Oct. 29, 1968 W. W. BIRD 3,407,534

PRESSURE BALANCED DOOR

Filed March 1, 1967 4 Sheets-Sheet 1

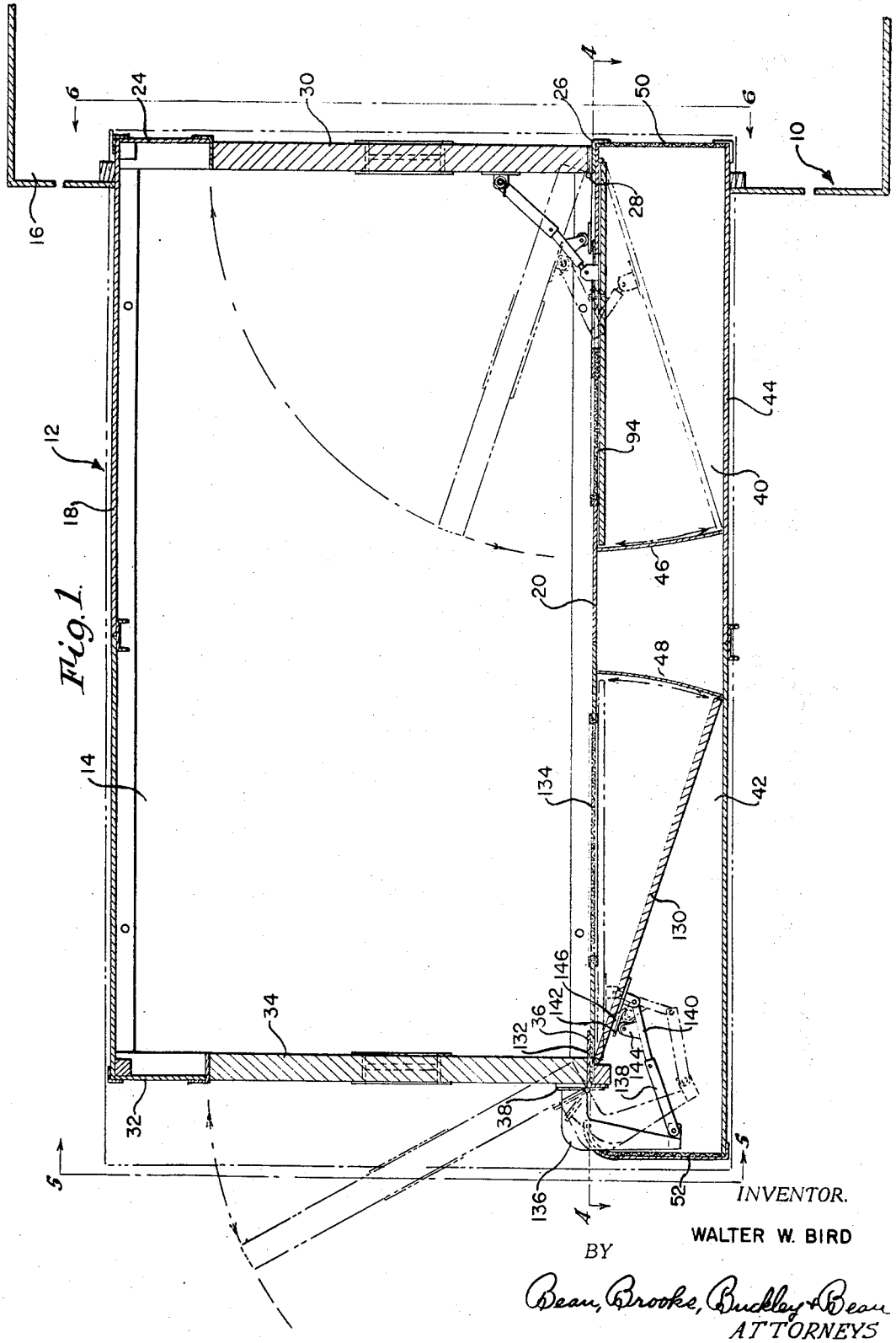


Fig. 1.

