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(54) OPTIMIZED-INSTALLATION FLOOD PROTECTION BARRIER

(57) The present invention relates to a flood protection barrier (10) configured to at least partially close in a watertight manner an access opening to a room of a building comprising a flat structure (11) comprising a front plane (12), a rear plane (12'), a first and a second vertical edge (13,13'), a lower transverse edge (14) and an upper transverse edge (14'); and a pair of side seals (20), wherein each side seal (20) of the pair of side seals (20) is positioned at a respective vertical edge (13,13'), and is characterized in that at least one side

seal (20) of the pair of side seals (20) is a layered seal which comprises at least a first sealing element (21) coupled to a respective vertical edge (13,13'), a moving plane element (22) coupled to the first sealing element (21) and at least a second sealing element (23) coupled to the moving plane element (22), wherein the moving plane element (22) and the second sealing element (23) extend substantially for the entire development of the first sealing element (21) along the vertical edge (13,13').

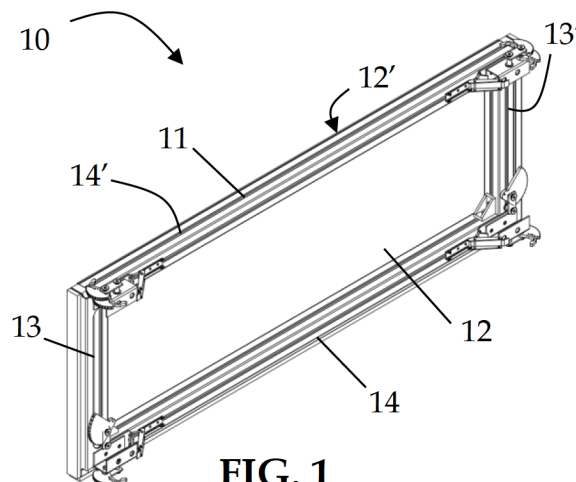


FIG. 1

Description

TECHNICAL FIELD

[0001] The present invention relates to a flood barrier used in general terms for the protection of buildings from flooding. In particular, the present invention relates to a flood protection barrier used to at least partially close in a watertight manner an access opening to a room of a building, such as for example doors and windows, to prevent water and mud from passing through the opening and invading the room.

STATE OF THE ART

[0002] In general terms, the problem of flooding of rooms that occurs during heavy rains, floods or river overflows is known. This problem is particularly felt in the case of buildings whose entrance opening is on the street level, or only slightly raised. Flooding of such buildings occurs as use is usually made of fixtures that are not able to provide a watertight seal and a barrier sufficiently resistant to the pushing force generated by the water.

[0003] To remedy the general problem of flooding of buildings, it is known to install special anti-flood devices commonly known as "flood protection barriers".

[0004] Typically, such devices comprise a panel mountable at an opening of a building, either on this side or on the other side of the fixture, or internally thereof, at an opening of a room within the building. Between the two vertical sides of the panel and the walls of the opening, it is provided for mounting hydraulic tightening seals, arranged vertically and such as to create, together with the presence of the panel, a watertight barrier that prevents the passage of water or mud inside the room. More in detail, the panel has the possibility of being made integral with the vertical walls of the opening by using vertical guides comprising tightening seals. Furthermore, in the area between the surface of the floor and the panel there is usually a hydraulic tightening seal arranged horizontally along the lower side of the panel.

[0005] In the known flood protection barriers, the tightening seals are compressed against the relative vertical walls or against the floor by means of screw or lever members that exert a punctual compressive force. The compression of the seals resulting from the action of these members is therefore not uniform along their entire extension.

[0006] In addition, for mounting the barrier in the seat, it must have dimensions substantially comparable or slightly smaller than the horizontal gap of the opening, requiring that during installation the compression means adequately compensate for the exact width dimension between the two vertical walls of the opening. However, the compression means of the seals used in the flood protection barriers known today are not suitable

for the purpose. This problem is further accentuated in case of construction imperfections and at the overlap between the vertical seals and the horizontal seal.

[0007] To this end, it is known to use vertical guides and a flat lower abutment, which are mounted in advance at the vertical walls and possibly also at the floor of the opening and left fixed, creating a possible risk of tripping, as well as causing a functional and aesthetic deterioration of the entrance opening to the building or room when the barrier is not in use. Moreover, the preventive mounting of the guides and of the abutment requires complex and onerous masonry works of tessellation and sealing to be carried out through the intervention of a specialised technician.

OBJECTS AND SUMMARY OF THE INVENTION

[0008] In light of the above, the problem underlying the present invention is to overcome the drawbacks of the known art. In particular, as part of this problem, an object is to devise a flood protection barrier that is able to offer an optimal and uniform watertight seal along the points of contact with the lateral surfaces of the opening, even in case of construction imperfections.

[0009] As part of this problem, an object of the present invention is to realize a flood protection barrier that provides an optimal watertight seal without making use of accessory elements that require a fixed mounting at the opening.

[0010] A further object of the present invention is to study a flood protection barrier that can be installed easily and quickly, without requiring the intervention of specialised technicians.

[0011] Still an object of the present invention is to design a flood protection barrier that has a simple structure and is realizable at low cost.

[0012] In accordance with a first aspect thereof, the invention therefore relates to a flood protection barrier configured to at least partially close in a watertight manner an access opening to a room of a building, which comprises a flat structure comprising a front plane, a rear plane, a first and a second vertical edge, a lower transverse edge and an upper transverse edge.

[0013] The flood protection barrier further comprises a pair of side seals, wherein each side seal of the pair of side seals is positioned at a respective vertical edge.

[0014] According to the present invention at least one side seal of the pair of side seals is a layered seal comprising at least a first sealing element coupled to a respective vertical edge, a moving plane element coupled to the first sealing element and at least a second sealing element coupled to the moving plane element, wherein the moving plane element and the second sealing element extend substantially for the entire development of the first sealing element along the vertical edge.

[0015] Thanks to the use of at least one layered side seal with two sealing elements to which a moving plane

element is interposed, it is possible to vary the width dimension of the flood protection barrier in an optimal and uniform way to allow easy positioning of the same at the internal gap of the access opening that one wishes to make watertight, without the intervention of specialised technicians

[0016] In addition, once the barrier is positioned, its watertight engagement against the side walls of the opening is also facilitated by the at least one layered seal that can assume an expanded configuration, adapting even to surfaces that are not constructionally perfect.

[0017] Therefore, for its implementation and to ensure a watertight engagement with the walls of the opening, it is no longer necessary to use accessory elements, such as for example guides, which require a fixed mounting at the opening.

[0018] Further characteristics of the preferred embodiments of the flood protection barrier according to the present invention are the subject-matter of the dependent claims.

[0019] In a variant of the invention, the first sealing element extends substantially for the entire development of said vertical edge.

[0020] Preferably, the first sealing element and/or the second sealing element is of the deformable and/or compressible type, preferably made of at least one material selected from the group consisting of PVC, EPDM, PP, rubber and a soft material suitable for providing a watertight seal.

[0021] Preferably, the first sealing element and/or the second sealing element is made of a foamed and/or expanded material, with open cells or closed cells or semi-closed cells.

[0022] In a variant of the invention, the flood protection barrier comprises at least one actuating group associated with the at least one layered side seal, wherein the actuating group is at least configured to act on the layered side seal to reduce its lateral bulk.

[0023] Preferably, the actuating group is configured to assume at least a first configuration in which it acts on the moving plane element to bring it closer to the vertical edge.

[0024] Preferably, the actuating group is further configured to act on the layered side seal to press the layered side seal against a wall of the opening.

[0025] Preferably, the actuating group is configured to assume at least a second configuration in which it acts on the moving plane element to move it away from the vertical edge.

[0026] Preferably, the moving plane element comprises at least one extension which develops orthogonally to the moving plane element and parallel to the flat structure, wherein the actuating group is configured to exert at least a traction force on the extension.

[0027] In a variant of the invention, the actuating group comprises an L-shaped lever hinged to a first end of a curved connecting rod, wherein a second end

of the curved connecting rod is constrained to slide within a slot made on the extension of the moving plane element.

[0028] In a further variant of the invention, the actuating group comprises a metal wire in turn connected to a lever constrained to rotate around a vertical rotation axis, wherein the at least one extension carries a hook in which it engages the metal wire.

[0029] In another variant of the invention, the actuating group comprises a central nut screw coupled to a pair of tie rods each fixed to a respective central extension of the moving plane element.

[0030] Preferably, the actuating group comprises two rods of which at least one threaded with the function of central nut screw coupled to a pair of tie rods, each fixed to a respective central extension of the moving plane element.

