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CLOSURE FOR PRESSURIZED STRUCTURE

Original Filed July 11, 1967

3 Sheets-Sheet 1

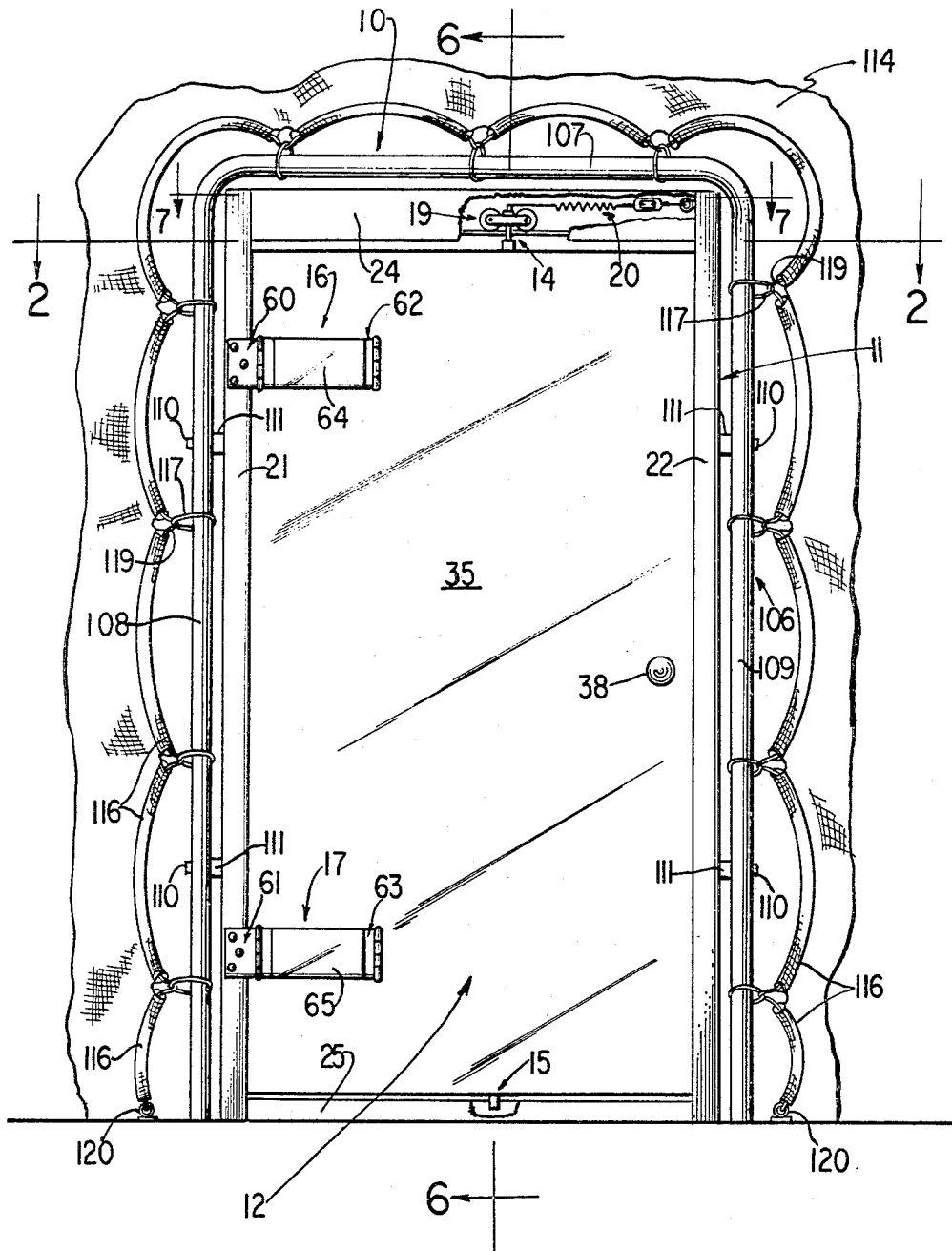


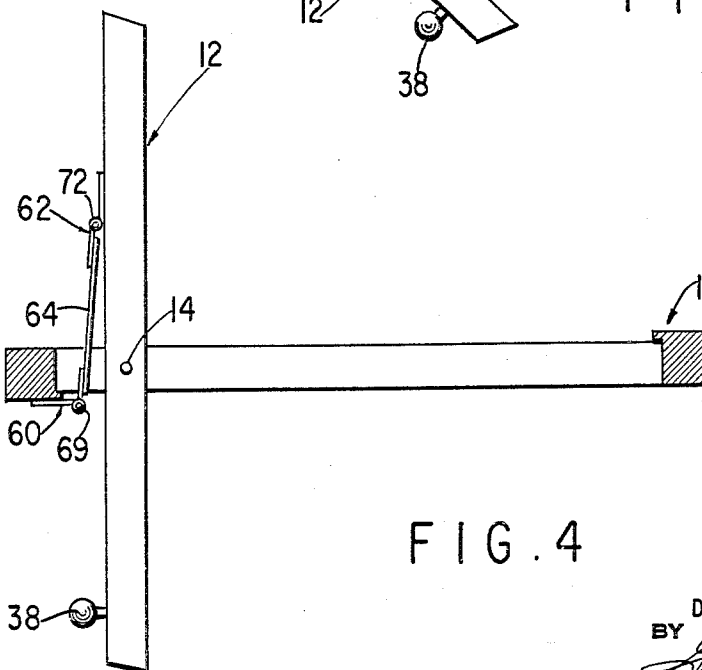
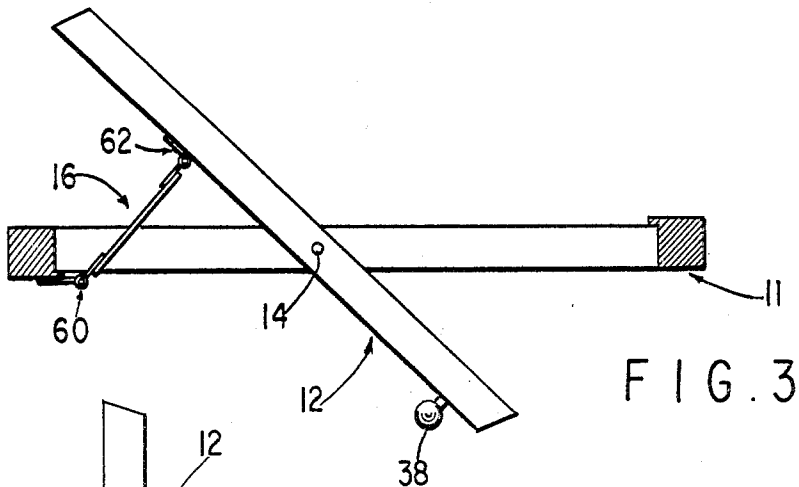
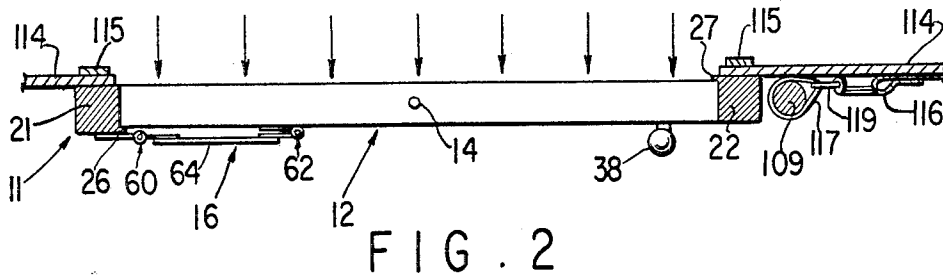
FIG. 1

