June 9, 1964 M. D. MEARS 3,136,356

IMPERMEABLE SLIT-TYPE FLEXIBLE DOOR

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Fig.1

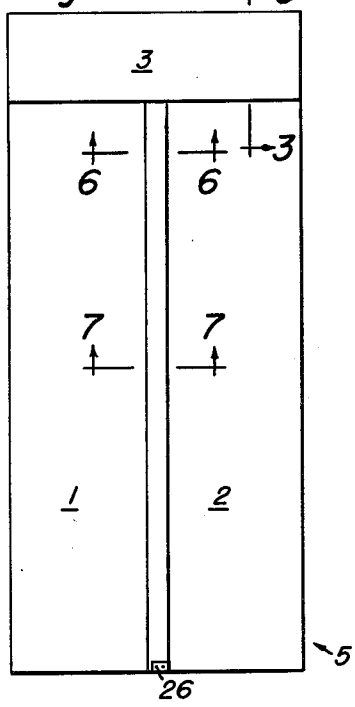


Fig.2

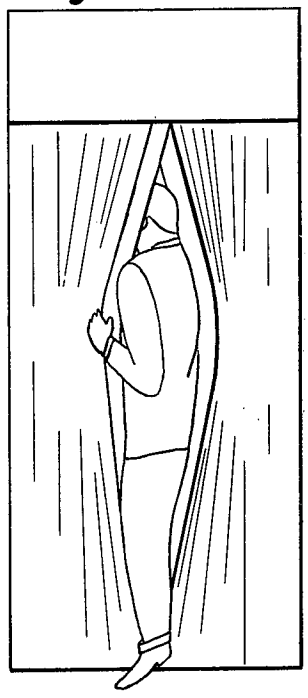


Fig.3

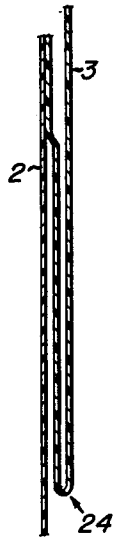


Fig.4

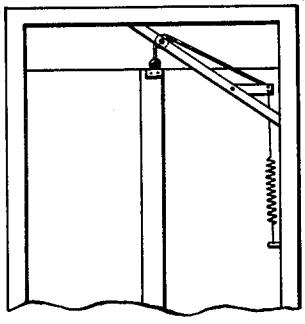


Fig.5

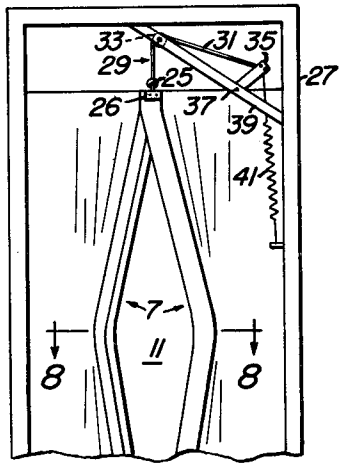


Fig.6

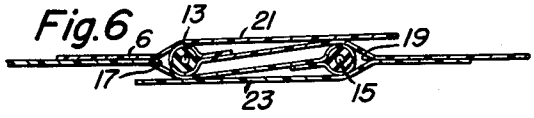
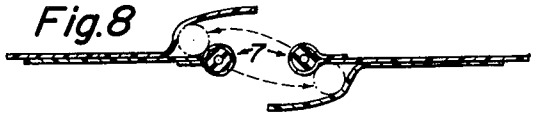


Fig.7

Fig.8



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IMPERMEABLE SLIT-TYPE FLEXIBLE DOOR

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Fig. 10

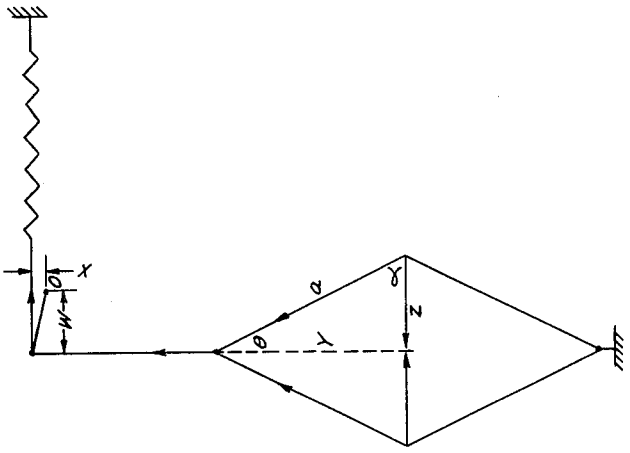
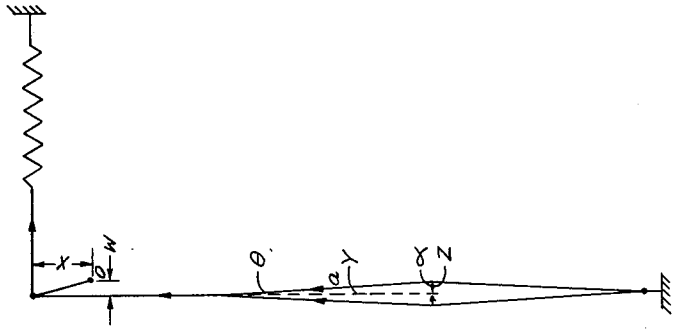


