Aug. 6, 1968 A. A. VAN BERGEN 3,395,488

VERTICALLY SWINGING DOOR

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Fig. 1

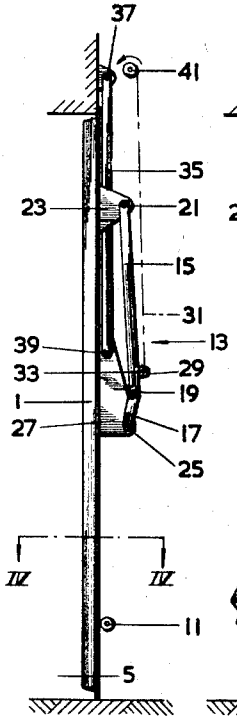

Fig. 2

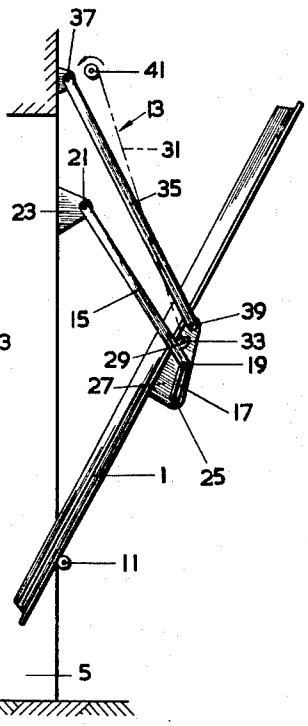

Fig. 4

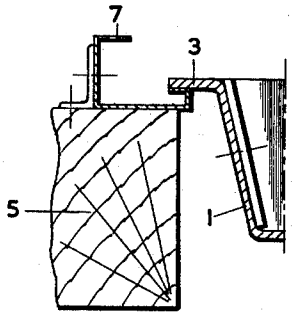

Fig. 3

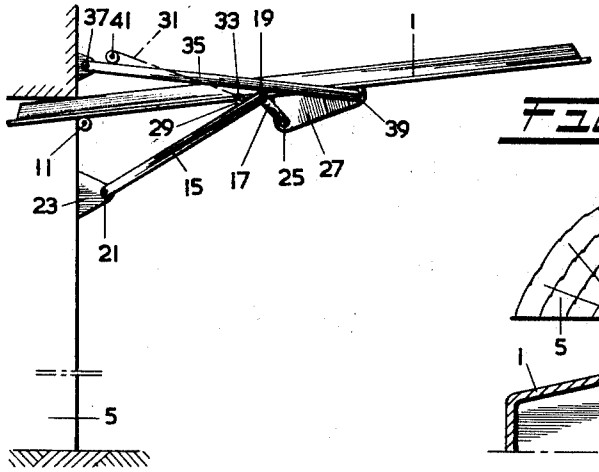

Fig. 5

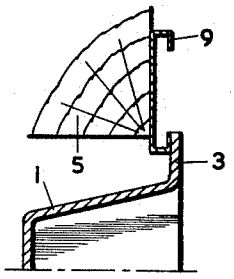

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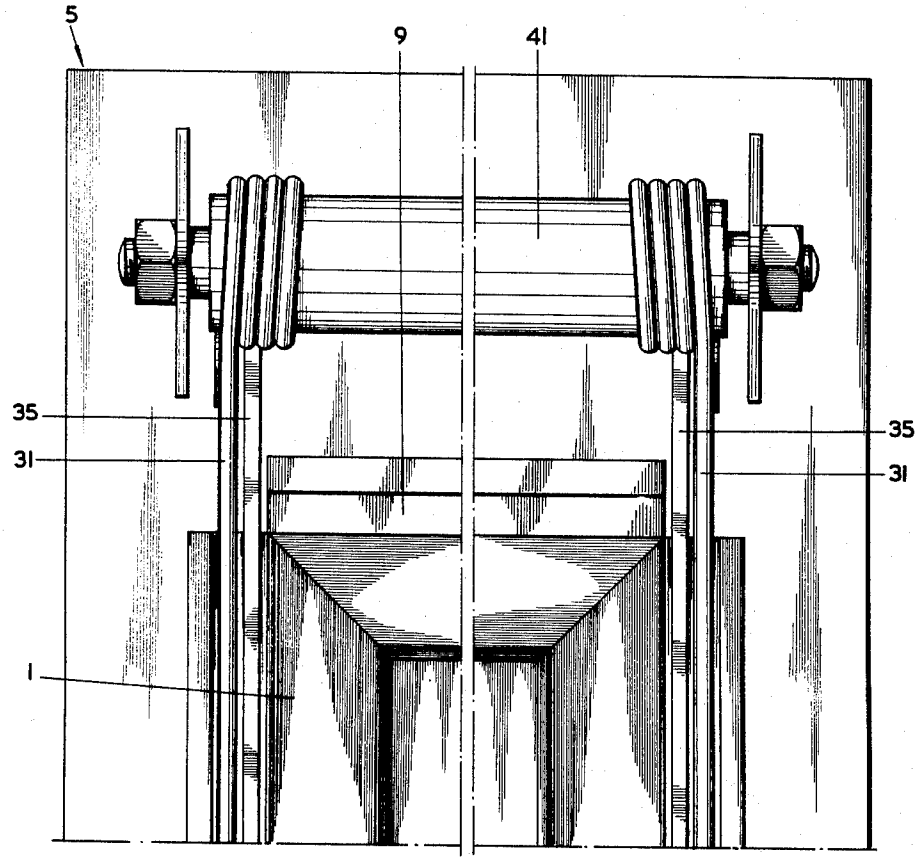
Fig. 6