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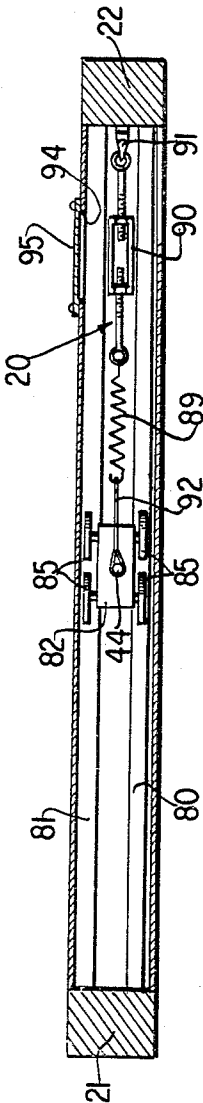
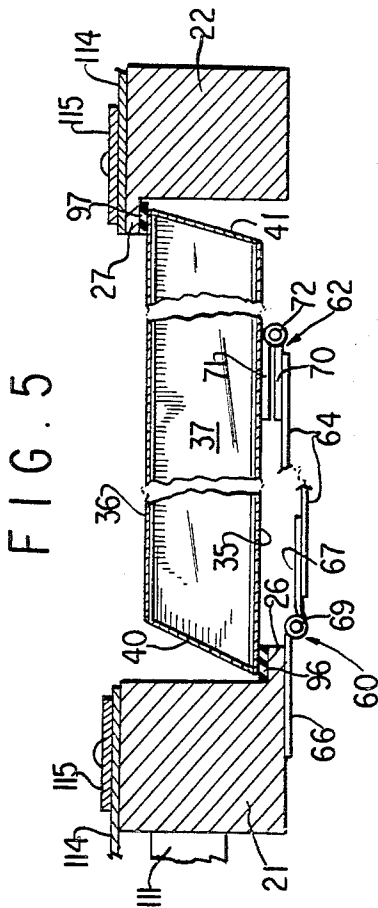
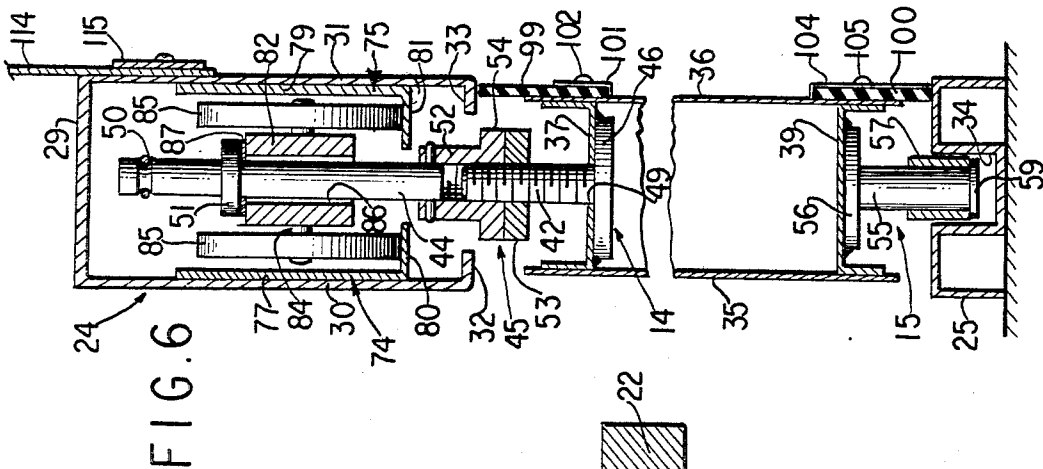
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CLOSURE FOR PRESSURIZED STRUCTURE

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3 Sheets-Sheet 3



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3,483,657

CLOSURE FOR PRESSURIZED STRUCTURE
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Continuation of application Ser. No. 652,461, July 11,
1967. This application Feb. 20, 1969, Ser. No. 809,451
Int. Cl. E05d 15/30

U.S. Cl. 49—252

2 Claims

ABSTRACT OF THE DISCLOSURE

A closure for a pressurized structure including a frame connected to the structure, a door carried by the frame provided with a vertically oriented pivot fixed to the top of the door and seated in a horizontally traveling hanger within the top of the frame, a pair of hinges attached to one side of the frame, a pair of hinges attached to the door between the hinge side of the frame and the axis of the pivot, and a pair of links each interconnecting one of the frame hinges to one of the door hinges so that upon opening, the door rotates about the pivot and simultaneously moves laterally toward the hinge side of the frame.