Fig. 9



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3,136,356

IMPERMEABLE SLIT-TYPE FLEXIBLE DOOR

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Filed June 15, 1962, Ser. No. 202,923
1 Claim. (Cl. 160—87)

The invention herein described may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment to me of any royalty thereon.

This invention relates to an impermeable slit-type flexible door used as a passage into and out of protective shelters with a minimum infiltration of contaminants. More particularly, the door is designed to stay closed under constant tension in pressurized as well as in non-pressurized protective shelters, which is unlike any other known to me. The patent in Flanigan, 2,854,070, is representative of the prior art in this field.

The opened slit of the door conforms, in general, to the shape of a person passing therethrough thus reducing the tendency for contaminated air to be carried along. In the closed position, the door leaks very little, even under pressures up to one inch water gage.

In a non-pressurized shelter, several doors may be used in series between the contaminated area and the shelter proper, with compartments between, to give graduated reduction in the degree of contamination as the shelter proper is approached. In a pressurized structure, the door is used in the air-lock.

The invention will be best understood by reference to the accompanying drawings forming a part of this specification, and in which;

FIG. 1 is a front view of the subject door.

FIG. 2 shows the door panels spread apart to permit a person to pass therethrough.

FIG. 3 is an enlarged sectional view of the upper panel, showing it cemented onto the door panels.

FIG. 4 is a fragmentary rear view of the door in a closed position.

FIG. 5 is a fragmentary rear view of the door in a partially open position.

FIG. 6 is an enlarged sectional view taken through section 6—6 showing the relative position of the panel elements.

FIG. 7 is an enlarged sectional view taken through section 7—7 showing the relative position of the panel elements.

FIG. 8 is an enlarged sectional view taken through section 8—8 showing the relative position of the panel elements in an open position.

FIG. 9 is a schematic representation of forces involved when the door is in the closed position.

FIG. 10 is a schematic representation of forces involved when the door is in an open position.

The door consists essentially of three panels usually of rubber coated cloth or sheet plastic; the right door panel 1, the left door panel 2, and the upper panel 3. The right panel 1, and the left panel 2, constitute the door proper generally shown at 5. These two panels are placed in a plane with their vertical edges meeting in the center of the door so that when they are pulled apart they will form or create a slit or opening 11. Each adjacent edge (shown at 7) is cemented or heat sealed around flexible tubing (made of rubber or other resilient material) 13 and 15. The panels 1, 2 have cemented along their entire vertical lengths at seams 17 and 19, flaps 21 and 23. The loose edge of flap 21 extends inwardly beyond the edge 7 containing the tubing while the loose edge of flap 23 extends outwardly beyond the edge 7 containing the tubing. This creates a space between the flaps and the panels for the insertion of the tubed edge of the opposite panel, so that, when the door is closed the tubed edges, shown at 7, and the flaps 21, 23 of the panels 1 and 2 interlock to form a seal. The boundaries of the seams 17, 19 are in the shape of an arc (not shown) with the arc being closer to the tubed edges (as shown in FIG. 7) at their mid points. The purpose of the tubing in said edges and said arc-shaped seams is to assure positive sealing.

It is to be noted that the tubing 13, 15 does not extend quite to the extreme upper and lower ends of the door panels (this is not shown) but stops approximately 2 inches short from said ends. The edges of the flaps and panels at these ends are cemented and clamped together with rivets and plates 26. The upper panel 3 is cemented and sealed with the upper end of the panels 1, 2 and folded (as shown at 24) to allow the top of the door panels to drop as the panels are parted or opened. A slit is thus formed between these secured ends of the panels for passage through the door.

The door panels 1, 2 have at their upper edge a hook and eye 25. The door assembly consisting of the three panels is attached and sealed to a rigid frame 27. The frame may be of any material and shape. It may be designed to be taken apart or folded.

At the rear, the door panel assembly has attached thereon a spring-lever means shown at 29. Said spring-lever means comprises a cable 31 having its one end attached to the hook and eye of the door panel, while engaging a pulley 33 it has its other end attached to a lever 35. This lever is through means of pin 37 pivotally fastened to a diagonally positioned support or bracket 39 which in turn is rigidly fastened to the frame 27. The lever 35 also has an extension spring 41 which at its lower end is fastened to the frame 27.