[0031] In a variant of the invention, the flood protection barrier comprises an anchoring group for constraining the flat structure to the walls of the opening, wherein the anchoring group comprises at least one pair of first cams, wherein each cam of the at least one pair of first cams is positioned at or near a respective vertical edge and is shaped like a spiral portion, wherein each cam of the at least one pair of first cams is hinged on a respective vertical pin integral with the flat structure and is elastically preloaded by elastic means in such a way that, when the barrier is mounted at the access opening in such a way that the cams of the at least one pair of first cams are in frictional contact against a vertical wall of the opening, an orthogonal force component applied to the flat structure causes a rotational thrust of the cams of the pair of first cams in the opposite direction to each other.

[0032] Advantageously, when the flat structure is subjected to a hydrostatic-hydrodynamic thrust exerted by water and/or mud, this is translated into a rotational thrust of the first cams of the pair of first cams in the opposite direction to each other. The cams, however, by engaging the walls of the opening, cannot rotate and thus transform the rotational thrust into a lateral force against the walls, constraining the flat structure even more firmly against them.

[0033] Preferably, a tip portion of a first cam of the at least one pair of first cams develops from the respective vertical pin in the opposite direction to a development of a tip portion of a second cam of the at least one pair of first cams from the respective vertical pin.

[0034] Preferably, the anchoring group comprises two pairs of first cams wherein each pair of first cams of the two pairs of first cams is positioned at or near a respective vertical edge.

[0035] More preferably, a first pair of the two pairs of first cams is positioned substantially at the height of the lower transverse edge and a second pair of the two pairs of first cams is positioned substantially at the height of the upper transverse edge.

[0036] In a variant of the invention, each cam of the

at least one pair of first cams is elastically preloaded, such that, when the barrier is mounted at the access opening, each first cam normally pushes against a part of the opening.

[0037] Alternatively or additionally, each cam of the at least one pair of first cams is elastically preloaded in angular separation from each other with respect to a rotation about the respective vertical pin.

[0038] In a variant of the invention, each cam of the at least one pair of first cams and the relative vertical pin are carried by a first support.

[0039] Preferably, each cam of the at least one pair of first cams and the relative vertical pin are constrained to the first support by means of a first plate connected to the first support through a first screw, in such a way that the first cam and the relative vertical pin are interposed between the first support and the first plate.

[0040] In a variant of the invention, each cam of the at least one pair of first cams is shaped so as to define a pressure angle such that, when the barrier is mounted at the access opening, an orthogonal force component applied to the flat structure causes a force component orthogonal to a part of the opening in which it engages the first cam.

[0041] In a variant of the invention, each cam of the at least one pair of first cams is shaped so as to define a pressure angle between 1° and 40°.

[0042] Preferably, each cam of the at least one pair of first cams is shaped so as to define a pressure angle between 3° and 30°.

[0043] More preferably, each cam of the at least one pair of first cams is shaped so as to define a pressure angle between 5° and 20°.

[0044] In a variant of the invention, the anchoring group comprises at least one pair of additional cams hinged on respective vertical pins and positioned upside down with respect to the at least one pair of first cams.

[0045] In a variant of the invention, the anchoring group comprises at least one pair of second cams, wherein each cam of the at least one pair of second cams is positioned at or near a respective vertical edge and wherein each cam of the at least one pair of second cams is shaped like a spiral portion and is hinged on a respective horizontal pin and orthogonal to the flat structure and integral with the flat structure.

[0046] In a variant of the invention, the anchoring group comprises a temporary constraint system configured to counteract the elastic preload condition of the cams.

BRIEF DESCRIPTION OF THE DRAWINGS

[0047] Further characteristics and advantages of the present invention will be more evident from the following detailed description of some preferred embodiments thereof made with reference to the appended drawings.

[0048] The different characteristics in the individual configurations can be combined with each other at will according to the following description, if the advantages resulting specifically from a particular combination should be used.

[0049] In such drawings,

- figures 1 and 1a are respectively a perspective view and an enlarged detail thereof of a first preferred embodiment of a flood protection barrier according to the present invention;
- figure 2 is a front elevation view of the flood protection barrier of figure 1;
- figures 3a and 3b are enlarged details in front elevation and in plan of the flood protection barrier of figure 1 in the configuration of flood protection barrier in engagement against a wall;
- figures 4a and 4b are enlarged details in front elevation and plan view of the flood protection barrier of figure 1 in the configuration of the flood protection barrier not in engagement;
- figure 5 is an exploded view of the support of the seal used in the flood protection barrier according to the present invention;
- figures 6a and 6b are enlarged details in perspective view of a second embodiment of a flood protection barrier according to the present invention with a different actuating group of the seals;
- figure 7 is a perspective view of a third embodiment of a flood protection barrier according to the present invention with a different actuating group of the seals;
- figures 8 and 8a are respectively a perspective view and an enlarged detail thereof of a fourth preferred embodiment of a flood protection barrier according to the present invention;
- figures 9a and 9b are respectively an exploded perspective view of a support used in the anchoring group of the embodiments of figure 1 and 8 and a schematic image of a cam used in such anchoring group; and
- figures 10 and 11 are respectively a perspective view of a fifth and a sixth preferred embodiment of a flood protection barrier according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0050] For the illustration of the figures, use is made

in the following description of identical reference numerals or symbols to indicate construction elements with the same function. Moreover, for clarity of illustration, certain references may not be repeated in all figures.

[0051] While the invention is susceptible to various modifications and alternative constructions, certain preferred embodiments are shown in the drawings and are described hereinbelow in detail. It must in any case be understood that there is no intention to limit the invention to the specific embodiment illustrated, but, on the contrary, the invention intends covering all the modifications, alternative and equivalent constructions that fall within the scope of the invention as defined in the claims.

[0052] The use of "for example", "etc.", "or" indicates non-exclusive alternatives without limitation, unless otherwise indicated. The use of "comprises" and "includes" means "comprises or includes, but not limited to", unless otherwise indicated.

[0053] In the description, in the figures and in the appended claims, the orientations and spatial references, such as vertical, horizontal, longitudinal, transverse, internal and external, refer to the configuration of normal use of the individual elements to form a flood protection barrier put in place.

[0054] With reference to the figures, some preferred embodiments of a flood protection barrier indicated as a whole with 10 are illustrated. The flood protection barrier 10 is configured to be positioned at an access opening to a room of a building to prevent a fluid, typically water and/or mud, from passing through the opening and entering the room.

[0055] The flood protection barrier 10 comprises a flat structure 11 defining a front plane 12 and a rear plane 12', a vertical direction V and a transverse direction O. The flat structure 11 further comprises a first and a second vertical edge 13,13', as well as a first and a second transverse edge 14,14'.

[0056] In the embodiment of figure 1, the flat structure 11 comprises a perimeter frame 11' that supports a thin panel 11" made of lightweight material, such as for example aluminium. In alternative embodiments, illustrated for example in figures 8 and 11, the flat structure 11 comprises a perimeter frame 11' provided with one or more intermediate beams that support two or more thin panels 11" in lightweight material, such as for example aluminium.

[0057] In still further alternative embodiments, not illustrated, a sheet of flexible and waterproof material, such as for example plastic material, may be constrained to the frame 11'. The fixing of the sheet of flexible and waterproof material to the frame 11' can take place by means of a double-sided adhesive tape, through a hook-and-loop fixing system made of fabric commonly known under the trade name of Velcro®, by gluing or in another equivalent way. Preferably, the sheet of flexible and waterproof material has dimen-

sions greater than the frame 11 in such a way as to serve as a protection for the seals 15,20 placed perimetrically to the frame 11 and better described below with respect to mud and debris.

[0058] In other alternative embodiments, not illustrated, the flat structure 11 may be composed of a plurality of flat panels having horizontal slat structure couplable in vertical succession or, alternatively or in addition, the flat structure 11 may be composed of a plurality of flat panels having vertical slat structure couplable in horizontal succession.

[0059] The flat structure 11 carries at least two side seals 20 positioned each at a respective vertical edge 13,13'. A lower seal 15 positioned at a first lower transverse edge 14 is also preferably provided.

[0060] According to the present invention, at least one of the side seals 20 is of the layered type (see fig. 1a). The side seal 20 of the layered type comprises at least a first sealing element 21, coupled to the respective vertical edge 13,13' and which extends substantially for the entire development of said vertical edge 13,13', a moving plane element 22 coupled to the first sealing element 21 and which extends substantially for the entire development of the same 21 along the vertical edge 13,13', and a second sealing element 23 coupled to the moving plane element 22 and which extends substantially for the entire development of the same 22 along the vertical edge 13,13'.

[0061] Coupling between the sealing elements 21,23 and the moving plane element 22 can be understood as a mere rest coupling, rather than a gluing or a mechanical fixing of any kind. By way of example, the first sealing element 21 is glued to the moving plane element 22 while the second sealing element 23 is pressed against the moving plane element through its elastic preload.