This application is a continuation of Ser. No. 652,461, filed July 11, 1967, and now abandoned.

BACKGROUND OF THE INVENTION

Field of the invention

The present invention relates to closures for pressurized structures and more particularly to doors for structures comprising a fabric shell which is supported by maintaining an above atmospheric air pressure within the structure.

Description of the prior art

Air supported structures of the type for which the present closure is primarily intended, comprise a fabric shell which is attached and sealed to the ground and is inflated by pumping air into the structure until the pressure within the structure is on the order of five (5) pounds per square foot greater than the atmospheric pressure surrounding the structure. The pressure within the structure lifts and supports the fabric shell to provide a usable structure. Each of these structures is provided with at least one personnel door fitted into the fabric wall to allow people to walk in and out of the structure.

In the past, these personnel doors have consisted of a conventional door mounted to swing either inwardly or outwardly. Such doors have proven to be quite unsatisfactory. When an inwardly swinging door is used, the air pressure within the structure makes opening of the door difficult. At normal operating pressures, the air pressure against a conventional 30" x 78" door exerts a force of about 80 pounds against which the door must be moved upon opening. Also, on closing, the door must be held to prevent violent slamming. Under high wind conditions the pressure in the building is increased from 5 to 8 pounds per square foot to maintain the structure rigid, and consequently the force of the door increases to 130 pounds making the door extremely difficult to use.

A door arranged to swing outwardly opens easily but has a number of other disadvantages. A strong latch must be provided to hold the door against the pressure; it is difficult to close the door against the pressure, particularly from the inside; opening of the door from the outside can be dangerous because upon releasing the latch the door swings violently outwardly unless restrained by the user; and if the door is not properly closed, or if the latch fails, the door swings open and

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remains in the open position allowing a continuous flow of air from the structure.

SUMMARY

Accordingly, it is an object of the present invention to provide a closure for pressurized structures which is not subject to the foregoing disadvantages.

Another object is to provide such a closure which requires a minimum of effort to operate.

Another object is to provide such a closure which is held in its closed position by the pressure within the structure.

Another object is to provide such a closure which is self closing.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

In accordance with the present invention the foregoing objects are accomplished by providing a closure for use between an outside space at one pressure and an inside space at a higher pressure including in combination a movable closure member for permitting access between the spaces, a frame for supporting the movable closure member, first pivot means on the movable closure member defining an axis about which said movable closure member rotates, a hinge assembly including a rigid link member extending from adjacent the frame toward the axis, first hinge means hinging one end of the link member to the frame, and second hinge means hinging the other end of the link member to the movable closure member, the first and second hinge means having hinge lines parallel with this axis, and second pivot means in said frame cooperating with the first pivot means to define the position of the axis with respect to the frame, the second pivot means being formed to permit the position of the axis to shift as the movable closure member is rotated about the first pivot means and the first and second hinge means.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the invention has been chosen for purposes of illustration and description, and is shown in the accompanying drawings, forming a part of the specification wherein:

FIG. 1 is an outside view in elevation of a closure in accordance with the present invention installed in an air supported building.

FIG. 2 is a sectional view taken along the line 2—2 on FIG. 1.

FIG. 3 is a view similar to FIG. 2 showing the door in a partially open position.

FIG. 4 is a view similar to FIGS. 2 and 3 showing the door in the fully open position.

FIG. 5 is an enlargement of portions of FIG. 2 showing details of construction.

FIG. 6 is a sectional view taken along the line 6—6 on FIG. 1 illustrating the construction of the pivot and hanger assemblies.