INVENTOR.
WALTER W. BIRD
BY
Bean, Brooke, Buckley & Bean
ATTORNEYS

Oct. 29, 1968 W. W. BIRD 3,407,534

PRESSURE BALANCED DOOR

Filed March 1, 1967 4 Sheets-Sheet 2

Fig. 2.

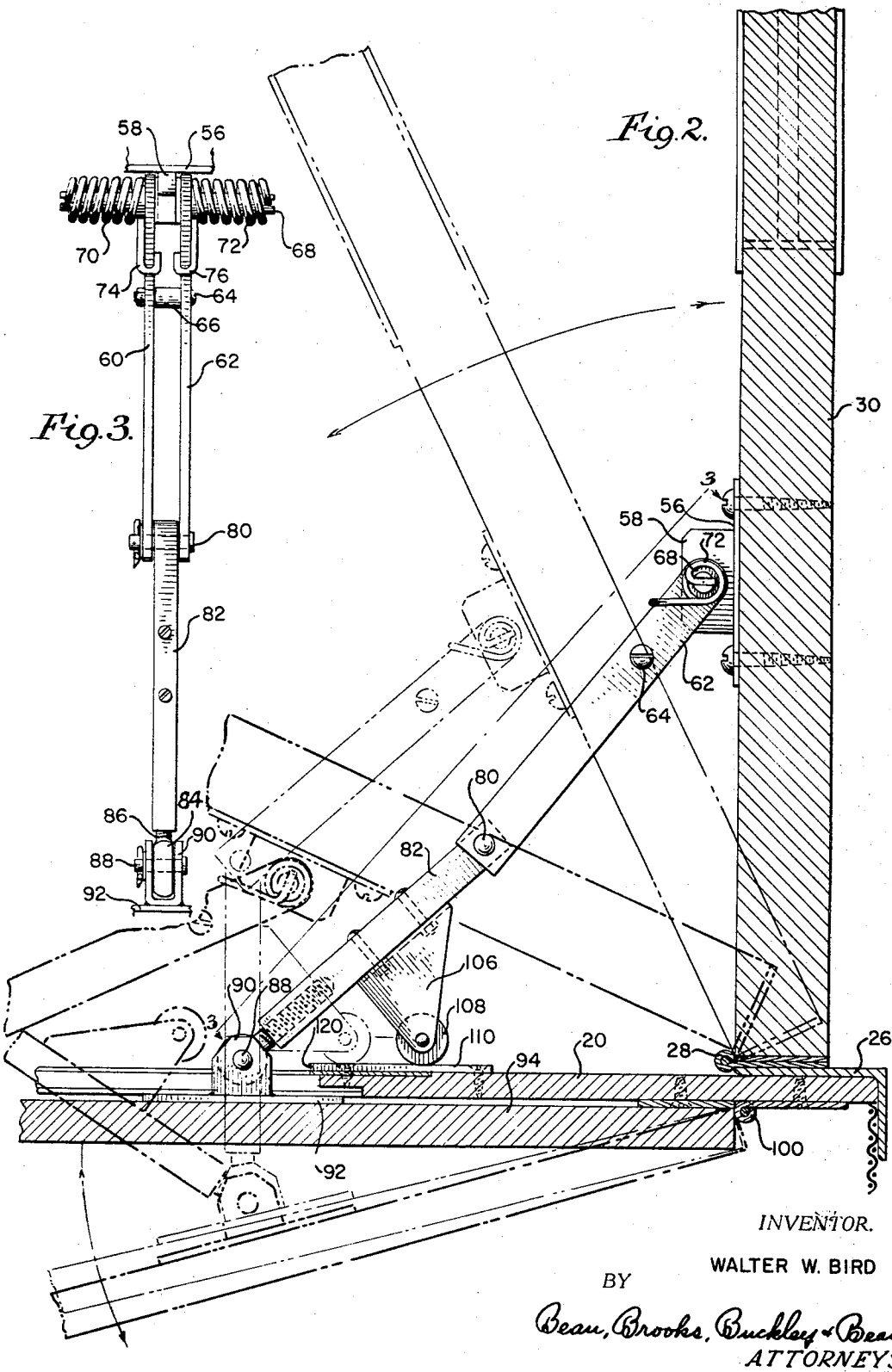


Fig. 3.

INVENTOR.