[0062] At least one of the first and second sealing elements 21,23 is preferably of the deformable and/or compressible type, such as for example made of at least one of the following materials: PVC, EPDM, PP, rubber and a soft material suitable for providing a watertight seal, foamed-expanded materials, with open cells or closed cells or semi-closed cells. The sealing element 21 is therefore compressible and is provided with its own elastic force which serves as a spring when compressed so as to push back the moving plane element 22.

[0063] Alternatively, the sealing element 21 may be a bellows which is devoid of its own mechanical elastic force and which serves as a mere seal between the vertical edge 13,13' and the moving plane element 22. In this case, the expansion force of the moving plane element 22 is provided by an actuating group 30 described below.

[0064] Specifically, the flood protection barrier 10 comprises at least one actuating group 30 of the seal associated with the at least one layered side seal 20. In particular, the actuating group 30 is configured to act on

the layered side seal 20 to reduce its lateral bulk.

[0065] The actuating group 30 acts on the moving plane element 22 of the side seal 20 to bring it closer to the vertical edge 13,13', compressing the first sealing element 21. Specifically, the actuating group 30 exerts a traction force on the moving plane element 22 towards the vertical edge 13,13'. In this way, the first sealing element 21 is uniformly compressed along its own entire extension and the overall lateral bulk of the seal 20 decreases.

[0066] Thanks to the layered side seal 20 and its actuating group 30, it is therefore possible to vary the width dimension of the flood protection barrier 10 to allow an easy positioning thereof at the internal gap of the access opening and, once positioned, its watertight engagement against the side walls of the opening. In particular, in the absence of the action of the actuating group 30 the first sealing element 21 is free to expand and to press the second sealing element 23 against the wall of the opening. The engagement between the side seal 20 and the wall becomes in this way watertight.

[0067] Moreover, thanks to the presence of two sealing elements 21,23, the passage between the condition of engagement and the condition of disengagement from the wall of the opening is carried out while maintaining a condition of substantial seal between the vertical edge 13,13' of the flat structure 11 and the moving plane element 22.

[0068] In the embodiment of figures 1-5, the moving plane element 22 comprises a pair of extensions 24 which develop substantially from the end portions of the moving plane 22, orthogonally thereto 22 and parallel to the flat structure 11 and the actuating group 30 acts on the extensions 24. Each of the extensions 24 carries a hook 24b in which it engages a metal wire 33 in turn connected to a lever 34 constrained to rotate about a vertical rotation axis R. Preferably, the lever 34 is of the toggle type, having a ridge point beyond which it is self-stable under load.

[0069] When the lever is in an open configuration (fig. 3a and 3b), i.e. in an arrangement substantially protruding from the plane of the structure 11, then the side seal 20 assumes its configuration of maximum lateral expansion thanks to the decompression action of the first sealing element 21. Otherwise, when the lever is in the closed configuration (fig. 4a and 4b), i.e. in an arrangement substantially parallel to the plane of the structure 11, then the side seal 20 assumes its configuration of maximum lateral compression as the moving plane 22 is pulled by the metal wire 33 closer to the vertical edge 13,13'.

[0070] Figures 6a-6b show the actuating group of a second embodiment of a flood protection barrier 10 according to the present invention. In the second embodiment, the moving plane element 22 comprises a single extension 24 which develops substantially from the centre of the moving plane 22, orthogonally thereto 22 and parallel to the flat structure 11 and the actuating

group 30 acts on the extension 24. Specifically, the actuating group 30 comprises an L-shaped lever 31 hinged to a first end of a curved connecting rod 32. A second end of the curved connecting rod 32 is also constrained to slide within a slot 24a made on the extension 24 of the moving plane 22. The rotation of the L-shaped lever 31 causes a translation of the curved connecting rod 32 in the slot 24a until it engages the ends thereof and then drags into translation the extension 24 and the moving plane 22.

[0071] In this case, the actuating group 30 is additionally configured to press the side seal 20 against the wall of the opening ensuring a watertight engagement thereof. The actuating group 30 can therefore be moved between a configuration in which it acts on the moving plane element 22 of the side seal 20 to bring it closer to the vertical edge 13,13', as seen with reference to the first embodiment, and a second configuration, in which the actuating group 30 acts on the moving plane element 22 of the side seal 20 to move it away from the vertical edge 13,13'. In the second configuration, the actuating group 30 exerts a pushing force on the moving plane element 22 away from the vertical edge 13,13'. In this case, the watertight engagement of the seal 20 against the respective side wall is offered, not only by the decompression of the first sealing element 21, but also thanks to the action of movement towards the side wall of the opening exerted by the actuating group 30 on the flat element 22.

[0072] Figure 7 shows a third embodiment of a flood protection barrier 10 according to the present invention wherein the actuating group 30 comprises a central nut screw 35 coupled to a pair of screw tie rods 36 each fixed to a respective central extension 24 of the moving plane element 22 by means of an L-shaped element 24c. By setting the central nut screw 35 in rotation, the tie rods 36 are translated closer to, or away from, the nut screw 35 positioned substantially at the centre of the flat structure 11 with respect to a transverse extension thereof. In this way, an action is exerted on the moving plane element 22 of the side seal 20 to bring it closer to, or away from, the vertical edge 13,13'.

[0073] In a still alternative embodiment (not illustrated), the actuating group 30 comprises a central nut screw coupled to a first threaded tie rod and a second tie rod has a head that freely engages an internal seat of the nut screw, in such a way as to halve the force necessary to compress both seals 21 simultaneously.

[0074] In further alternative embodiments (not illustrated), the actuating group can be made as a toggle group, a group of levers different from those illustrated, an eccentric group, by means of linear actuators or through any other linear movement system.

[0075] The flood protection barrier 10 according to the present invention preferably further comprises an anchoring group 40,40' for anchoring the barrier to the wall.

[0076] With reference to the embodiments illustrated so far, the anchoring group 40 comprises at least one pair of first cams 41 shaped like a spiral portion, for example logarithmic or snail-shaped, each hinged on a respective vertical pin 42 integral with the flat structure 11. Each cam 41 of the pair of first cams 41 comprises a tip portion 41a defined as the portion more distant from a fulcrum point F in which it engages the vertical pin 42. In particular, each cam of the pair of first cams 41 is arranged at or near a vertical edge 13,13'.

[0077] Figures 8 and 8a show a fourth embodiment of a flood protection barrier 10 according to the present invention in which the anchoring group 40 comprises a single pair of first cams 41. In this case, the cams 41 are positioned at the same intermediate level along the extension of the vertical edges 13,13'.

[0078] Each cam of the pair of first cams 41 and the relative pin 42 are carried by a first support 43, illustrated in detail in figure 9a, integral with the flat structure, preferably near the front plane 12 thereof.

[0079] In alternative embodiments not illustrated, the first support 43 is not present. In this case the pair of first cams 41 and the relative pin 42 are directly constrained to the frame 11'.

[0080] Each cam 41 is elastically preloaded by elastic means 44, so that the cams 41 normally push against the walls of the opening when the barrier is mounted at the access opening. In other words, the cams 41 of the pair of first cams 41 are elastically preloaded in angular separation from each other with respect to a rotation about the respective vertical pin 42.

[0081] The two cams 41 forming the pair of first cams 41 are hinged to the respective vertical pin 42 in such a way that, when the barrier is mounted at the access opening, the preload offered by elastic means 44 and the frictional contact between the cam 41 and the vertical wall of the opening, cause a thrust orthogonal to the flat structure 11 to cause a tendency for the cams of the pair of first cams 41 to rotate in the opposite direction to each other.

[0082] In structural terms, the two cams forming the pair of first cams 41 are hinged to the respective vertical pin 42 in such a way that, with reference to a plane orthogonal to the development of the pins 42, the tip portion 41a of a first cam 41 of the pair of first cams 41 develops from the respective vertical pin 42 in the opposite direction to a development of a tip portion 41a of a second cam 41 of the pair of first cams 41 from the respective vertical pin 42.

[0083] The cams 41, the pin 42 and the elastic means 44 are constrained to the first support 43 by means of a first plate 45 connected to the first support through a first screw 46, in such a way that the elements 41,42,44 are interposed between the first support 43 and the first plate 45. The first plate 45 is also connected to the first support 43 through a second screw 47, to offer greater structural strength to the rotation axis of the cam.

[0084] The cam of the first pair of cams 41 preferably comprises a peduncle 41b configured to engage the second screw 47 and realize a temporary constraint of the cam in the open position, in contrast to the action of the elastic means 44. In this way, the cam 41 is maintained in a condition of non-engagement with the wall of the opening. In this way, the mounting and dismounting of the flood protection barrier 10 within the opening is facilitated.