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VERTICALLY SWINGING DOOR

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1 Claim. (Cl. 49—204)

ABSTRACT OF THE DISCLOSURE

A vertically swinging door comprises a doorframe, a panel, and link means on each side of the panel mounting the panel on the doorframe for vertical swinging movement relative to the frame. Each link means comprises a relatively long link and a relatively short link pivotally interconnected at a first point. The long link is pivotally connected to an upper portion of the doorframe at a second point. The short link is pivotally connected to the panel at a third point. The long and short links form an obtuse angle with each other that opens toward the panel in the closed-door position. Said first and third points are about the same distance from said second point in the fully open position of the door. Each link means includes a further link pivotally connected at a fourth point to the doorframe above said second point and at a fifth point to the panel above said third point in the closed-door position, said fourth and fifth points lying in a common plane which is disposed between the panel and said third point in the closed-door position. Torsion spring means common to both link means, and flexible pull members interconnecting the torsion spring means with the long links, continuously apply an upward force to the long links along lines of force that lie in a plane spaced from said second points on the side of said second points opposite the panel.

The present invention relates to vertically swinging doors, more particularly of the type in which linkage at each side of the door supports a panel for bodily upward and rotative movement of a type that can be generally designated vertically swinging.

It is an object of the present invention to provide vertically swinging doors in which the link means at either side of the door is out of the way when the door is open.

Another object of the present invention is the provision of vertically swinging doors having portions that run vertically on the adjacent doorframe, in which the runner portions exert very little horizontal thrust on the doorframe.

Still another object of the present invention is the provision of vertically swinging doors having link means that are free from forces which would cause any portion of the link means to deflect sideways.

Finally, the invention contemplates the provision of vertically swinging doors which will be relatively simple and inexpensive to manufacture, easy to install, operate, maintain and repair, and rugged and durable in use.

Other objects and advantages of the present invention will become apparent from a consideration of the following description, taken in connection with the accompanying drawing, in which:

FIG. 1 is a side elevational view of a door according to the present invention, in the closed position;

FIG. 2 is a view similar to FIG. 1 but showing the door partly open;

FIG. 3 is a view similar to FIGS. 1 and 2 but showing the door fully open;

FIG. 4 is an enlarged fragmentary cross-sectional view taken on the line 4—4 of FIG. 1; and

FIG. 5 is an enlarged fragment of the upper portion of FIG. 1; and

FIG. 6 is an enlarged fragmentary rear elevational view, showing the door in closed position.

Referring now to the drawings in greater detail, there is shown a door comprising a panel **1** which may be for example of a synthetic material such as polyester reinforced with glass fibers or any other lightweight material. Panel **1** has an outwardly extending marginal flange **3** on its inner side. Panel **1** is set in a doorframe **5** which on its outer side is provided with a pair of upright stiles **7** interconnected at their upper ends by a horizontal lintel **9**. In the closed position of the door, flange **3** contacts stiles **7** and the lintel **9** as shown in FIGS. 4 and 5. Panel **1** also carries a runner **11** at each side thereof, which rides in the associated stile **7**.