WALTER W. BIRD

BY

Beau, Brooks, Buckley & Beau

ATTORNEYS

Oct. 29, 1968 W. W. BIRD 3,407,534

PRESSURE BALANCED DOOR

Filed March 1, 1967 4 Sheets-Sheet 3

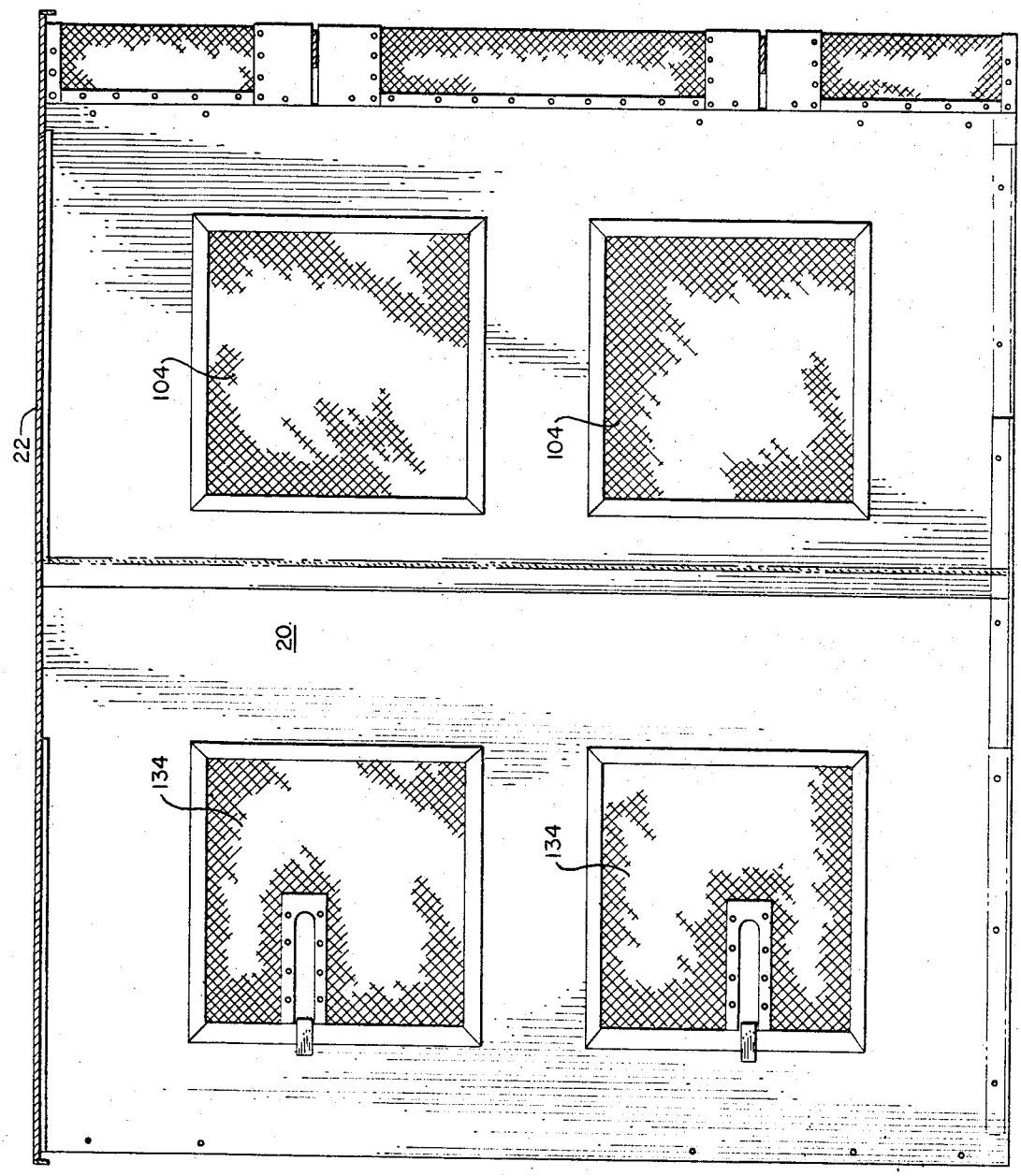


Fig. 4.