In operation, the person entering through the door, pulls apart the door panels 1, 2 (at the edges shown at 7) activating the spring-lever means shown at 29. The spring lever means is designed to exert an upward pull at the top of the door above the slit 11 through means of the extension spring 41. As the door is opened, by parting the door panels, the force exerted on the door, through the lever means, decreases and the effort necessary to further open the door diminishes. The upper edge of the door is brought downwardly, upon parting the door panels, resulting in pulling with it the hook and eye 25 and the cable 31 which engages the pulley 33 pivotally moving the lever 35 in a counter clockwise direction. The lever 35 is arranged so that the moment around pin 37 decreases as the door is opened, thereby reducing the effectiveness of the extension spring 41. This pivotal movement of the lever 35 stretches the extension spring 41. As the person completes the passage through the door, the latter action will be in reverse. When the door is closed the movement around pin 37 is such that the maximum tension is exerted on the door thereby increasing the effectiveness of the extension spring 41. The extension spring 41 attached to the frame 27 and to the lever 35 exerts a torque on said lever turning same on pin 37 in a clockwise direction. A force is transmitted along the cable 31 over pulley 33 and to the top of the door through the hook and eye 25 thereby bringing the door in a closed position.

This upward vertical force holds the door closed under tension. The tubed edges (shown at 7) are held under pressure against the (previously mentioned) arc-shaped seams 17, 19 of the adjacent panel thus sealing the door. The resultant tension causes the edges along the slit to interlock and part of the vertical tension is translated into a horizontal component which exerts pressure be-

tween the tubed edges and the arc-shaped seams (referred to earlier) of the door panels and the flaps. The spring-lever means is designed to exert the maximum vertical force on the door at its closed position when sealing is desired.

In operation, the door is opened just enough to allow the person to pass through. Upon release, the door automatically closes and seals.

It is to be understood that while the above described spring-lever door is the preferred embodiment of my device, other means may be employed to keep tension on the tubed edges **7**. For example, the lever **35** could be replaced by a second pulley. This would destroy the novel features of my device set forth above but the sealing of the door would be approximately the same. In like manner, the spring can be replaced with weights in either of the above modifications, without greatly changing the function of the door.

The forces exerted on the door are shown diagrammatically in FIGS. 9 and 10.

An analysis follows:

Let

T be the torque around fulcrum O

F be the horizontal force exerted by spring

F_1 be the vertical tension at the top of the door

F_2 be the component of F_1 along a

F_3 be the component of F_2 along z and represent the horizontal force or effort required to open the door

x be the vertical distance between fulcrum O and the line of force of the spring

w be the horizontal distance between the fulcrum O and the line of tension on the door

a be one half of the height of the door when closed

z be one half of the width of the door at its midpoint

y be one half of the height of the door when opened

Then

$$T=Fx$$

$$F_1=\frac{T}{w}=\frac{Fx}{w}$$

$$F_2=F_1\cos\theta=F_1\frac{y}{a}=\frac{Fxy}{aw}$$

$$F_3=F_2\cos\alpha=F_2\frac{z}{a}=\frac{Fxyz}{a^2w}$$

Although the force exerted directly by the spring is slightly greater as the door is opened, the change of moments around O results in a decreasing tension on the door and the force against which the door is opened, F_3 is greatly reduced.

As the door closes, the moments around O react to greatly increase the effectiveness of the spring in a vertical tension on the door. As the dimension represented by Z approaches zero, the horizontal force F_3 approaches zero. But Z never reaches zero because of the arc designed in the attaching of the door flaps. Thus, there is always a horizontal force between and along the flap and the tubed edge of one panel and the tubed edge and the flap of the other panel, assuring a positive seal.

Various modifications and changes in the embodiments of the invention as disclosed are contemplated and may obviously be resorted to without departing from the spirit and scope of the invention as hereafter defined by the appended claim.

I claim:

An impermeable slit-type door for protective shelters comprising:

a door frame;

a top panel folded over on itself attached to the top and sides of said frame on three edges;

two side panels meeting at the center of said frame to form central edges and attached to the sides, bottom of said frame and the fourth edge of said top panel;

sealing means mounted on said central edges;

tension means mounted on said frame to vertically tension said central edges comprising:

a mounting bracket attached to said frame;

a lever pivotally attached to said bracket at a point intermediate the ends thereof;

a pulley mounted on said bracket vertically above said central edges;

an extension spring attached to said frame and the end of said lever remote from said pivoted attachment;

a cable running from said central edges over said pulley to said remote end of said lever.

References Cited in the file of this patent

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2,321,491	Keys et al.	June 8, 1943
2,560,661	Poovey	July 17, 1951
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