FIG. 7 is a sectional view taken along the line 7—7 on FIG. 1 illustrating the details of the door closing assembly.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings in detail, a closure 10 for a pressurized structure is shown which generally comprises a frame 11, a door 12 supported by the frame, an upper pivot assembly 14 fixed to the top of the door, a lower pivot assembly 15 fixed to the bottom of the door, an

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upper hinge assembly 16 and a lower hinge assembly 17 interconnecting the door and the frame, a horizontally sliding hanger assembly 19 housed in the frame, and a door closing assembly 20 operating upon the upper pivot assembly 14.

The frame 11 includes a vertical left side member 21, a vertical right side member 22, a top member 24, and a bottom member 25. As shown in FIGS. 2 to 5, the left side frame member 21 is provided with a door engaging flange 26 on the low pressure side of the closure and the right side frame member 22 is provided with a door engaging flange 27 on the high pressure side of the closure. The top frame member 24, as best shown in FIG. 6, is a downwardly facing U-shaped member having a top wall 29 and side walls 30 and 31. The side walls 30 and 31 are provided at their lower edges with inwardly extending horizontal flanges 32 and 33 respectively. The bottom frame member 25 is provided with a longitudinal groove 34 for receiving the lower pivot member 15.

Referring to FIGS. 5 and 6, the door 12 includes an outside wall 35 in communication with atmospheric pressure, an inside wall 36 in communication with the interior pressure of the building, an upwardly facing U-shaped top edge member 37, a downwardly facing U-shaped bottom edge member 39, and flat side edge members 40 and 41. The door is provided with a door knob 38 and may also be provided with a suitable lock if desired.

The pivot assemblies 14 and 15 are positioned to the right of the center of the door 12 and define a vertical pivot axis about which the door rotates.

The upper pivot assembly 14 includes a bolt 42 and a rod 44 joined together by an adjustable interconnecting device 45. The bolt 42 comprises a large head portion 46 welded to the lower surface of the top edge member 37 and a screw threaded rod portion 47 extending upwardly through a hole 49 provided in the member 37. The rod 44 extends vertically between the side walls 30 and 31 of the top frame member 24 and is provided with a groove 50 adjacent its upper end and an annular flange 51 below the groove 50. The adjustable interconnecting device 45 includes an internally threaded sleeve 52 and a lock nut 53. The sleeve 52 is pinned to the bottom end of the rod 44 and is provided with an enlarged hexagonally shaped formation 54 at its lower end to receive a wrench. The locknut 53 and the sleeve 52 are threaded onto the rod 47.

The lower pivot assembly 15 includes a rod member 55 having a large flat head portion 56 welded to the door edge member 39, and loose fitting plastic bushing 57 positioned on the rod 55 to reduce friction and retained by an enlargement 59 formed at the lower end of the rod.

The hinge assemblies 16 and 17 include respectively a hinge 60, 61 attached to the side frame member 21, a hinge 62, 63 attached to the wall 35 of the door and a flat bar shaped link 64, 65. In the hinge assembly 16, which is shown in detail in FIG. 5, the hinge 60 includes a leaf 66, a leaf 67 and a barrel 69 hinging the leaves 66 and 67 together; and the hinge 62 includes a leaf 70, a leaf 71, and a barrel 72. The leaf 66 is screwed to the frame member 21 and the leaf 71 is screwed to the wall 35 of the door. The leaf 67 and the leaf 70 are welded to opposite ends of the bar 64.

Referring to FIG. 4, the length of the link 64 is selected so that the distance between the barrel 69 and the barrel 72 is equal to the distance from the pivot 14 to the barrel 72 (measured along the edge of the door) plus the perpendicular distance from the line along which the pivot moves to the barrel 69. The hinge assembly 17 is similarly constructed.

The hanger assembly 19 includes a pair of L-shaped track members 74 and 75, and a trolley 76 riding on the track members. The track members each have a vertical leg 77, 79 respectively and a horizontal leg 80 and 81, respectively. The vertical legs 77 and 79 are respectively attached to the inside surfaces of the side walls 30 and

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31 of the top frame member 24 and the horizontal legs extend toward each other and are separated by a large enough space to accommodate the rod 44.