[0085] In the embodiment of figures 1-5, the anchoring group 40 comprises two pairs of first cams 41. In particular, each pair of first cams 41 is arranged at or near a vertical edge 13,13', preferably with a first pair of first cams 41 positioned substantially at the height of the lower transverse edge 14 and a second pair of first cams 41 positioned substantially at the height of the upper transverse edge 14'.

[0086] In this embodiment there is also at least one pair of additional cams 48 hinged on respective vertical pins 42 and positioned upside down with respect to the pairs of first cams 41 of the anchoring group 40. The pair of upside down cams 48 ensures sealing in case of a thrust to the flat structure 11 from inside out, for example in case of an accidental thrust. Advantageously, the upside down cams 48 prevent, in case of thrust to the flat structure 11 from inside out, the flood protection barrier from being de-positioned from the seat defined by the opening.

[0087] Preferably, the flood protection barrier 10 according to the present invention comprises in addition a pair of second cams 51 (indicated in figure 1a) each hinged on a respective horizontal pin 52 and orthogonal to the flat structure 11. Each cam 51 of the pair of second cams is positioned at a respective vertical edge 13,13' of the flat structure 11.

[0088] The cams 51 of the pair of second cams 51 oppose an upward thrust resulting from the tendency of the lower seal 15 to expand when it is pressed downwards.

[0089] Similarly to the cams 41 of the pair of first cams 41 hinged on a respective vertical pin 42, the cams 51 of the pair of second cams 51 hinged on a respective horizontal pin 52 are also elastically preloaded and constrained to the flat structure 11, for example through a second support (not visible in the figures) in a configuration interposed between the second support and a second plate 55.

[0090] The cams 41,48 hinged on vertical pins 42 are shaped so as to define a pressure angle α such that, given the preload of the spring 44 and the friction existing between the cam and the vertical wall of the opening, a thrust orthogonal to the flat structure 11 translates into a corresponding lateral thrust towards the walls of the opening.

[0091] Similarly, the cams 51 hinged on horizontal pins 52 translate a vertical upward thrust of the flat structure 11, for example exerted by the force of the lower seal 15 once compressed, into a lateral thrust

towards the walls of the opening.

[0092] Preferably, the cams 41, 48, 51 are shaped so as to define a pressure angle α between 1° and 40° , more preferably, so as to define a pressure angle between 3° and 30° , even more preferably, so as to define a pressure angle between 5° and 20° .

[0093] With reference to the quantities indicated in figure 9b, a typical formula that describes the course of the spiral is:

$$\begin{cases} x(\theta) = ae^{b\theta} \cos(\theta) \\ y(\theta) = be^{a\theta} \sin(\theta) \end{cases}$$

[0094] Note that the variable θ does not correlate with the pressure angle α , the latter depending only on the coefficient "b" according to the formula reported below. Therefore, the pressure angle α is constant.

$$\alpha = \arctan\left(\frac{1}{b}\right)$$

[0095] From the above we can derive, for example, that with a pressure angle α of 15° , the hydrostatic thrust of half a metre in height of water on a flat structure 11 one metre wide, and which translates into a force orthogonal to the flat structure 11 of about 1750N, is discharged on the walls through the cams with a total force of about 6500N based on the relationship

$$F_r = F_a \arctan(\alpha) = F_a \frac{B_1}{B_2}$$

[0096] The relationship between B2 on B1 also causes the minimum coefficient of friction necessary to prevent the cams 41,58,51 from sliding on the walls of the opening. With a pressure angle α of 15° , the minimum coefficient of friction required is equal to 0.26.

[0097] Having said this, the elastic element 44 is fundamental to trigger the initial frictional force that causes the subsequent proportional increase in force; in fact, without an initial minimum preload, the initial frictional force would be zero and the hydrostatic thrust would not be converted into a force resulting from the pressure angle α of the cams 41,48,51 that friction on the vertical walls of the opening.

[0098] The implementation of the flood protection barrier 10 according to the present invention is particularly simple. It is positioned at the access opening with the side seals 20 in compressed configuration. This operation can be easily made as the overall transverse dimensions of the barrier 10 are smaller than the transverse gap of the opening.

[0099] After that the temporary constraint system of the cams 51 hinged on horizontal pins 52 is released,

compressing the barrier downwards so as to block it in height. The actuating groups 30 are then released, allowing the side seals 20 to expand and create in this way a watertight seal with the walls of the opening. Finally, the cams 41,48 hinged on vertical pins 42 are released, blocking the barrier 10 stably in place.

[0100] A fifth embodiment of a flood protection barrier 10 according to the present invention is illustrated in figure 10 which differs from the embodiment of figure 1-5 in the embodiment of the anchoring group 40'.

[0101] In this case the anchoring group 40' comprises a pair of side guides 49 configured to be constrained to a wall of the opening. The side guides 49 are further configured to slidably receive the side seal 20 in their inside. The internal space defined by the side guides 49 is increased with respect to the dimensions of the side seal 20 in compressed condition in order to make their insertion very easy.

[0102] In use, each side guide 49 is constrained to a respective side wall. The side seals 20 are fitted into the side guides 49 when they are in their compressed configuration to facilitate insertion thereof. Once in place, the actuating group 30 is released allowing the side seals 20 to expand and thereby create a watertight seal with the side guides 49.

[0103] Figure 11 illustrates a sixth embodiment of a flood protection barrier 10 according to the present invention which differs from the embodiment of figure 1-5 in that the lower seal 15 is advantageously a layered seal of the type illustrated in figure 5 and in the additional presence of an actuating group 60 of the lower seal 15.

[0104] In particular, the actuating group 60 of the lower seal 15 is also configured to act on said layered seal 15 to reduce the bulk thereof, however, in this case, due to how the seal 15 is mounted on the flat structure 11, the vertical bulk.

[0105] The actuating group 60 of the lower seal 15 acts on the moving plane element 22 of this seal 15 to bring it closer to the lower transverse edge 14, compressing the first sealing element 21. Specifically, the actuating group 60 of the lower seal 15 exerts a traction force on the moving plane element 22 towards the lower transverse edge 14. In this way, the first sealing element 21 is uniformly compressed along its own entire extension and the overall vertical bulk of the lower seal 15 decreases homogeneously. This allows the flat structure 11 to be positioned at a particularly low level with the lower transverse edge 14 very close to the floor. Once the flat structure 11 is blocked in place, it is possible to release the actuating group 60 of the lower seal 15 in such a way that it expands and adheres homogeneously against the floor. The engagement between the lower seal 15 and the floor thus becomes watertight.

[0106] In particular, the actuating group 60 of the lower seal 15 can be made similarly to the actuating group 30 of figures 1-5, with the moving plane 22 of the

layered lower seal 15 having a pair of extensions 24 which develop substantially from the end portions of the moving plane 22, orthogonally thereto 22 and parallel to the flat structure 11 and the actuating group 60 of the lower seal 15 acting on the extensions 24. In particular, each of the extensions 24 carries a hook 24b in which it engages a metal wire 63 in turn connected to a lever 64 constrained to rotate around a horizontal rotation axis R'.

Claims

1. Flood protection barrier (10) configured to at least partially close in a watertight manner an access opening to a room of a building comprising:

- a flat structure (11) comprising a front plane (12), a rear plane (12'), a first and a second vertical edge (13,13'), a lower transverse edge (14) and an upper transverse edge (14'); and
- a pair of side seals (20), wherein each side seal (20) of the pair of side seals (20) is positioned at a respective vertical edge (13,13');

characterized in that at least one side seal (20) of the pair of side seals (20) is a layered seal comprising at least a first sealing element (21) coupled to a respective vertical edge (13,13'), a moving plane element (22) coupled to the first sealing element (21) and at least a second sealing element (23) coupled to the moving plane element (22), wherein the moving plane element (22) and the second sealing element (23) extend substantially for the entire development of the first sealing element (21) along the vertical edge (13,13').

2. Flood protection barrier (10) according to claim 1, wherein the first sealing element (21) extends substantially for the entire development of the vertical edge (13,13').
3. Flood protection barrier (10) according to claim 1 or 2, wherein the first sealing element (21) and/or the second sealing element (23) is of the deformable and/or compressible type, preferably made of at least one material selected from the group consisting of PVC, EPDM, PP, rubber and a soft material suitable for providing a watertight seal.
4. Flood protection barrier (10) according to any one of claims 1 to 3, wherein the first sealing element (21) and/or the second sealing element (23) is made of a foamed and/or expanded material, with open cells or closed cells or semi-closed cells.
5. Flood protection barrier (10) according to any one of the preceding claims, comprising at least one

actuating group (30) associated with the at least one layered side seal (20), wherein the actuating group (30) is at least configured to act on the layered side seal (20) to reduce its lateral bulk.