Means mounting panel **1** for vertical swinging movement on and relative to frame **5** are provided, comprising link means indicated generally at **13**, one of which is provided for each side of panel **1**. The two link means **13** are identical to each other. Each link means comprises a relatively long link **15** and a relatively short link **17**. Links **15** and **17** are pivotally interconnected at a first point **19**. Link **15** is pivotally connected to doorframe **5** at a second point **21** on a bracket **23** that projects inwardly from doorframe **5** at the level of an upper portion of panel **1**. Link **17** is pivotally connected to panel **1** at a third point **25** on a bracket **27** carried on the inner side of panel **1**.

Link **15** is provided with a leg **29** that extends inwardly from link **15** adjacent point **19** when link **15** extends downwardly as in FIG. 1. A pull cable **31** is secured to leg **29** at point **33** and continuously pulls on link **15** along a line of force. As cables **31** are duplicated on each side of the door, those lines of force are disposed in a common plane, and point **21** is disposed between the door and that plane in the closed position of the door and is spaced a substantial distance from that plane in all positions of the door. Cable **31** forms an acute angle with link **15** in all positions of panel **1**.

Link means **13** also includes a further link **35**, which is pivotally interconnected at a fourth point **37** to doorframe **5** a substantial distance above point **21**. Link **35** at its other end is pivotally interconnected with panel **1** at a fifth point **39** on bracket **27**, fifth point **39** being a substantial distance above point **25** and a substantial distance outward of point **25**, in the closed door position of FIG. 1.

It should also be noted that in the fully closed door position of FIG. 1, the links **15** and **17** form an obtuse angle that opens toward the door. That is to say that the plane in which points **19** and **21** lie, and the plane in which points **19** and **25** lie, form an obtuse dihedral angle on their side toward the door.

It is also to be noted that, in the fully opened door position of FIG. 3, the points **19** and **25** are about equidistant from point **21**.

Means for insuring that cables **31** will continuously be in tension are provided, comprising a torsion spring **41** that is common to both cables **31** and that is carried by the doorframe. Of course, other spring means and/or tensioning means for cables **31** may be provided as desired, it being important only that the tension in cables **31** or the like be equal on both sides of the door in all door positions.

It should still further be noted that the point **25** is disposed a little below the center of gravity of the panel in the closed door position of FIG. 1.

As a result of these relationships, the forces imposed on the door by cable **31** and those imposed on the door by gravity and those imposed on the door by reaction

through links **15** and **17** and **35** acting on the door at points **25** and **39**, will be so balanced that the resultant horizontal thrust will be practically zero. This means that runner **11** will bear very lightly against doorframe **5** and will perform the function of guiding and steadying the door but will impose substantially no horizontal thrust on the doorframe.

It is also to be understood that panel **1** and link means **13** and stiles **7** and lintel **9** may be assembled as a prefabricated unit, with the brackets for supporting points **21** and **37** in place and with brackets for supporting spring **41** on lintel **9**, so that the panel and link means and torsion spring means may be assembled to a doorframe as a unit for ease of manufacture and shipping and installation.

From a consideration of the foregoing disclosure, therefore, it will be evident that all of the initially recited objects of the present invention have been achieved.

Although the present invention has been described and illustrated in connection with a preferred embodiment, it is to be understood that modifications and variations may be resorted to without departing from the spirit of the invention, as those skilled in this art will readily understand. Such modifications and variations are considered to be within the purview and scope of the present invention as defined by the appended claim.

What is claimed is:

1. A vertically swinging door comprising a doorframe, a panel, link means on each side of the panel mounting the panel on the doorframe for vertical swinging movement relative to the frame, each link means comprising a relatively long link and a relatively short link pivotally

interconnected at a first point, the long link being pivotally connected to an upper portion of the doorframe at a second point, the short link being pivotally connected to the panel at a third point, and means continuously applying an upward force to the long links along lines of force that lie in a plane spaced from said second points on the side of said second points opposite the panel, the long and short links forming an obtuse angle with each other that opens toward the panel in the closed-door position, said first and third points being about the same distance from said second point in the fully opened position of the door, each link means including a further link pivotally connected at a fourth point to the doorframe above said second point and at a fifth point to the panel above said third point in the closed-panel position, said fourth and fifth points lying in a common plane which is disposed between the panel and said third point in the closed-door position, said means applying an upward force comprising torsion spring means common to both link means, and flexible pull members interconnecting the torsion spring means with the long links.

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