INVENTOR.
WALTER W. BIRD

BY
Bean, Brooks, Buckley & Bean
ATTORNEYS

Oct. 29, 1968 W. W. BIRD 3,407,534

PRESSURE BALANCED DOOR

Filed March 1, 1967 4 Sheets-Sheet 4

Fig. 6.

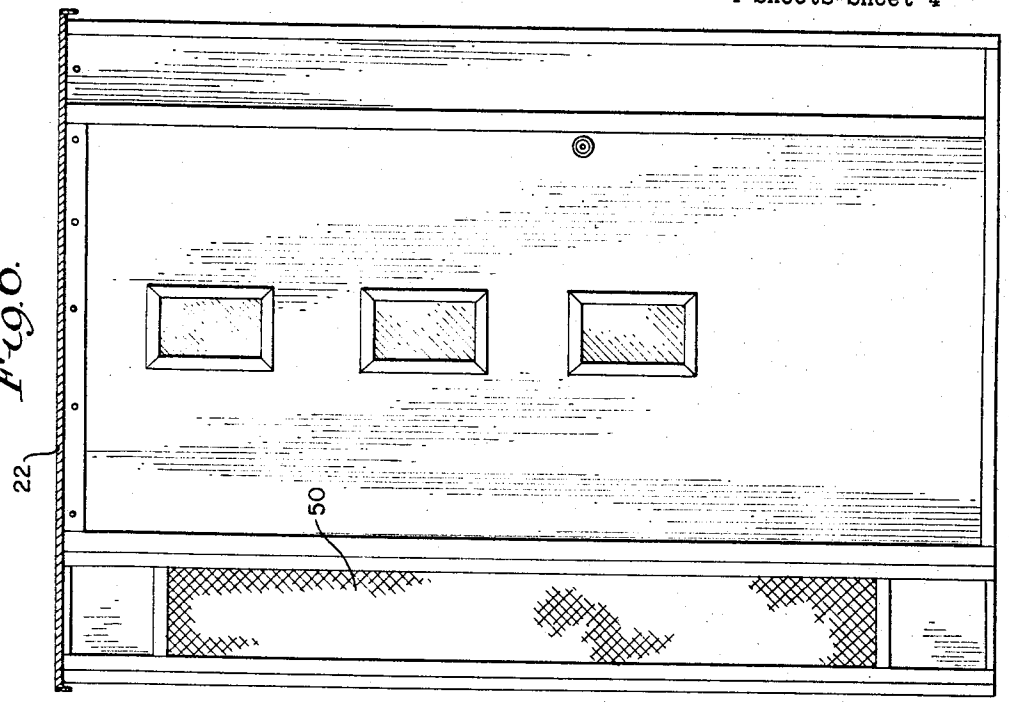
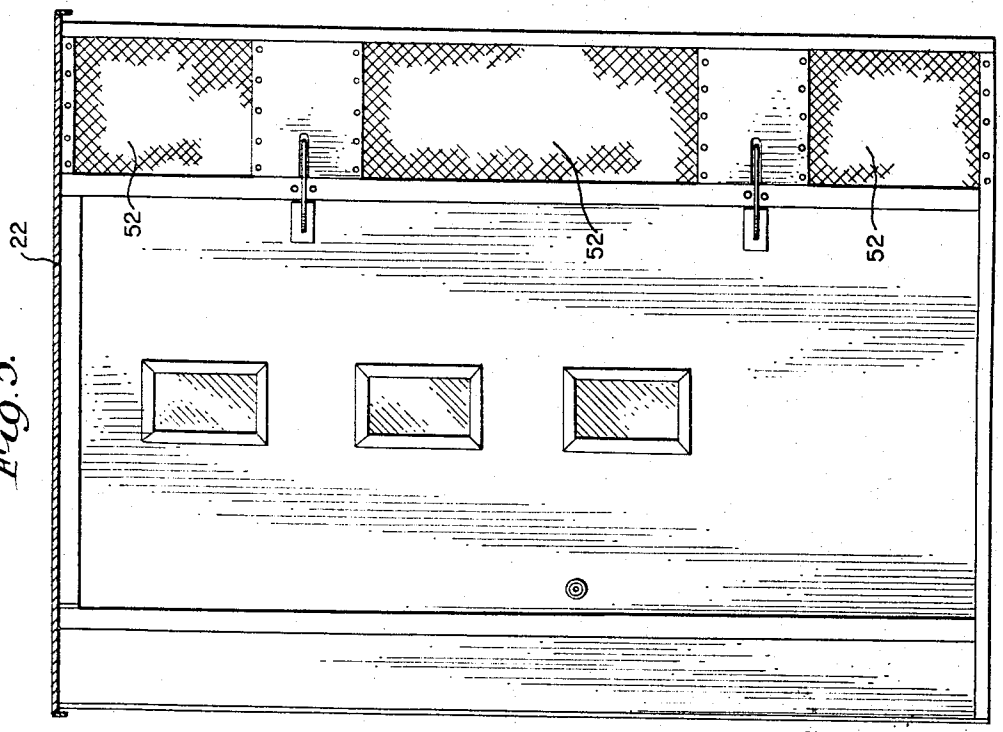