The trolley, as shown in FIGS. 1, 6 and 7, inside a block 82, a pair of axles 84 extending through the body, and four wheels 85 mounted on the axles. The block 82 is provided with a vertical bore 86 for receiving the rod 44 of the pivot assembly 14. The weight of the door is transmitted through the pivot assembly 14 to the trolley 76 by means of the flange 51. A washer 87 is positioned on the rod 44 between the top of the block 82 and the flange 51 to allow the rod 44 to rotate with respect to the block during the operation of the door.

The door closing assembly 20, as best shown in FIG. 7, includes a spring 89 and a turnbuckle 90 connected together between the rod 44 and the right side frame member 22. The turnbuckle 90 is attached to the frame member by means of a hook 91, and the spring 89 is attached to the rod 44 by means of a metal cable 92. The cable 92 has one end looped about the rod 44 (and seated in the groove 55) and has its other end looped about the end of the spring.

The wall 31 of the top frame member 24 is provided with an opening 94 through which the turnbuckle can be adjusted. A plate 95 is removably mounted to cover the opening 94.

To provide an air seal around the door, vertically extending strips 96 and 97 are cemented to the frame flanges 26 and 27 (FIG. 5) and horizontally extending sealing strips 99 and 100 are respectively secured to the top and bottom edges of the inside wall 36 of the door (FIG. 6). The sealing strip 99 is secured to the door by means of a retaining strip 101 and screws 102 and is positioned so that its upper edge contacts and seals against the flange 33. The sealing strip 100 is similarly secured by means of a retaining strip 104 and screws 105 so that its lower edge contacts and seals against the lower frame member 25.

The frame 11 is supported by a U-shaped pipe support 106 having a horizontal top member 107 and vertical sides 108 and 109 extending below the surface of the ground and preferably embedded in concrete. The frame 11 is secured to the pipe support 106 by means of four bolts 110 which extend through the sides 108 and 109 of the pipe support and through spacers 111 into the side members 21 and 22 of the frame.

The pressurized structure shown in FIGS. 1 and 2 is of the air inflated type such as disclosed in U.S. Patent No. 2,939,467 and has a fabric shell 114 which is supported by maintaining the pressure within the structure above atmospheric pressure. As shown in FIGS. 2, 5 and 6, the fabric 114 is secured to the top and sides of the door frame 11 by means of metal strips 115 which are screwed to the frame to sandwich the fabric between the frame and the strip.

The tension in the fabric 114 due to the inflation of the building or wind loads is transferred directly to the pipe support 106 by means of a cable system including a series of arcuate pockets 116 sewn to the fabric 114 around the pipe support, a series of short cables 117 encircling the pipe support 106, and a cable 119, threaded through the pockets 116 and through the loops formed by the cables 117. The ends of the cable 119 are secured to anchors 120 embedded in the ground at the sides of the closure.

In operation, when the interior of the structure containing the closure 10 is pressurized and when the door 12 is in the closed position, the pressure within the structure acts on the door to hold it in the closed position. Since the vertical pivot axis defined by the pivot assemblies 14 and 15 is positioned to the right of the center line of the door, the door area to the left of this axis is somewhat greater than the area to the right of the axis. The pressure acting on the inner surface of the door thus tends to rotate the door counter clockwise (as viewed in FIG.

2) against the flanges 26 and 27 on the frame 11. If, for example, the pivot assemblies are positioned 17 inches from the left edge of a 30-inch wide door having a height of 78 inches, then the closing force exerted against the door is about 11 pounds when the pressure in the building is 5 pounds per square foot above atmospheric and 17 pounds when that pressure is 8 pounds per square foot. Of course the pivot assemblies can be located to increase or decrease the closing force as desired.

