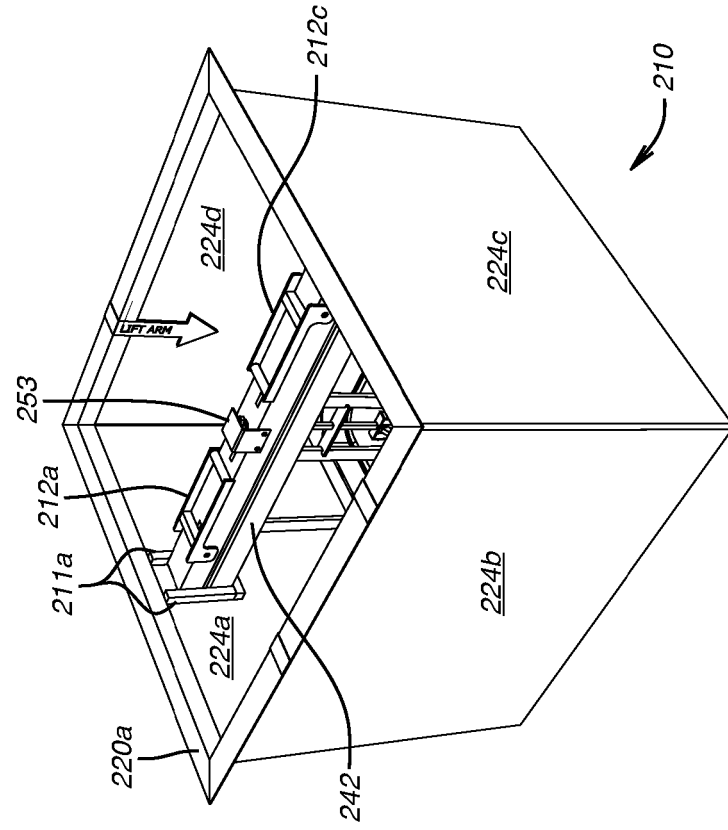


FIG. 13

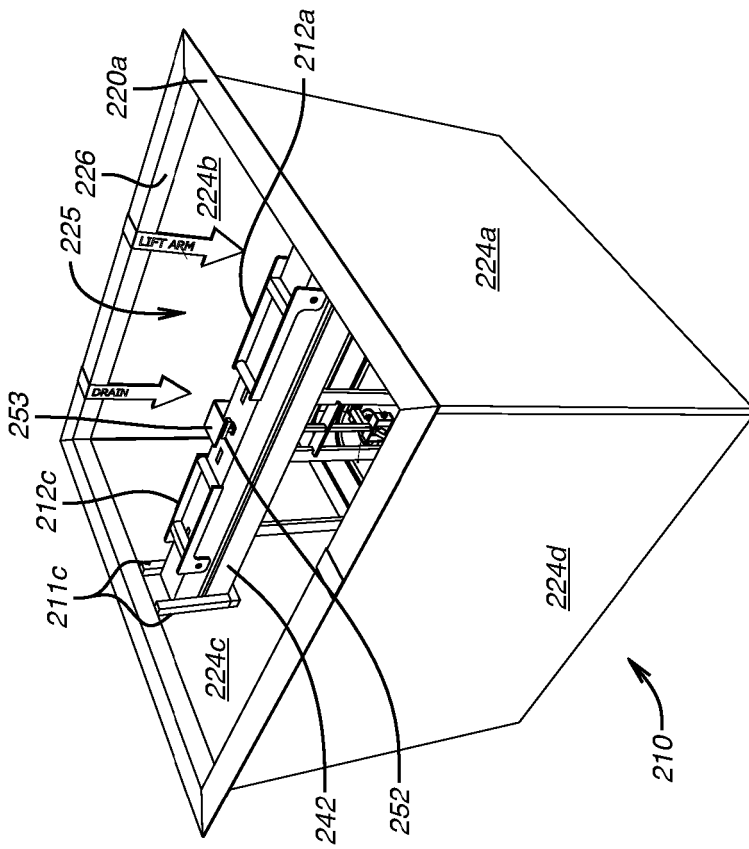