Fig. 5.



INVENTOR.

WALTER W. BIRD

BY

Bean, Brooks, Buckley & Bean

ATTORNEYS

United States Patent Office 3,407,534
Patented Oct. 29, 1968

3,407,534

PRESSURE BALANCED DOOR

Walter W. Bird, Williamsville, N.Y., assignor to Birdair Structures, Inc., Buffalo, N.Y.

Filed Mar. 1, 1967, Ser. No. 619,829
5 Claims. (Cl. 49—68)

ABSTRACT OF THE DISCLOSURE

An outwardly swinging door in association with an internally pressurized building and coupled to a piston or vane subjected to the internal pressure normally to hold the door closed. The manner in which the door is coupled to the vane is such as to exert a non-uniform closing force which is greatest at and near the closed position of the door.

Brief summary of the invention

This invention is directed in particular to the art of air inflated structures which depend upon internal air pressure to retain their structural integrity. In such an arrangement, it is desirable to minimize the loss of internal air incidental to door opening and closing action. With regard to this, the present invention is concerned with an airlock assembly.

A further problem and one which does not relate to the airlock is the provision of emergency door exits required by ordinance. Usually, the requirements necessitate an outwardly opening door which operates with a minimum of effort or manipulation. In an internally pressurized environment, it will be appreciated that an emergency door raises certain problems. For example, the door when closed will be subjected to considerable opening force due to the internal pressure. If this internal pressure is counterbalanced by a spring of sufficient strength to overcome the pressure, the door will be exceedingly difficut to open beyond that point at which the internal pressure ceases to exert any substantial door opening effect. On the other hand, a door held closed by a conventional panic lock will, when released, fly open and will require substantial effort to reclose.

The present invention involves basically an arrangement in which the internal pressure itself is used to hold the door closed and which tends to counterbalance the internal pressure against the door at and near the closed position.

It is a primary concern in connection with this invention to provide an improved form of door and means associanted with the door ad acted upon by differential fluid pressure serving to return or maintain the door in its closed position against the differential fluid pressure acting thereagainst.

Another object of this invention is to provide an improved structure as aforesaid incorporating a door and a movable vane, both operated upon by differential fluid pressure, there being link means joining the door to the vane and effective therewith to increase the door-closing force as the door is moving toward its closed position and vice versa.

Another object of this invention resides in the provision of an improved structure as aforesaid wherein the link means is in the form of pivotally interconnected strut members and a reaction member normally allowing the strut members to reside in over-center relation to thereby constrain the strut members to act as a compression or tension element joining the door and the vane, and wherein a cam plate is provided for cooperation with the reaction member to gradually move the strut members to and past dead center as the door is moved away from its closed position to thereafter allow these strut members to pivot relative to each other in substantially unrestrained fashion so as to substantially completely destroy their compression or tension transmitting effect, all to the end that the door and vane are interconnected for conjoint movement only in that region of movement of the door where it is at or near its closed position.

A further object of this invention is to provide an assembly according to the preceding object wherein spring means is associated with the strut members to cooperate with the aforesaid over-center strut arrangement to provide a return force on the door which does not abruptly terminate when dead center is passed.

Another object of this invention is to provide an improved airlock structure incorporating door assemblies as above described.