To open the door 12 from the outside, the knob 38 is pulled to rotate the door clockwise about the pivot axis. As the door rotates clockwise, the hinge links 64 and 65 rotate counter-clockwise, and the door is drawn to the left (as shown in FIG. 3) causing the trolley 76 to roll along the tracks 80, 81 and causing the rod 55 to slide in the groove 34. Air from within the structure flows out from both the left and right sides of the door and acts on both surfaces of the door to equalize the pressure forces upon the door. As the door continues to open, its rotation and movement toward the left continues until it assumes the position shown in FIG. 4.

The leftward motion of the pivot assembly 14 that accompanies the opening of the door causes the stretching of the spring 89 of the door closing mechanism 20. When the door is released, the spring 89 pulls the pivot assembly to the right and the hinge assemblies 16 and 17 cause the door to rotate counter-clockwise to bring it back toward the closed position. As the door approaches the closed position, the pressure within the structure again becomes effective and pushes the door into the fully closed position.

The turnbuckle 90 is preferably adjusted so that no significant tension is placed in the spring (upon opening the door) until the door approaches a position similar to that of FIG. 3 where the effect of the pressure on the door is partially equalized. Thus adjusted, the closing mechanism 20 brings the door back to the position where the pressure within the structure completes the closing operation.

The adjusting mechanism 45 is utilized to vertically position the door with respect to the frame so that the seals 99 and 100 are effective and so that the rod 55 clears the bottom of the groove 34.

The space between the flange 32 of the upper frame member 24 and the upper edge of the door wall 35 is sufficient to accommodate an open end wrench, and the hexagonal formation 54 and the lock nut 53 of the mechanism 45 are positioned to be accessible through this space. The vertical position of the door can thus be adjusted while the door is in place.

It will be seen from the foregoing that the present invention provides an improved closure for pressurized buildings which is held in the closed position by the pressure within the structure, is self closing, and yet requires only a minimum effort to operate.

As various changes may be made in the form, construction and arrangement of the parts herein, without departing from the spirit and scope of the invention and without sacrificing any of its advantages it is to be understood that all matter herein is to be interpreted as illustrative and not in any limiting sense.

I claim:

1. A closure for use between an outside space at one pressure and an inside space at a higher pressure including in combination a movable closure member permitting access between the spaces, a frame for supporting said closure including first and second vertical side members and upper and lower horizontal members, said lower horizontal member being provided with an upwardly facing slot having sides and a bottom extending lengthwise thereof, said upper member being generally U-shaped and facing downwardly, a track within said upper member extending lengthwise thereof, a hanger assembly mounted on said track including roller means riding on said track, an upper pivot assembly extending vertically upwardly from said closure member for supporting and guiding said closure member, a lower pivot assembly extending vertically downwardly from said closure member part way into said slot to only guide said closure member, said pivot assemblies defining a vertical axis about which said movable closure member rotates, said upper pivot assembly including a first member secured to said closure member and a second member engaging said hanger assembly and a third member adjustably interconnecting said first and second members for vertically positioning said closure member to space the end of said second pivot assembly from the bottom of said slot, said second member being provided with means for permitting free rotation between said upper pivot assembly and said hanger assembly, said upper horizontal frame member being spaced from said closure member and said third pivot member being positioned between said upper frame member and said closure member to be accessible for adjustment, a rigid link hinge member extending from adjacent said first vertical frame members toward said axis, first hinge means hinging one end of said link member to said first vertical frame member and second hinge means hinging the other end of said link member to said movable closure member, said first and second hinge means having hinge lines parallel with said axis to shift said axis toward said first vertical frame member as said closure is rotated about said axis, said axis being spaced from the vertical centerline of said closure member so that the fluid pressure on the closure member tends to hold the closure member in the closed position.

2. A closure according to claim 1 including spring means in said upper frame member operatively connected between said hanger assembly and said frame for imparting a force to said closure member at said axis in a direction toward said second vertical frame member when said closure is open so as to return said closure member to the closed position.

References Cited

UNITED STATES PATENTS

2,019,527	11/1935	Ellison	49—252
2,059,143	10/1936	Renwick	49—251 XR
2,565,383	8/1951	Linebaugh	49—177
3,247,617	4/1966	Catlett	49—252 XR

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