6. Flood protection barrier (10) according to claim 5, wherein the actuating group (30) is further configured to act on the layered side seal (20) to press the layered side seal (20) against a wall of the opening.
7. Flood protection barrier (10) according to claim 5 or 6, wherein the actuating group (30) is configured to assume at least a first configuration in which it acts on the moving plane element (22) to bring it closer to the vertical edge (13,13').
8. Flood protection barrier (10) according to any one of claims 5 to 7, wherein the actuating group (30) is configured to assume at least a second configuration in which it acts on the moving plane element (22) to move it away from the vertical edge (13,13').
9. Flood protection barrier (10) according to any one of claims 5 to 8, wherein the moving plane element (22) comprises at least one extension (24) which develops orthogonally to the moving plane element (22) and parallel to the flat structure (11), wherein the actuating group (30) is configured to exert at least a traction force on the extension (24).
10. Flood protection barrier (10) according to claim 9, wherein the actuating group (30) comprises an L-shaped lever (31) hinged to a first end of a curved connecting rod (32), wherein a second end of the curved connecting rod (32) is constrained to slide within a slot (24a) made on the extension (24) of the moving plane element (22).
11. Flood protection barrier (10) according to claim 9, wherein the actuating group (30) comprises a metal wire (33) in turn connected to a lever (34) constrained to rotate around a vertical rotation axis (R), wherein the extension (24) carries a hook (24b) in which it engages the metal wire (33).
12. Flood protection barrier (10) according to claim 9, wherein the actuating group (30) comprises a central nut screw (35) coupled to a pair of tie rods (36) each fixed to a respective central extension (24) of the moving plane element (22).
13. Flood protection barrier (10) according to claim 12, wherein a second tie rod of the pair of tie rods comprises a head that freely engages an internal seat of the nut screw.

14. Flood protection barrier (10) according to any one of the preceding claims, comprising an anchoring group (40) for constraining the flat structure (11) to the walls of the opening, wherein the anchoring group (40) comprises at least one pair of first cams (41), wherein each cam (41) of the at least one pair of first cams (41) is positioned at or near a respective vertical edge (13,13') and is shaped like a spiral portion, and wherein each cam (41) of the at least one pair of first cams (41) is hinged on a respective vertical pin (42) integral with the flat structure (11) and is elastically preloaded by elastic means (44) in such a way that, when the barrier is mounted at the access opening in such a way that the cams (41) of the at least one pair of first cams (41) are in frictional contact against a vertical wall of the opening, an orthogonal force component applied to the flat structure (11) causes a rotational thrust of the cams of the pair of first cams (41) in the opposite direction to each other.
15. Flood protection barrier (10) according to claim 14, wherein a tip portion (41a) of a first cam (41) of the at least one pair of first cams (41) develops from the respective vertical pin (42) in the opposite direction to a development of a tip portion (41a) of a second cam (41) of the at least one pair of first cams (41) from the respective vertical pin (42).