Other objects and advantages of the invention will appear from the specification hereinafter and the accompanying drawings, wherein:

FIG. 1 is a horizontal section taken through an airlock structure and a portion of an adjoining building constructed in accordance with the present invention;

FIG. 2 is an enlarged horizontal sectional view illustrating the details of the link means according to the present invention;

FIG. 3 is a horizontal elevational view taken substantially along the plane of section line 3—3 in FIGURE 2 showing further details of the link means;

FIG. 4 is a vertical section taken substantially along the plane of section 4—4 in FIGURE 1 and illustrating the vent means for the chambers housing the vane members;

FIG. 5 is a vertical elevational view taken substantially along the plane of section line 5—5 in FIGURE 1 illustrating the mounting of one of the doors; and

FIG. 6 is a vertical elevation taken substantially along the plane of section line 6—6 in FIGURE 1 showing the air access door mounting arrangement.

In what follows, the basic concept of a pressure balanced door is described in conjunction with an airlock assembly. It is to be understood, however, that an outwardly swinging emergency door separate and apart from any airlock feature may be installed by simply mounting one of the airlock doors at a suitable site in the building. In such a case, no external handle would be provided on the door whereas it is easily opened from inside simply by pushing against it. The amount of force required is minimal but, at the same time, the door will automatically close when released.

With reference at this time more particularly to FIGURE 1, the reference character **10** indicates in general a building construction which may taken any desired form such as for example it may be in inflatable type of building construction maintaining its shape and structural rigidity by virtue of internal air pressure to which the enclosure defined by the building is constantly maintained, as will be understood by those skilled in the art. The reference character **12**, on the other hand, indicates in general an airlock assembly constructed in accord with the principles of this invention. The airlock assembly provides means for entrance and egress and defines a secondary enclosure **14**, as distinct from the enclosure **16** defined by the building structure **10**, the secondary enclosure being adapted in a manner hereinafter more particularly pointed out, to isolate the building enclosure **16** from ambient atmosphere and minimize leakage of internal pressurizing fluid from the interior of the building **10** during entrance or egress.

The airlock structure **12** consists essentially of oppositely disposed side walls **18** and **20**, a top wall **22** (FIGURES 4–6), an inner end wall **24** having an access opening and hingedly mounting, as by a suitable frame member **26** and associated hinge **28**, an access door **30** for the interior **16** of the building **10** and swingable inwardly into

the airlock structure **12**, as indicated by dashed lines in FIGURE 1. The airlock structure **12** also includes an outer end wall **32** provided with an access opening and hingedly mounts an exterior door **34** which swings outwardly as shown, the structure having a suitable jam member **36** and associated hinge **38** mounting the door **34**, substantially as is shown.

The airlock structure also includes first and second chambers **40** and **42** defined between the outer wall structure **44** and the wall **20** spaced therefrom and by the associated top wall **22** and the corresponding inner wall members **46** and **48**. The chamber **40** is vented to the interior of the building **10** as by foraminous member **50** (FIGURES 1 and 6). The second chamber **42** is similarly vented but to ambient atmosphere by means of the foraminous means **52** (FIGURES 1 and 5).

The operation of the airlock structure is, in general, quite conventional. That is to say, the building structure **10** is subjected to some internal fluid pressure which is greater than the ambient atmosphere exterior to the building and the airlock structure **12**. The interior **14** of the airlock structure **12** will normally be at ambient pressure so that a differential pressure will be acting upon the access door **30**. This differential in pressure will tend to open the door **30** and permit the fluid to escape from the interior of the building into the airlock structure **12**. This invention concerns means for preventing this from occurring. Similarly, should the interior **14** of the airlock structure **12** be subjected to the same pressure or substantially the same pressure as the interior **16** of the building **10**, as when a person leaves the interior of the building and enters the airlock structure **14**, thus inescapably pressurizing the interior **14**, a differential pressure will then be acting upon the exterior door **34** tending to force this door open. This invention also concerns means for preventing this from occurring relative to the exterior door **34**.

