July 21, 1970 L. DAY 3,521,546

ATMOSPHERIC PRESSURE EQUALIZING MEANS

Filed March 1, 1967

Fig. 1.

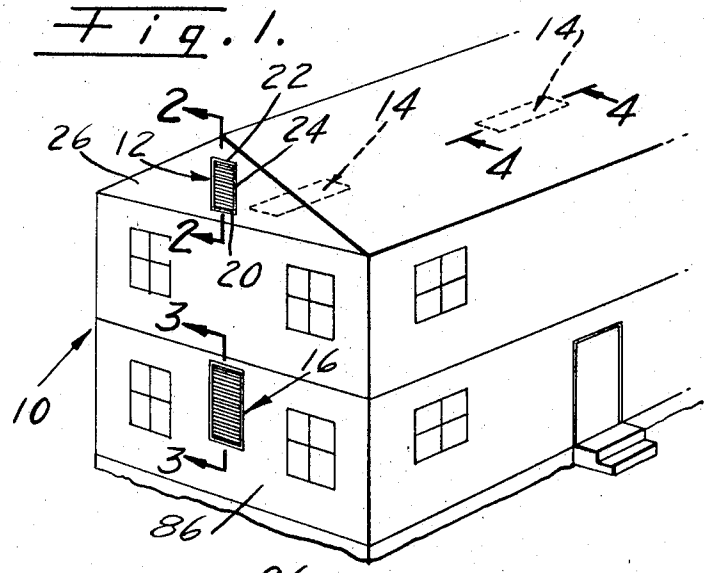


Fig. 2.

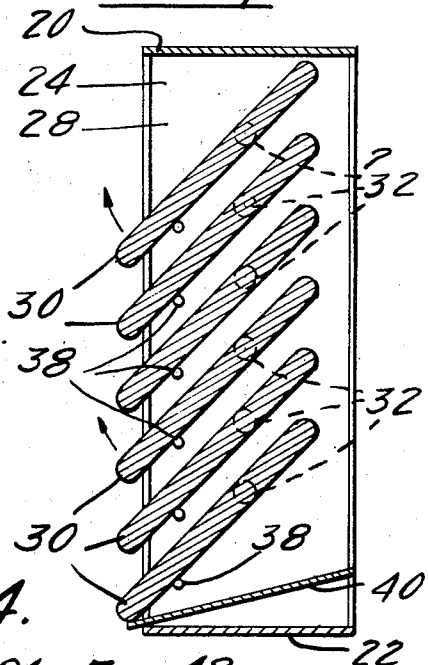


Fig. 3.

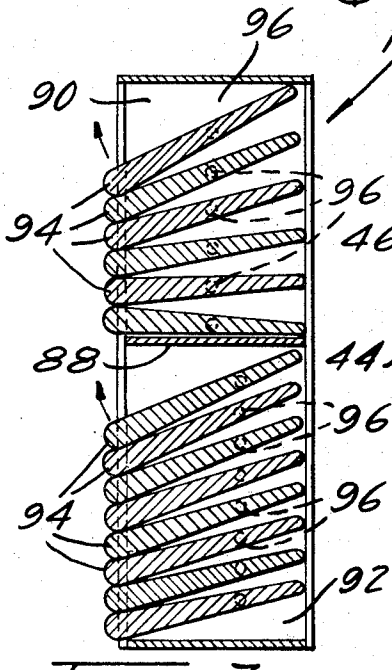
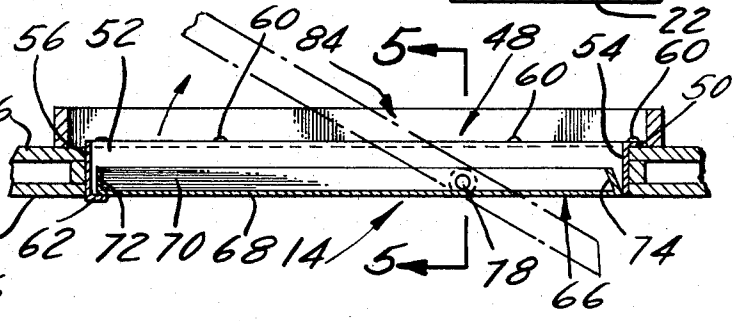


Fig. 4.