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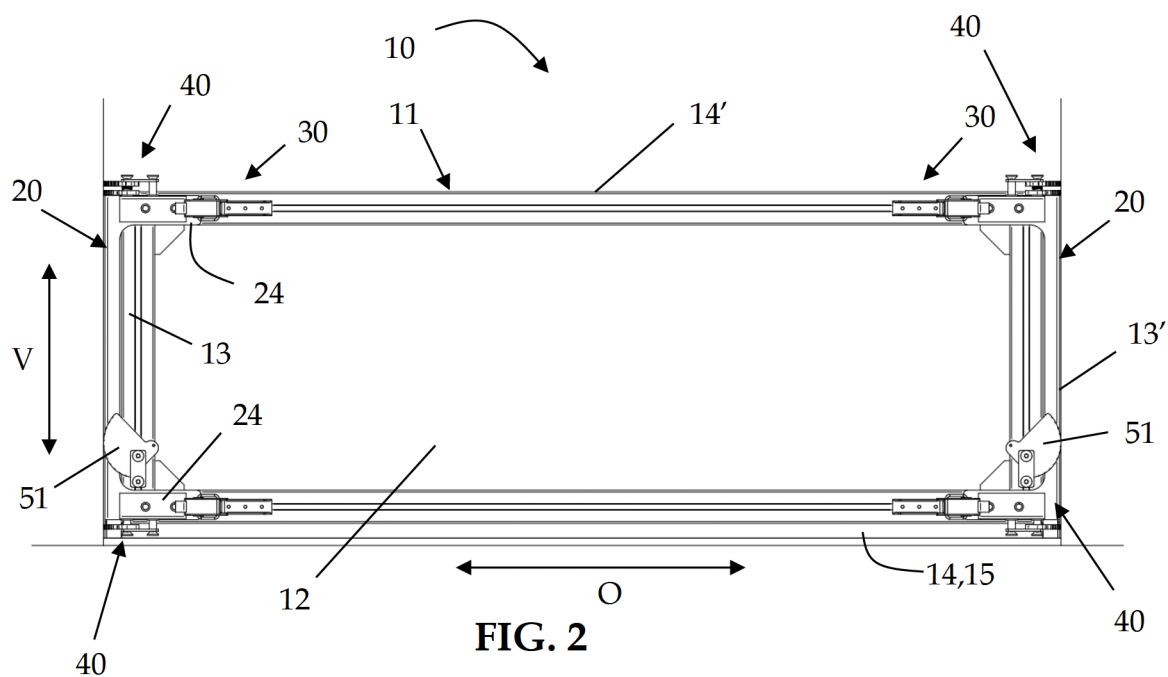
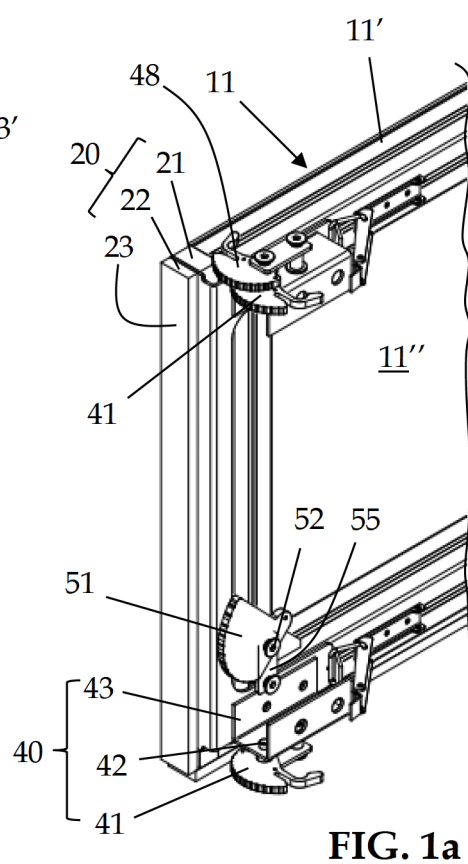
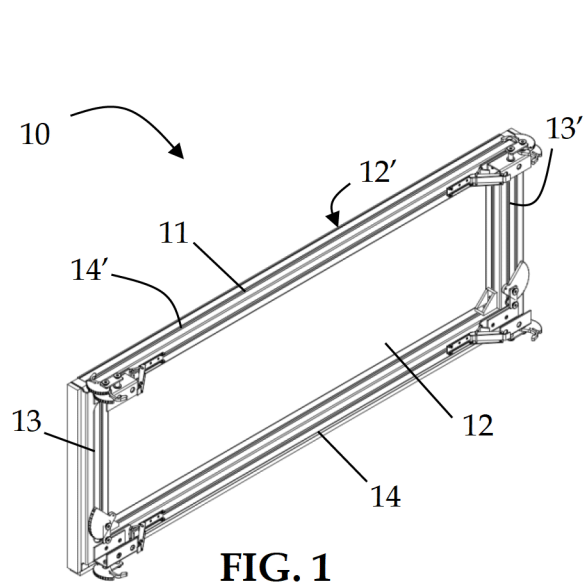
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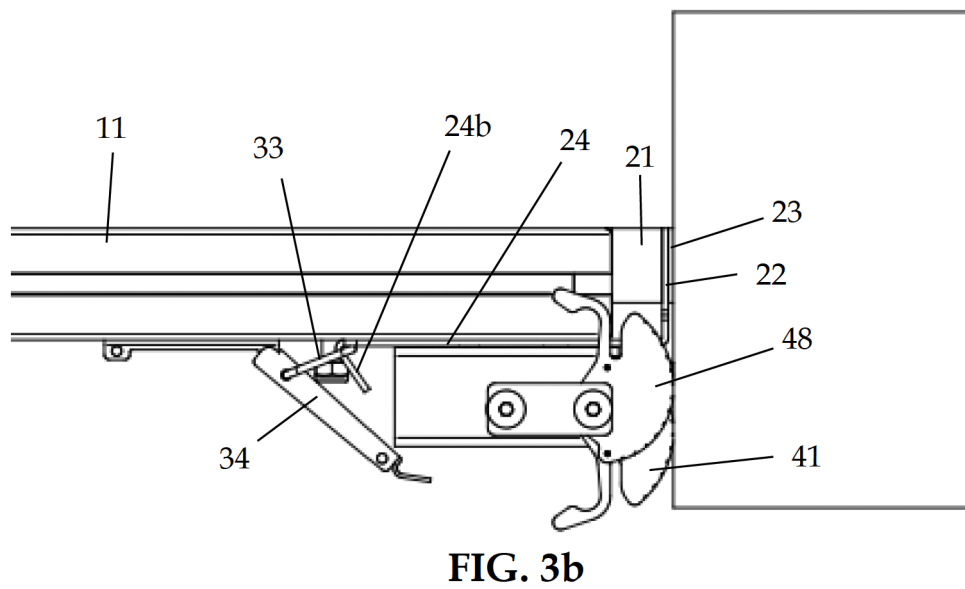
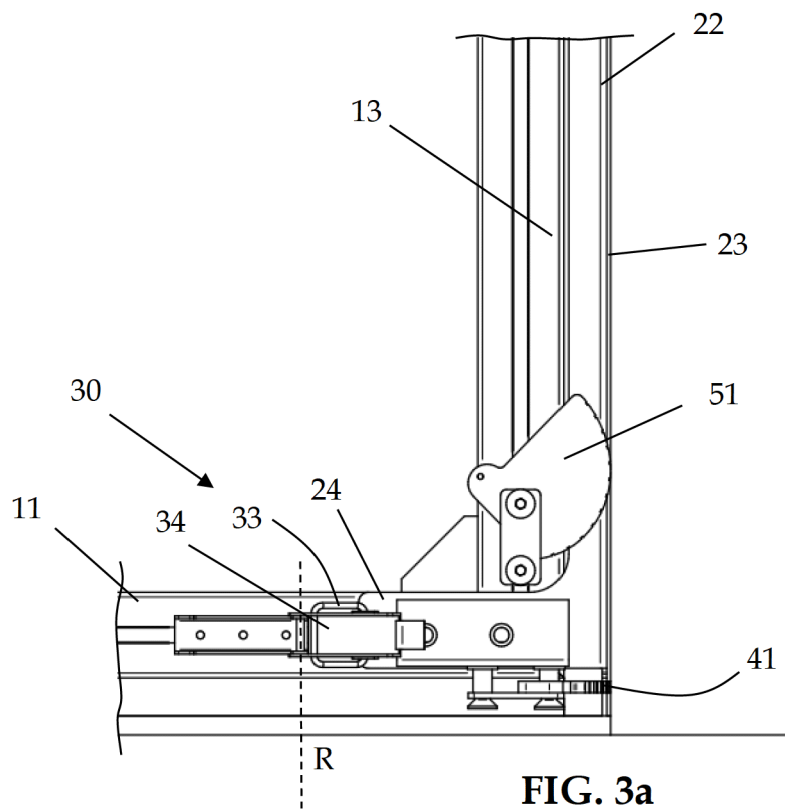
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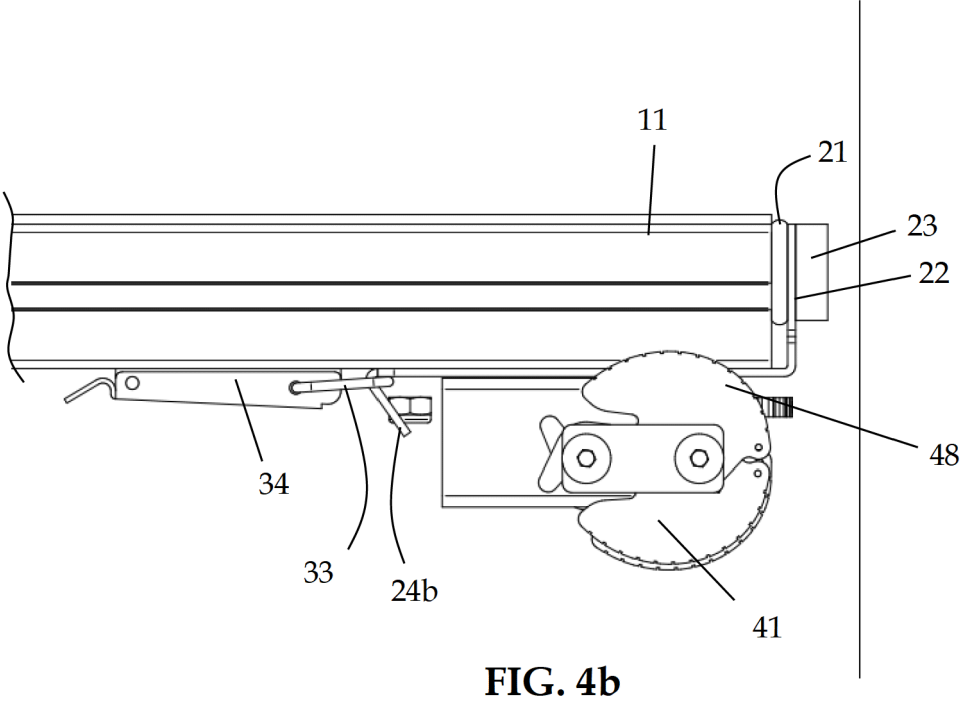
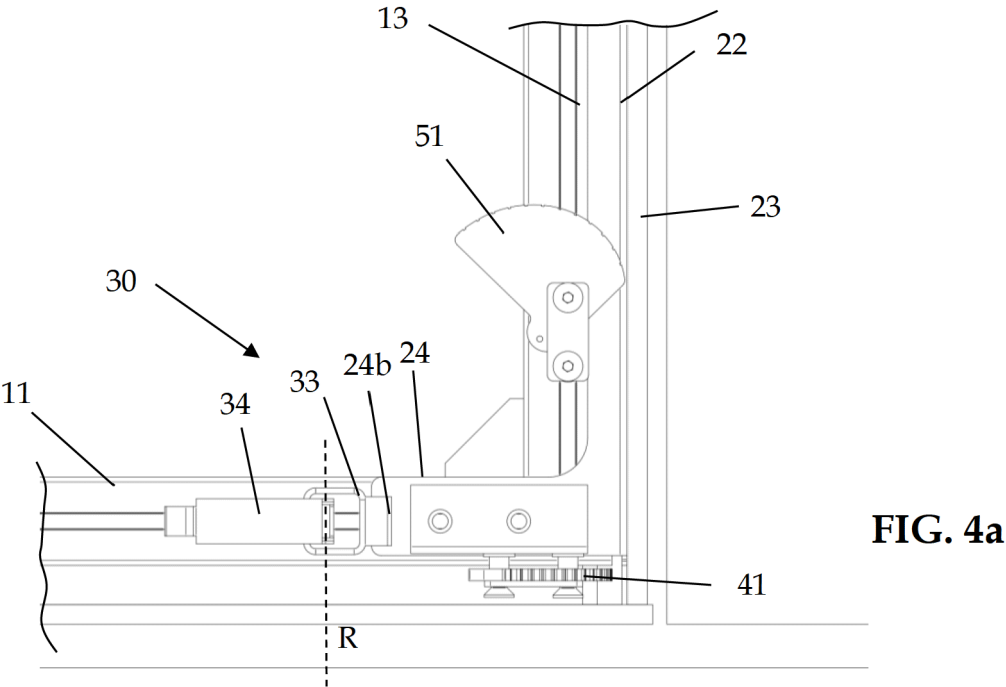
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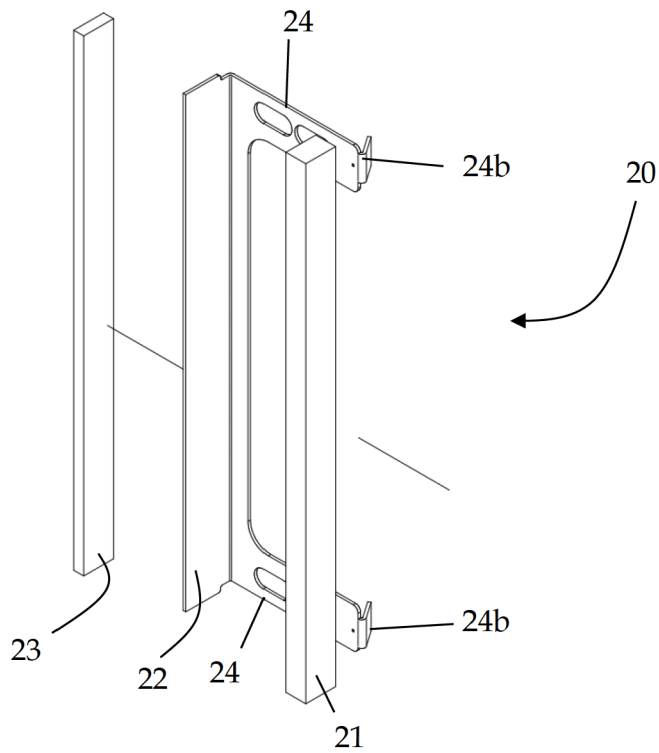