Reference will be had now to FIGURES 2 and 3 to illustrate the details of the means for preventing unwanted motions of the door **30**. In these figures, it will be noted that the inner side of the door **30** is provided with a mounting bracket member **56** having an outstanding ear **58** fixed thereto. A pair of link members **60** and **62**, joined as by the fastener **64** and intervening spacer **66**, straddle the ear **58** and are pivotally joined thereto as by a shaft member **68**. A pair of torsion springs **70** and **72** have each one end thereof received in a notch in a respective end of the shaft **68** as is clearly shown in FIGURES 2 and 3 and the opposite ends thereof are provided with hook portions **74** and **76** which engage over the members **60** and **62** serving normally to urge these members in a counterclockwise direction when viewed as in FIGURE 2, the purpose of which will be presently apparent. Obviously, the shaft **68** must be fixed to the ear **58** to prevent rotation of the shaft **68**. A link pin **80** is carried by the free ends of the members **60**, **62** and a further member **82** is pivotally joined to the members **60** and **62** in the manner indicated most clearly in FIGURE 3. The free end of the member **82**, in turn, carries an eye member **84** which may have a threaded stem **86** engaged with the member **82** for adjustment purposes. The eye **84** engages a pivot pin **88** carried by the ears **90** of a bracket **92** fixed to one side of a vane member **94**, see particularly FIGURE 2. The vane **94** is hingedly mounted as at **100** to the airlock wall **20** and is located within the chamber **40** it being seen, from FIGURE 1, that the free edge of the vane **94** swings in close proximity to the wall member **46** which is arcuate as shown.

Thus, the vane **94** effectively divides or partitions the chamber **40** with one side of the vane **94** being communicated with the interior **14** of the airlock structure by gratings **104**, see particularly FIGURE 4, and with the outer side of the vane **94** communicating with the interior of the building **10** through the grating or foraminous means **50** previously described. Thus, there is a differential pressure acting on the vane **94** which will be the same as the differential pressure acting upon the access door **30**.

The link member **82** carries a bracket **106**, see FIGURE 2, which in turn mounts a roller member **108** adapted to bear against a cam plate member **110** fixed to the wall **20** of the airlock, substantialiy as is shown. As is clearly illustrated in FIGURES 2 and 3, the links **60**, **62** and **82** are in an over-center relationship when the door is closed (full line position). The purpose of the roller **108** and cam **110** is to allow this over-center position as shown, but to move the two links when ultimately passed over-center position as the door is first swung toward open position and vice versa. As previously described, the springs **70** and **72** normally urge the link **60**, **62** counterclockwise as shown in the drawing and when the roller **108** has passed beyond contact with the cam plate **110**, the springs **70** and **72** tend to prevent the two links from buckling. The differential pressure acting on the vane **94**, however, exerts sufficient force on the vane which resists movement thereof as imparted by the links so that a buckling action does take place as is shown in dashed lines. The net result is that the movement of the vane **94** is substantially uniform with respect to the door **30** only at the very beginning of door opening movement. The vane **94** passes through only a short arc before further motion is arrested. By this time, however, the over-center relation of the links is broken and continued opening of the door causes further buckling of the links and is resisted only by the action of the springs **70**, **72**, the roller simply pivoting away from the cam plate about the then-fixed pivot point **88**. This is illustrated in FIGURE 1 by full and dashed lines for the components under consideration.

During the initial movement of the door, it will be clear that the links **60**, **62** and **82** are acting really only as a compression strut, substantially as if they were rigidly joined and not articulated by the member **80**. Once, however, the dead center position is passed, the action of the springs **70** and **72** takes over. The net result is that while the door is near the region of being closed, the movements of the vane **94** and the door **30** are substantially uniform and, therefore, the greatest door-closing force is exerted. There again, the door closing force progressively diminishes as the door is continued to be moved toward its open position. This counteracts very closely the forces acting on the door due to differential pressure and still leaves a net return force acting on the door to close it when released. The action is, of course, reversed when the door moves toward closed position and assures that the door will be positively closed to minimize leakage of the internal pressurized air.