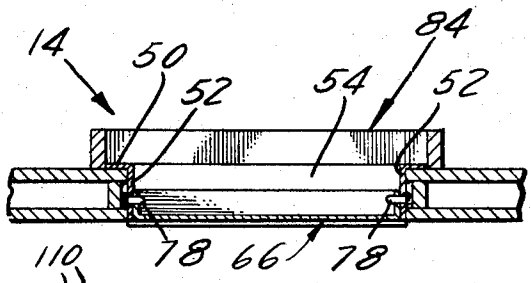
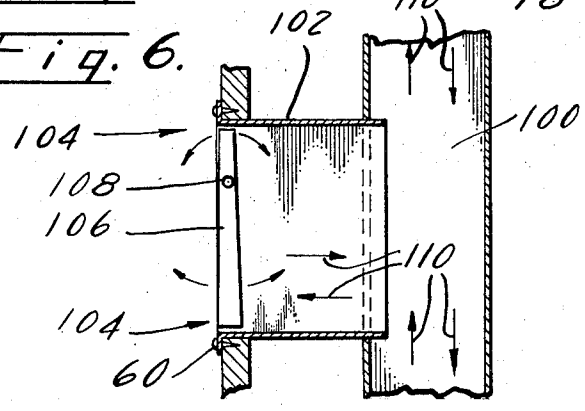


Fig. 5.

Fig. 6.



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3,521,546

ATMOSPHERIC PRESSURE EQUALIZING MEANS

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U.S. Cl. 98—32 10 Claims

ABSTRACT OF THE DISCLOSURE

Means for automatically equalizing air pressure between that within a building and atmosphere when there is a sudden and/or extreme drop in atmospheric pressure in the vicinity of the building. The equalizing means provides normal ventilation air flow through said means in accordance with the normal relatively slight changes in atmospheric pressure causing differential of pressure between that within the building and atmosphere as well as providing means for the return to normal of the air pressure within the structure as the atmospheric pressure returns to normal after the passage of the extreme low pressure area. Accordingly, the abnormal and/or destructive inwardly acting pressure on the walls and roof of the building is avoided.

While the invention has particular utility embodied in buildings, for automatically equalizing the interior pressures and atmosphere where there is a sudden and/or severe drop in atmospheric pressure, it is to be understood that its utility is not confined thereto.

As is well known, much of the destruction caused by twisters, tornadoes, cyclones or other high velocity winds is due to buildings exploding as a result of the sudden and great drop or reduction in the atmospheric pressure in the vicinity of the buildings, in the path of such tornadoes, cyclones, twisters, or other high velocity winds.

It is known that the eye of a twister is at a greatly reduced barometric air pressure as it moves ahead in its path. The air in the buildings is at normal pressure which may vary from approximately 28" to 32" of mercury or about 2 pounds per square inch of surface, and this air at normal pressure is trapped inside the buildings when the twister arrives with its lower air pressure. This creates an unbalanced outwardly acting pressure in the buildings which causes weaker structures to "explode." The greater the differential of air pressure inside the structures as compared with the outside or atmospheric pressure the greater and more destructive the "explosion."

The present invention solves the problem and overcomes the difficulties thereof by providing means operative under and responsive to the outward pressure within a building to permit the higher pressure in said building to exhaust outwardly and harmlessly through valve means comprising unevenly balanced louver boards or vanes which are normally closed but which tilt upwardly to increase the effective size of the opening and allow maximum escape of interior air. While the louvers are normally closed, they do not seal the opening they control but are loosely enough disposed to permit the passage of air through the opening for normal ventilation and normal slow changes in atmospheric pressure.

Also contemplated by the present invention is means to relieve or release pressures in lower stories of multiple story buildings as well as the pressure in the upper story or in the attic. A pressure relief means, which may comprise a single louver board or vane in the ceiling of lower floor rooms for controlling an opening in such ceiling to allow the higher pressure air to escape into the attic and then out through the attic louvers.

In summation, the present invention allows air under normal conditions to enter or leave the building to provide pressure equalization between the interior of the building and atmosphere and thereby provide normal ventilation. However, under abnormal conditions of an act of nature, such as a twister, cyclone, tornado or the like which suddenly and violently reduces the atmospheric air pressure, the higher pressure air in the building is allowed to quickly escape and prevent the building from exploding. The invention also provides means for the return to normal of the air pressure within the structure as the atmosphere returns to normal after the passage of the extreme low pressure area, thereby avoiding abnormal inwardly acting pressure on walls and roof of the building.

It is, therefore, an object of the invention to provide means for preventing buildings from "exploding" when there is a sudden and relatively great reduction of atmospheric pressure.