FIG. 5

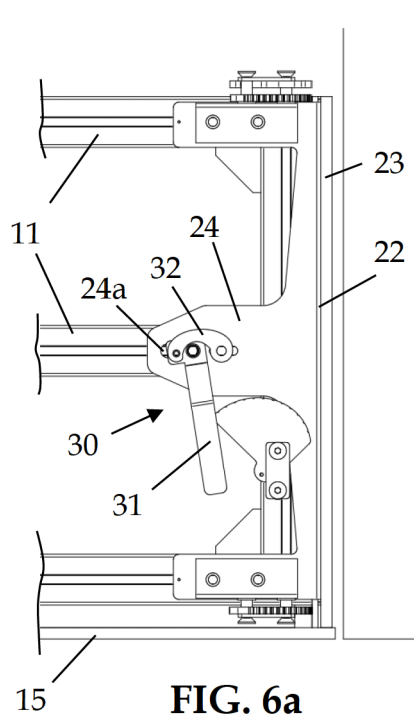


FIG. 6a

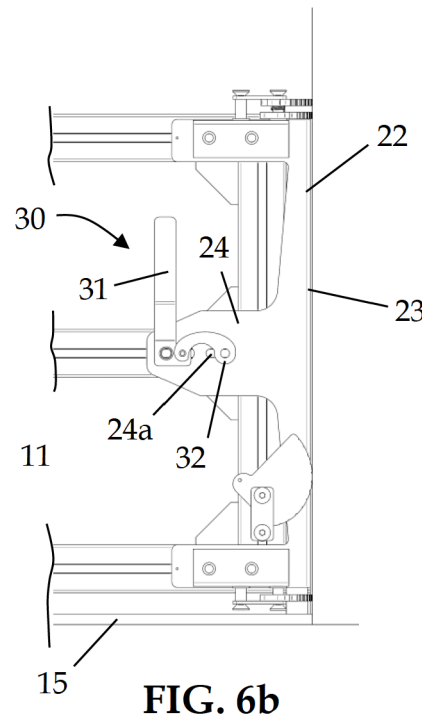
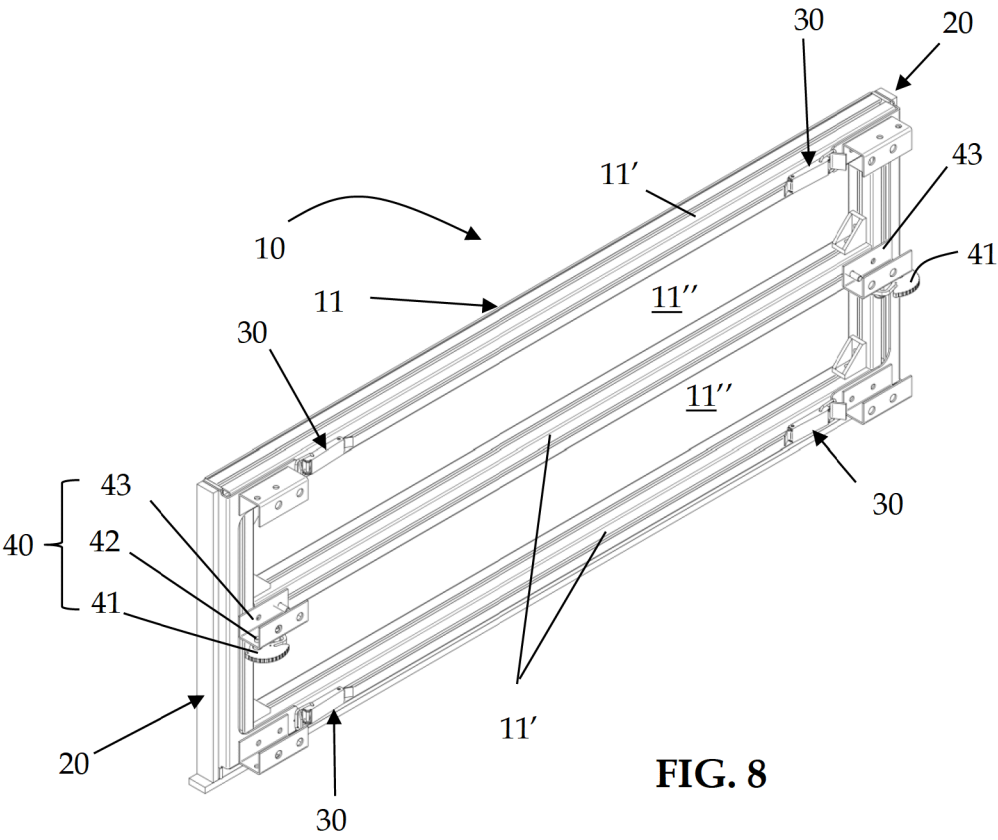
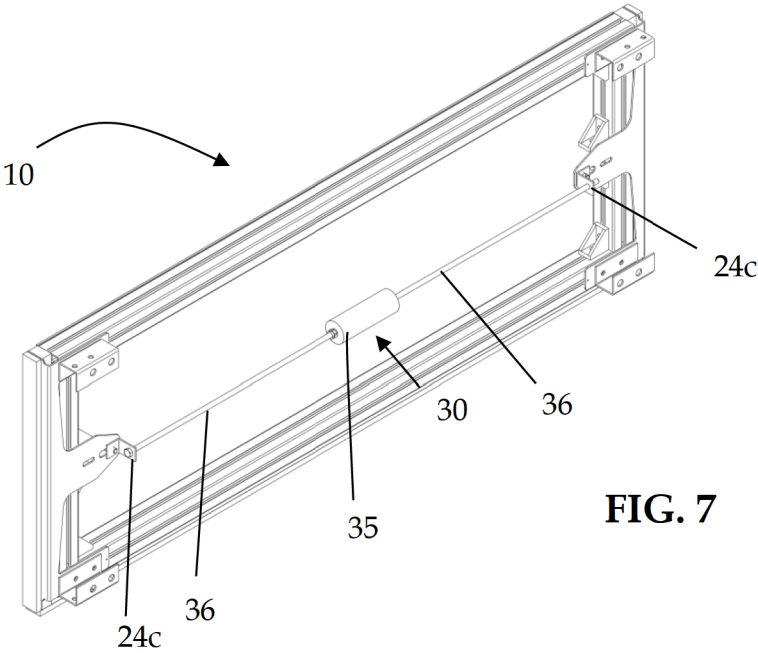