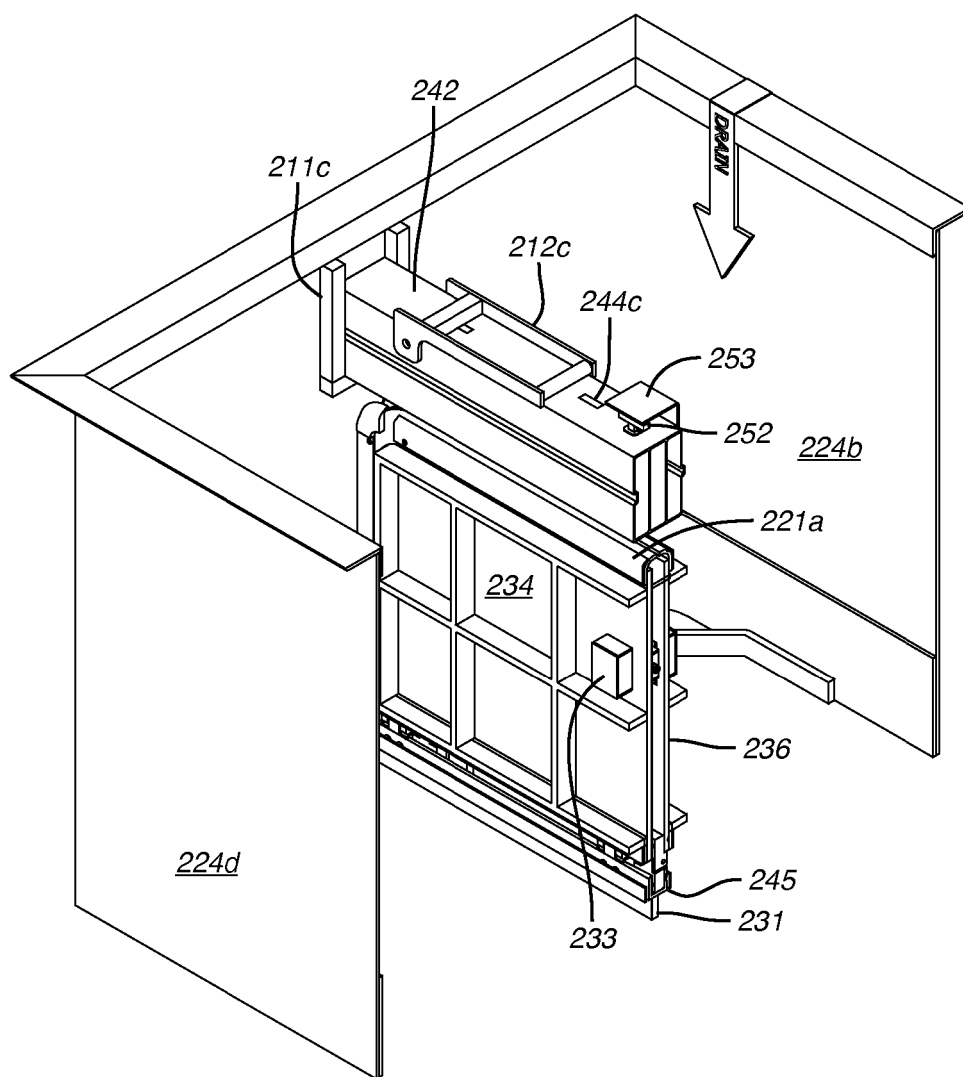
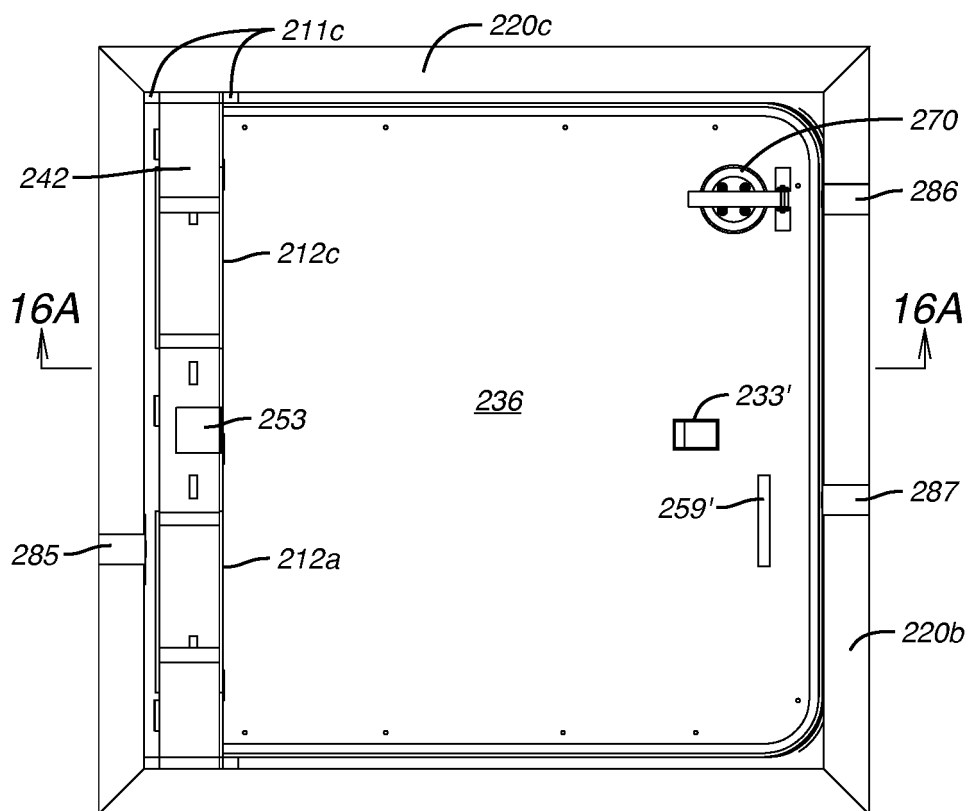