It is another object of the present invention to provide air pressure relief or equalizing means for permitting excessive air pressure within a building to escape to atmosphere upon a sudden and great drop in atmospheric pressure, and a corresponding return to normal air pressure within the building as atmospheric pressure returns to normal.

It is still another object of the invention to provide means of this character that permits normal breathing of air into and out of the structure with gradual changes in atmospheric pressure such as occurs under normal weather conditions.

It is a further object of the invention to provide means of this character that provides ventilation for the building under normal weather and atmospheric conditions.

It is a still further object of the invention to provide means of this character that prevents rain, or snow from entering the building.

It is another object of the invention to provide means of this character that is simple in construction and reliable and effective in operation.

Still another object of the invention is to provide means of this character that is relatively inexpensive to manufacture and to install.

These and other objects of the invention are achieved by providing a frame defining an opening in which a plurality of louver boards or vanes are mounted in an unbalanced condition so that they are normally in the closed position whereat they will permit ventilation through the framed opening and will prevent entrance of rain or snow but will swing open to permit rapid exhausting of excessive air pressure should there be a sudden and great drop in atmospheric pressure in the vicinity of the building caused by an abnormal weather condition such as a twister, tornado, cyclone or the like.

There is also contemplated by the present invention, pressure relief means for lower stories of multiple story buildings. This pressure relief means may comprise one or more pivoted louver boards or vanes unbalanced to be normally closed, and which, when opened by a differential of air pressure permits the air from such lower story to escape either to the upper story or attic of the building from which it is vented to atmosphere.

The characteristics and advantages of the invention are further sufficiently referred to in connection with the following detailed description of the accompanying drawings which represent one embodiment. After considering this example, skilled persons will understand that many variations may be made without departing from the principles disclosed, and I contemplate the employment of any structures, arrangements or modes of operation that are properly within the scope of the appended claims.

Referring to the drawings, which are for illustrative purposes only:

FIG. 1 is a perspective view of a portion of a building embodying the present invention;

FIG. 2 is an enlarged sectional view taken on line 2—2 of FIG. 1;

FIG. 3 is a similar view of an alternative arrangement of the louvers controlling the vent opening;

FIG. 4 is an enlarged sectional view taken on line 4—4 of FIG. 1;

FIG. 5 is a sectional view taken on line 5—5 of FIG. 4; and

FIG. 6 is a sectional view of an alternative arrangement of the vent control means.

Referring more particularly to FIG. 1 there is shown a building, indicated generally at **10**, having pressure relief or atmospheric pressure equalizer means, indicated generally at **12**, for the attic of the structure. There is also a pressure relief or equalizer means, indicated generally at **14**, for equalizing the pressure between the top story and the attic. An alternative atmospheric pressure equalizer means is indicated generally at **16**, for equalizing the pressure between a lower story of a multiple story structure and atmosphere.

The atmospheric pressure equalizer means **12** has a frame provided with top and bottom frame walls or members **20** and **22**, respectively, and vertical side frame walls or members **24** interconnecting the top and bottom frame walls. This frame is incorporated into an outside wall **26** of the building **10** and is so located as to provide what may be termed a vent opening **28** for the passage of air between the attic and atmosphere.

In the arrangement shown in FIG. 2 the vent opening **28** is controlled by a plurality of movable fins or vanes **30** spaced apart from each other said fins having pivot pins **32** secured thereto at the ends thereof, said pins being pivotally received in bores provided therefor in the frame side walls **24**. Pivot pins **32** are disposed closer to one side of the longitudinal center of the fins so that said fins are unbalanced. The larger parts of the fins are at the outer side and since said larger parts are heavier than the parts of said fins at the opposite side of the pivotal axis thereof said outer parts are urged downwardly by gravity. Means for limiting gravity urged movement of the fins is provided and comprises stop pins fixed in the side frame members or walls **24**, there being a stop pin **38** at each end of each fin. The stop pins **38** are so positioned that the fins or vanes **30** are substantially parallel to each other in the frame of the pressure equalizer means **12** and when in the normal position said fins thereof are inclined upwardly and inwardly, as shown in FIG. 2. When the fins are in this normal position there is sufficient spacing between them to provide for or permit normal ventilation through the opening **28** with air passing either inwardly or outwardly depending upon whether atmospheric pressure is higher or lower than the air pressure in the attic. Also this spacing of the vanes provides for the rapid return to normal of air pressure within the building or structure as the atmospheric pressure returns to normal after the passage of the extreme low pressure area, thereby preventing an abnormal inwardly acting pressure on walls and roof of the building.