FIG. 6b



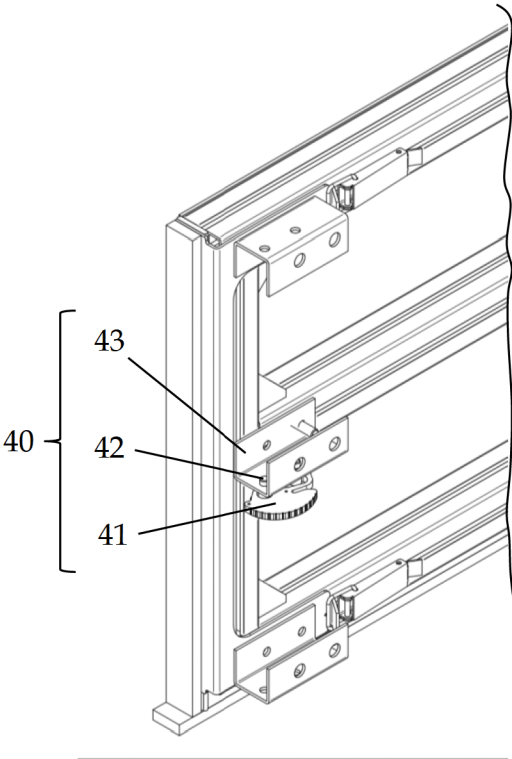


FIG. 8a

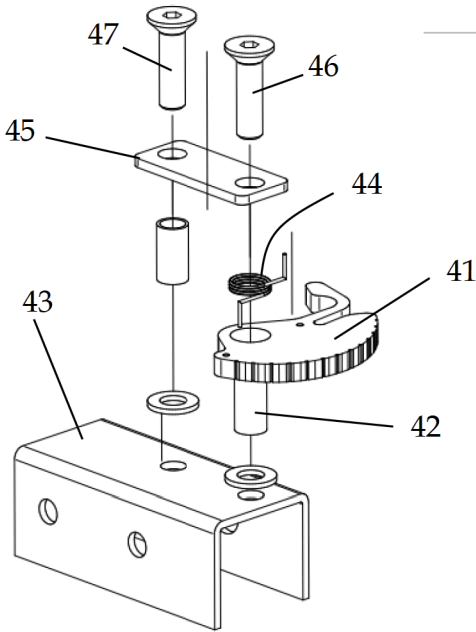


FIG. 9a

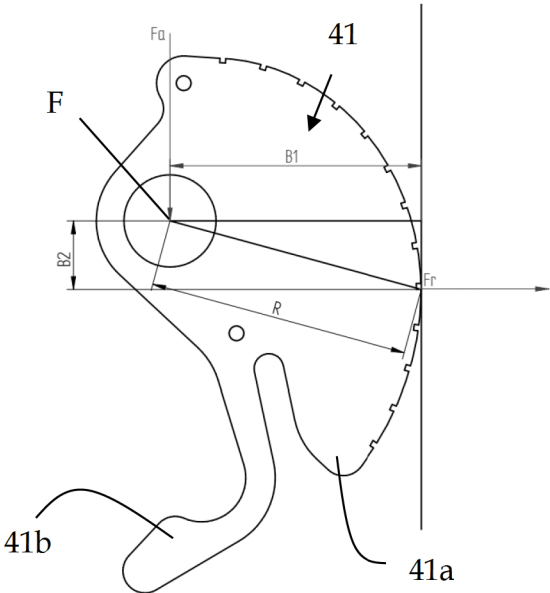


FIG. 9b

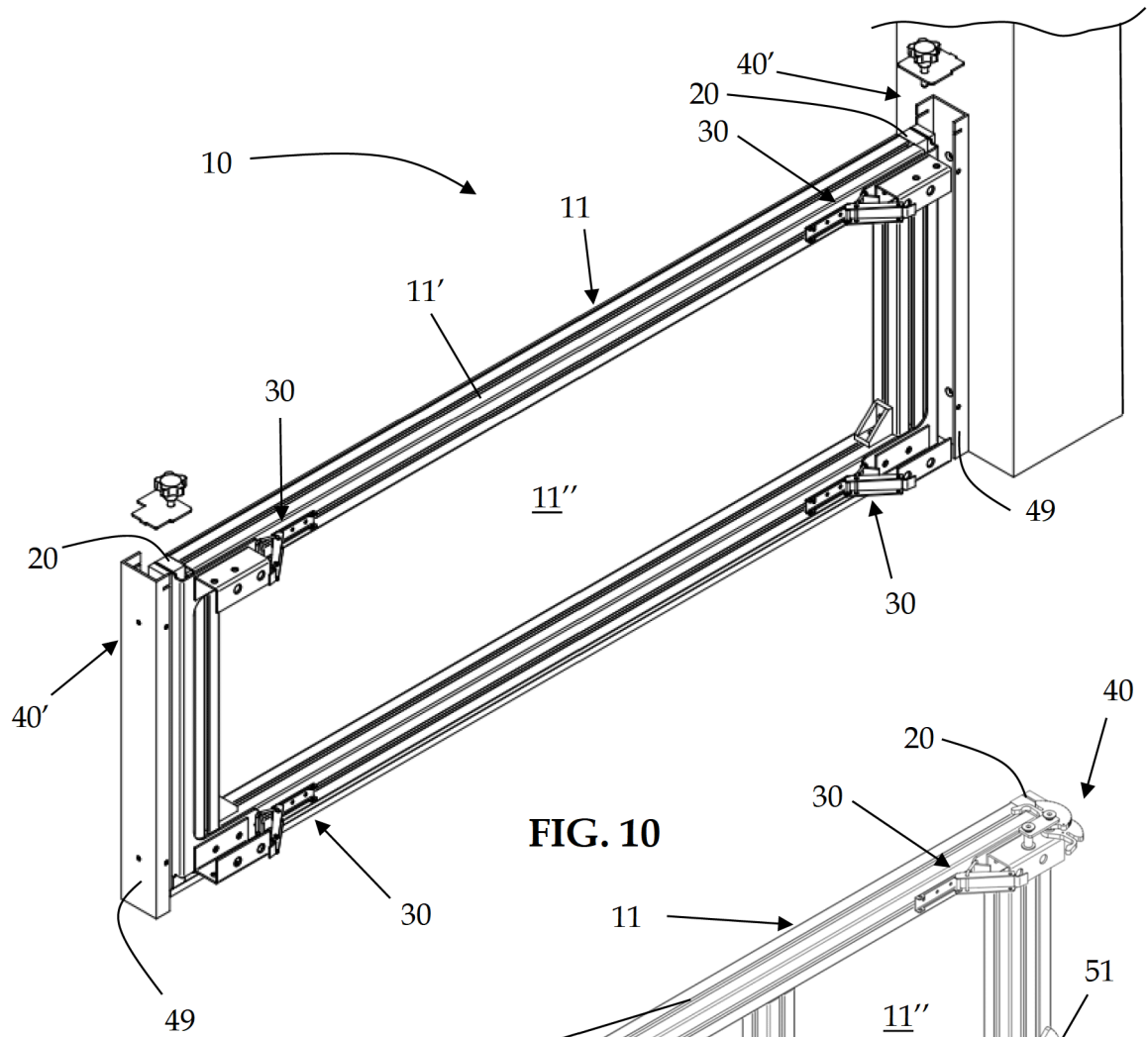


FIG. 10

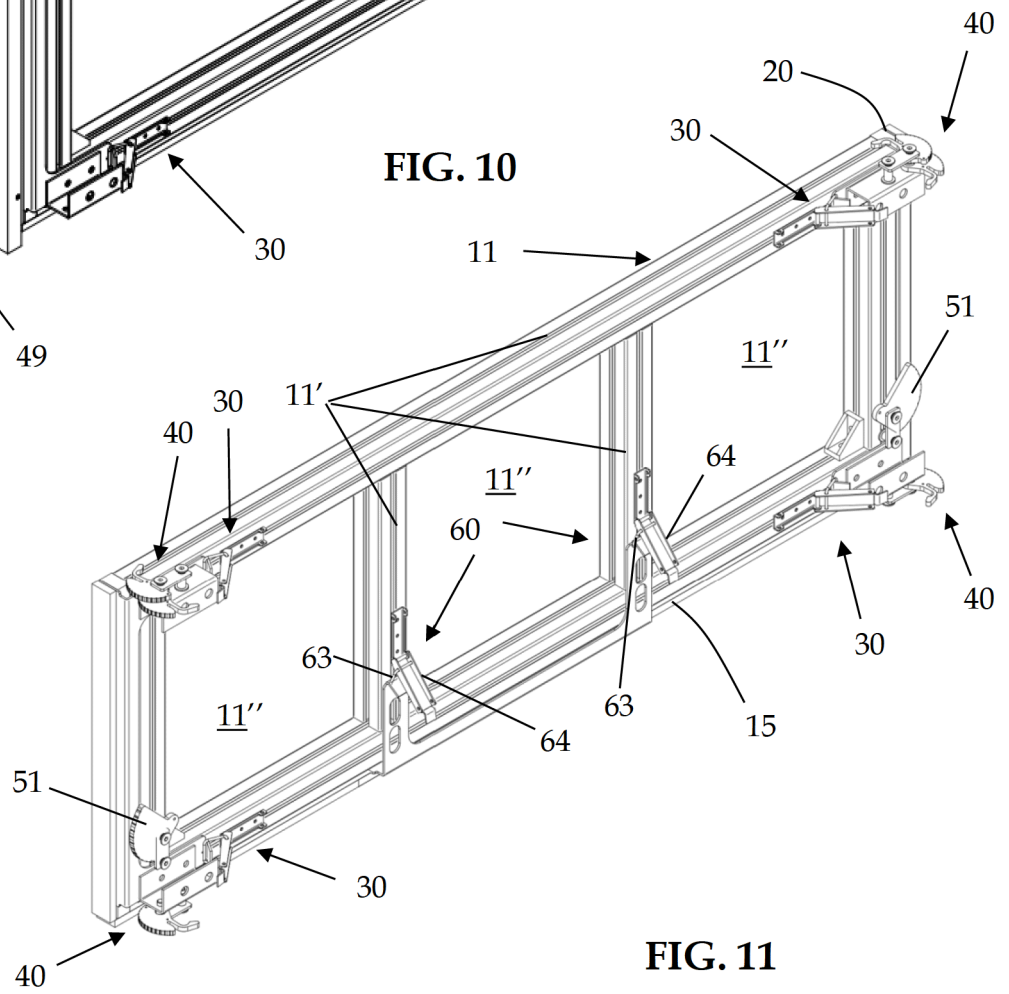


FIG. 11



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Application Number

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Place of search Munich		Date of completion of the search 18 August 2026	Examiner Cornu, Olivier
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