The same action applies for the door **30** and its associated vane **130**. The chamber **42** contains a vane **130** hingedly mounted as at **132** and the opposite sides of this vane are communicated respectively with ambient atmosphere through the grating **52** previously described and the grating means **134** on the wall structure **20**, see particularly FIGURE 4. As before, the free edge of the vane **130** runs in close proximity to the arcuate wall portion **48** in part defining the chamber **42**. As was the case in conjunction with the door **30**, the door **34** is provided with a bracket **136** which mounts the link means **138**. The link **138** corresponds to the members **60**, **62** of FIGURES 2 and 3 whereas the link **140** corresponds to the link member **82** of FIGURES 2 and 3. The vane **130** is normally disposed in the full line position shown in FIGURE 1 as opposed to the normal full line position of the vane **94**. The cam plate **142** for the roller assembly **144** carried by the link **140** is mounted on a suitable post or support member **146** which is, of course, fixed and stationary. The operation as between the door **34** and the vane **130** is in all of the respects, identical with the operation previously described in conjunction with the door **30** and the vane **94**.

I claim:

1. A building construction comprising, in combination:

an enclosure subjected to internal fluid pressure and having an access opening,

a door normally closing said access opening and hingedly mounted for opening movement relative to said access opening in a direction outwardly of said enclosure,

and means for holding said door closed against the action of fluid pressure thereagainst, said means comprising a chamber communicating both with the interior of said enclosure and with an environment external to said enclosure and of fluid pressure less than the fluid pressure within said enclosure, a vane movably mounted within said chamber and subjected on opposite sides thereof to the internal pressure of said enclosure and the fluid pressure of the external environment, and actuating means joining said access door to said vane for exerting a closing force on the access door which lessens as the door is opened.

2. The building construction according to claim 1 wherein said actuating means comprises two elements pivotally connected respectively to the door and the vane and pivotally connected to each other:

spring means urging said elements to swing toward the door and vane to which they are respectively connected,

and cam means acting on said elements allowing the elements to assume an over-center position when the door is closed.

3. The construction according to claim 2 wherein said cam means comprises a fixed reaction plate, a bearing member fixed to that link member joined to said vane, said reaction plate being positioned for engagement by said bearing member only when said access door is near its closed position.

4. In combination with a door hingedly mounted for movement between open and closed positions:

a fluid pressure operated vane hingedly mounted for swinging movement about an axis closely adjacent the hinge axis of said door,

a pair of elongate links, one pivotally connected at one end thereof to said door and the other pivotally conected at one end thereof to said vane, and said links being pivotally connected to each other at their proximal ends,

an abutment member carried by one of said links,

a fixed reaction plate engaged by said abutment member when said door is closed, said reaction plate being positioned to disengage said abutment member as said door is swung toward its open position,

and spring means acting on one of said links normally urging said abutment member toward said reaction plate.

5. A building construction comprising, in combination:

a building enclosure subjected to internal fluid pressure and having an access opening,

an airlock structure joined to said building enclosure and defining therewith a secondary enclosure communicating with the interior of said building enclosure through said access opening, said airlock structure having an exterior opening leading to ambient atmosphere which is at a lower fluid pressure than the internal fluid pressure of said building enclosure,

an access door normally closing said access opening, and hingedly mounted for opening movement relative to said access opening in a direction into said secondary enclosure,

an exterior door normally closing said exterior opening and hingedly mounted for opening movement relative to said exterior opening in a direction outwardly of said secondary enclosure,

said airlock structure including a pair of chambers, each having an opening communicating with said secondary enclosure, one of said chambers having an opening communicating with the interior of said building and the other having an opening communicating with ambient atmosphere, a vane hingedly mounted in each chamber and each such vane separating its respective chamber to isolate the aforesaid openings therein,

link means connecting that vane in said one chamber to said access door and link means connecting that vane in said other chamber to said exterior door.

said link means comprising two elements pivotally connected respectively to the door and the vane and pivotally connected to each other,

spring means urging said elements to swing toward the door and vane to which they are respectively connected,

and cam means acting on said elements allowing the elements to assume an over-center position when the door is closed.

References Cited

UNITED STATES PATENTS

1,184,725	5/1916	Dawes	49—68
1,842,708	1/1932	Barnes	49—109 X
1,941,969	1/1934	Calabrese	49—109 X
3,024,796	3/1962	Bird	52—2
3,314,198	4/1967	Frisk	52—2

FOREIGN PATENTS

14,196	3/1907	Great Britain.
1,100,930	4/1955	France.

DAVID J. WILLIAMOWSKY, *Primary Examiner.*

DENNIS L. TAYLOR, *Assistant Examiner.*