It is to be noted that the upper inner edge of the top fin or vane is positioned close to the top frame wall or frame member **20** and hence it may be said that the mechanism is in the closed position when in said normal position.

A drain board **40** is secured within the frame of the pressure equalizer means **12** adjacent the bottom thereof, said drain board being inclined downwardly and outwardly and extending outwardly beyond the outer edge of the lower or bottom frame member **22**. The outer edge of the lower fin or vane **30** is normaly close to the adjacent part of the drain board **40** so that substantially no air passes between these parts, normal ventilation being through the spaces between the fins or vanes.

Should there be a sudden abnormal drop in atmospheric pressure caused by an act of nature such as a twister, cyclone, tornado or the like the pressure within the structure, particularly within the attic will suddenly be very much greater than exterior atmospheric pressure and the sudden and great differential of pressure, with the higher pressure within the building, will cause the fins or vanes to swing on their pivotal axis, the parts of the fins at the outer side of said pivotal axis swinging or pivoting upwardly and the parts at the opposite side thereof swinging downwardly. Thus the fins will move to the "open" or pressure relief position and the spacing between said fins will increase to allow a greater volume of air to flow through the opening **28**. Also, the upper fin will swing upwardly to such an extent that there will be a substantial opening for air between said upper fin and the upper or top frame wall member **20** and the lower fin will move away from the drain board and provide for escape of air between said bottom fin and said drain board. The spacing of the fins or vanes is such that the effective size of the opening **28** of the pressure equalizer means will increase sufficiently to relieve any dangerous differential of pressure between that within the structure and atmosphere upon a sudden abnormal drop in atmospheric pressure and thereby prevent an explosion that would damage or destroy the structure.

When in the normal closed position the fins or vanes are inclined downwardly and outwardly to prevent rain from entering the building. The same is true of the drain board **40** which is similarly inclined so that rain water will drain outwardly.

There is also means provided for flow of high pressure air from the story of the building below the attic. An alternative pressure equalizer arrangement may be used such as that indicated at **14**.

This arrangement is installed in the ceiling of the story of the building just below the attic. Actually an opening is provided in both the ceiling **44** of the top story and the floor **46** of the attic, said openings being in alignment with each other and receive a metal frame, indicated generally at **48**.

Frame **48** may be of any suitable shape but is shown as being rectangular with an outwardly turned peripheral flanges **50** about the top edges of the side walls **52** and an end wall **54**, the opposite end wall **56** being without a top flange. Top flange **50** rests on the edge portion of the opening in said floor with the side and end walls of said frame **48** disposed within the aligned openings in the floor of the attic and ceiling of the top story, as shown in FIGS. 4 and 5. Nails **60** or other suitable means secure the flange **50** to the floor **46** of the attic. End wall **56** is provided with an inturned flange **62** at its lower edge.

There is a movable equalizer member, indicated generally at **66**, said member **66** having a panel portion **68**, and an upturned flange **70** along the side edges of the panel, said flange being normal to the plane of the panel **68**. There is also an upturned flange **72** along an end edge of the panel. At the opposite end of the panel there is an edge flange **74** which is inclined toward the panel end having the flange **72**, or said flange **74** may be considered as being inclined inwardly.

The equalizer member **66** is pivotally mounted in the frame **48** by means of axially aligned pivot pins **78** which have their outer ends secured as by brazing or welding or the like in openings provided therefor in the side walls **52** of the frame **48**, said pins being pivotally received in openings provided therefor in the side flanges **70**. The pins **78** are closer to one end of the equalizer member than the other end so that the equalizer member is unbalanced in such manner that the longer portion normally rests on the flange **62** of the frame. When there is a differential of pressure on opposite sides of the equalizer member **66**, with the higher pressure at the under side, the equalizer member will swing clockwise,

as shown in FIG. 4, to permit the higher pressure air to pass through the frame into the room or attic above. It is to be noted that the inward inclination of the flange **74** provides operable clearance with regard to the adjacent wall of the frame.

A frame **84** may be installed about the frame **48** if desired.

Referring to FIG. 3, the pressure relief or equalizer means **16** has a frame similar to the frame of the arrangement shown in FIG. 2, said frame having top and bottom frame walls **20** and **22** and vertical side walls or members **24**. While this equalizer means is shown as being installed in an autside vertical wall **86**, of a lower story of the structure, it is to be understood that it may be installed in the wall portion of another story.