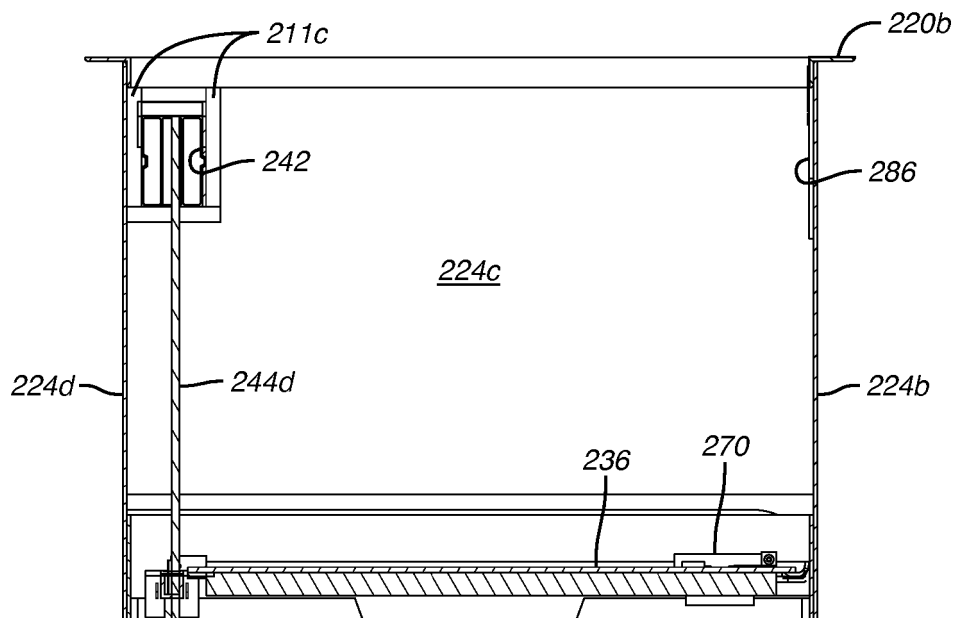
FIG. 14



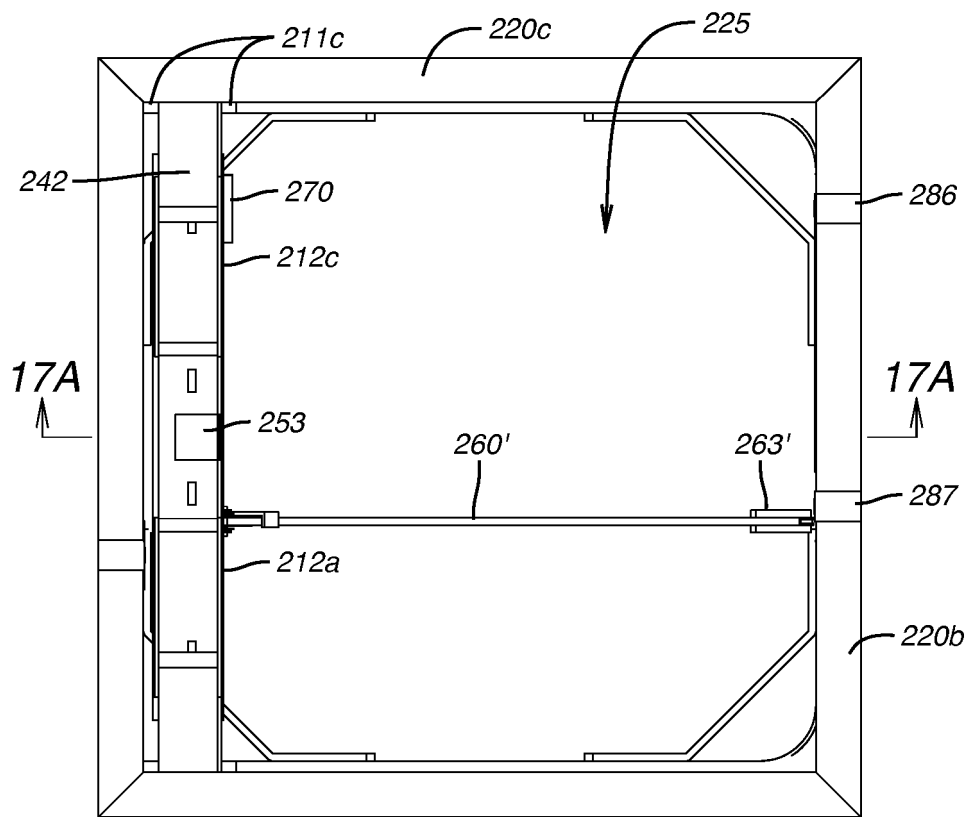
**FIG. 15**



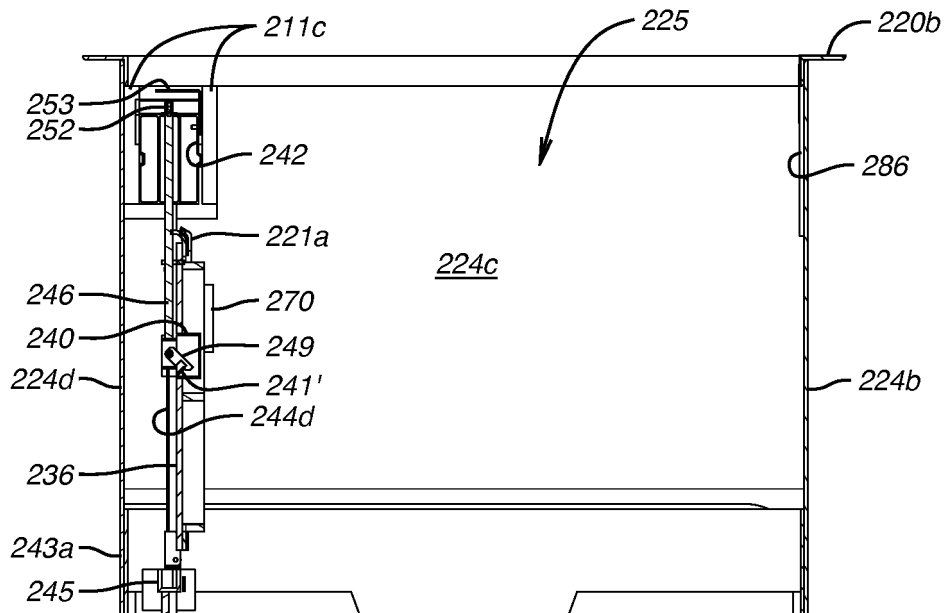
**FIG. 16**



**FIG. 16A**



**FIG. 17**



**FIG. 17A**

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

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