Within the frame of the arrangement of FIG. 3 is a horizontal partition **88** separating the frame into upper and lower parts or compartments **90** and **92**, respectively. This frame is open at the inner end as well as at the outer end as is the case with the frame of the arrangement shown in FIG. 2.

Both upper and lower portions of the frame have a plurality of movable fins or vanes **94** which taper from their inner edges to their outer edges, said vanes or fins being thicker at the thickest part adjacent their outer edges. Each fin or vane has axially aligned pivot pins **96** suitably secured in their ends, said pins being pivotally received in suitable openings provided therefor in the adjacent vertical or side frame walls. The longitudinal axes of the fins or vanes is offset toward the smaller, inner edges so that they are unbalanced outwardly, the unbalancing being increased by the additional weight provided by the thicker edge portions.

The pivot pins of the fins or vanes are spaced vertically apart to permit proper movement of the fins or vanes when the interior pressure becomes greater than the outside pressure. Normally, the outer edges of the fins or vanes rest on one another when in the normal closed position to close the compartments in which said fins or vanes are mounted. It is to be noted that the inner edge portion of the top fin or vane is normally in contact with the top frame member **20**.

While the vanes **94** are in a closed position, it is to be understood that they seal the compartments **90** and **92** so there is no seepage of air, rain or snow through the compartments **90** and **92**. When interior pressure becomes greater than exterior pressure the vanes are moved in a clockwise direction by the higher interior pressure air and become substantially parallel to one another thereby providing spaces therebetween to permit the higher pressure air to escape through the frame.

It is to be noted that the inner edge portion of the top fin or vane in the lower compartment **92** is positioned close to or may be in contact with the horizontal partition **88** when the vanes in said lower compartment are in the normal closed position.

The alternative arrangement of FIG. 6 comprises a duct **100** extending from a lower story to an upper story and opening into the upper story, there being a laterally turned part **102** at the lower end defining an opening **104** into the lower story and in which a fin or vane **106** is operably disposed. Vane **106** is pivotally mounted on pins **108** at opposite ends thereof, said pins being axially aligned on a horizontal axis. The pins **108** are pivotally mounted in openings provided therefor in the wall of the duct defining the laterally turned portion **102** and said pins are closer to the upper edge of the vane so that said vane is unbalanced with the lower portion heavier than the upper portion thereby causing said vane to normally be vertically disposed for closing the opening **104** when the pressures on opposite sides of said vane are equal. Should the atmospheric pressure suddenly drop and effect opening of the pressure relief means thereof so that the pressure in the upper story correspondingly drops the pressure will be reduced on the inner side of the vane **106** and the higher pressure at the opposite side will act on the lower portion of the vane to cause same to move inwardly and the upper portion of the vane to move outwardly relative to the opening **104** thereby permitting high pressure air to flow through said opening **104** and upwardly through the duct to the upper story which is already suitably vented to relieve the pressure thereof. The alternate direction of arrows **110** indicates the direction of the air flow when high pressure is being exhausted to atmosphere and/or the flow in opposite direction when the air pressure inside the structure is returning to normal in the event that said pressure is reduced by the outflow to a point below normal.

The invention and its attendant advantages will be understood from the foregoing description and it will be apparent that various changes may be made in the form, construction and arrangement of the parts of the invention without departing from the spirit and scope thereof or sacrificing its material advantages, the arrangement hereinbefore described being merely by way of example, and I do not wish to be restricted to the specific forms shown or uses mentioned except as defined in the accompanying claims.

I claim:

1. Atmospheric pressure equalizing means, comprising:

(a) walls defining a vent opening for the flow of air therethrough;

(b) a plurality of spaced apart louver vanes pivotally mounted in said opening on respective horizontal axes independently of each other, the axes of said vanes being vertically spaced apart and being closer to one edge than the other so that each vane has a portion at one side of its axis that is larger and heavier than the portion at the opposite side thereof and therefore is unbalanced with the heavier side urged downwardly by gravity, said vanes being moved to an open position by air pressure on their larger sides when there is an unusually large drop in atmospheric pressure;

(c) and means for maintaining the louvers normally partly open with the free edges of the larger sides spaced apart to permit free inflow and outflow of air therethrough in both directions for normal ventilation under normal pressure change conditions.

2. The invention defined by claim **1** wherein the equalizer means is installed in a building structure for the passage of air between the inside and outside of the structure, said pressure equalizer means being openable by inside air pressure when there is a sudden drop in outside pressure whereby to equalize inside air pressure with outside air pressure.

3. The invention defined by claim **2** wherein said structure has a plurality of stories, said equalizer means being installed in an outside wall of one story; and a second equalizer means for controlling in flow between stories of the structure, said second equalizer means having a movable control member actuated when there is a differential of pressure on either side of said control member.

4. The invention defined by claim **1**, wherein the vent opening is vertically arranged for generally horizontal airflow therethrough and the last mentioned means comprises stop means for the vanes for positively limiting gravity urged pivotal movement of said vanes at said normal position, said vanes when in said normal position being substantially parallel to each other with venting space between at least some of said vanes for normal ventilating airflow through said venting spaces.

5. The invention defined by claim **3** wherein said structure has means separating two stories, said means having a vent opening therethrough for the passage of air between said stories; and the second equalizer means includes at least one movable unbalanced panel for controlling the flow of air through said opening between stories; said

panel being pivotally mounted in said opening and movable between a normal position and an open position by air pressure.

6. In a multistory enclosed structure comprising outside atmospheric and internal air pressure equalizing means automatically maintaining internal air pressure equated to external atmospheric pressure arranged in selected areas of said structure including:

(a) a first equalizer means;

(b) a second equalizer means;

(c) said first and second equalizer means having louver vane means pivotally mounted therein;

(d) said vane means normally being in a substantially closed position for automatic opening response in two directions in accordance to the higher pressure of a differential of pressures on opposite sides thereof for increased air flow through said first pressure equalizing means and whereby internal pressure in said stories is equalized with the external atmospheric pressure.

7. The invention defined by claim 6, including at least one swingable element in said first and second atmospheric air pressure equalizing means, said element being automatically responsive in an opening direction to the higher of a differential of pressure on either side respectively thereof for effecting increased air flow through said pressure equalizing means.

8. The invention defined by claim 6, wherein said vane means of said first and second atmospheric air pressure equalizing means are gravity urged toward closed position and are openable upon an abnormal change in external atmospheric pressure.

9. Atmospheric pressure equalizing means, comprising:

(a) walls defining a vertical vent opening for the flow of air therethrough;

(b) a plurality of spaced apart vanes pivotally mounted in said opening on horizontal axes, the axes of said vanes being closer to one edge of the respective vanes than the other so that each vane has a portion at one side of its axis that is larger and substantially heavier than the portion at the opposite side thereof and therefore is unbalanced with the heavier side urged in the closing direction by gravity when atmospheric pressure is normal, said vanes being urged to the open position by internal air pressure on the larger sides when external pressure drops;

(c) and means for positively limiting closing movement of the vanes and holding the vanes in a normal partly open position so air can normally flow freely therethrough inwardly and outwardly with normal relatively slow changes in air pressure at one side relative to the air pressure at the opposite side.

10. Atmospheric pressure equalizing means, comprising:

(a) walls defining a vertical vent opening for the flow of air therethrough;

(b) a plurality of spaced apart vanes pivotally mounted in said opening on horizontal axes, the axes of said vanes being closer to one edge of the respective vanes than the other so that each vane has a portion at one side of its axis that is larger and substantially heavier than the portion at the opposite side thereof and therefor is unbalanced with the heavier side urged in the closing direction by gravity when atmospheric pressure is normal, the axes of said vanes being spaced vertically apart and said vanes being urged to the open position by internal air pressure on the larger sides when external pressure drops below internal pressure;

(c) and stop means for positively limiting closing movement of the vanes and holding the vanes in a normal partly open position so that air can normally flow freely therethrough inwardly and outwardly with normal relatively slow changes in air pressure at one side relative to the air pressure at the opposite side,

(d) said vanes being held by gravity against the stop means with normal relatively slow changes in air pressure at one side relative to the air pressure at the opposite side but said vanes being moved away from said stop means to a greater open position upon a sudden and substantial drop in atmospheric air pressure sufficient to cause the higher pressure air at the inner side, acting on the larger and heavier portions of the vanes, to overcome the force of gravity thereon and force said vanes to said greater open position and thereby provide an immediate relief of pressure at the inner side.

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MANUEL A. ANTONAKAS, Primary Examiner

U.S. Cl. X.R.

98—74, 121; 52—1

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,521,546 July 21, 1970

Leslie Day

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading to the printed specification, lines 3 to 5, cancel "assignor to Vacuum Concrete (Overseas) Co. Est., Vaduz, Liechtenstein, a corporation of Liechtenstein".

Signed and sealed this 19th day of January 1971.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents