April 11, 1967 W. H. KNIGHT 3,313,338

DOOR STRUCTURE

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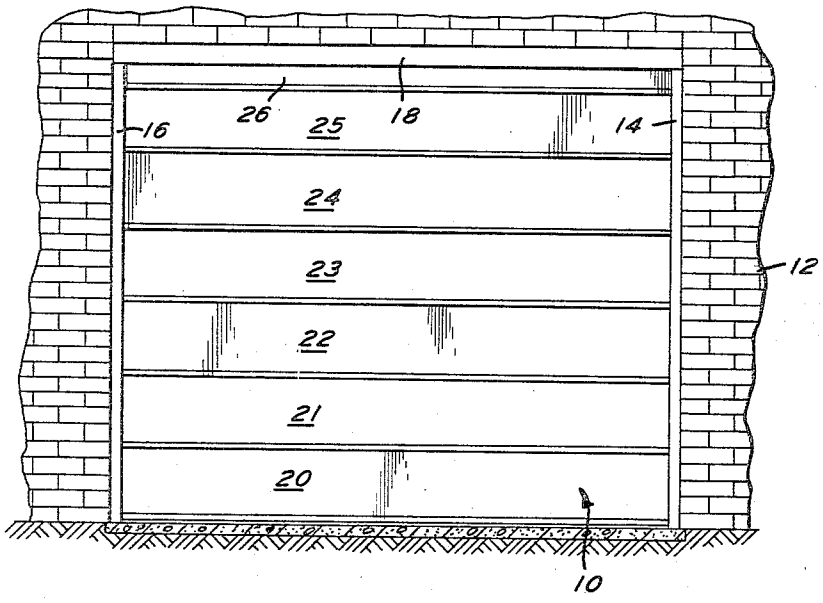


FIG. 1

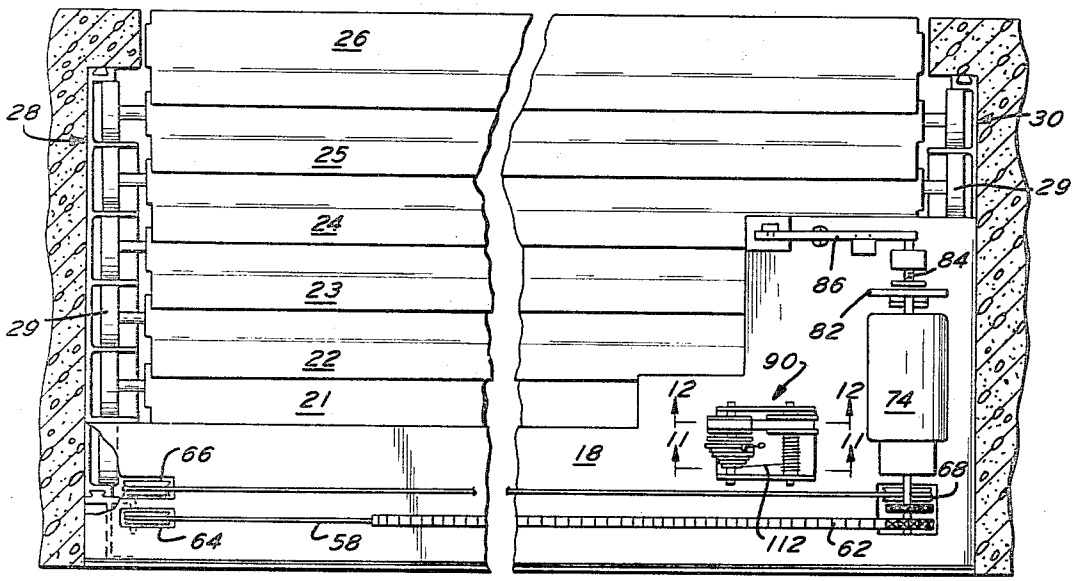


FIG. 4

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BY Seidel & Gonda

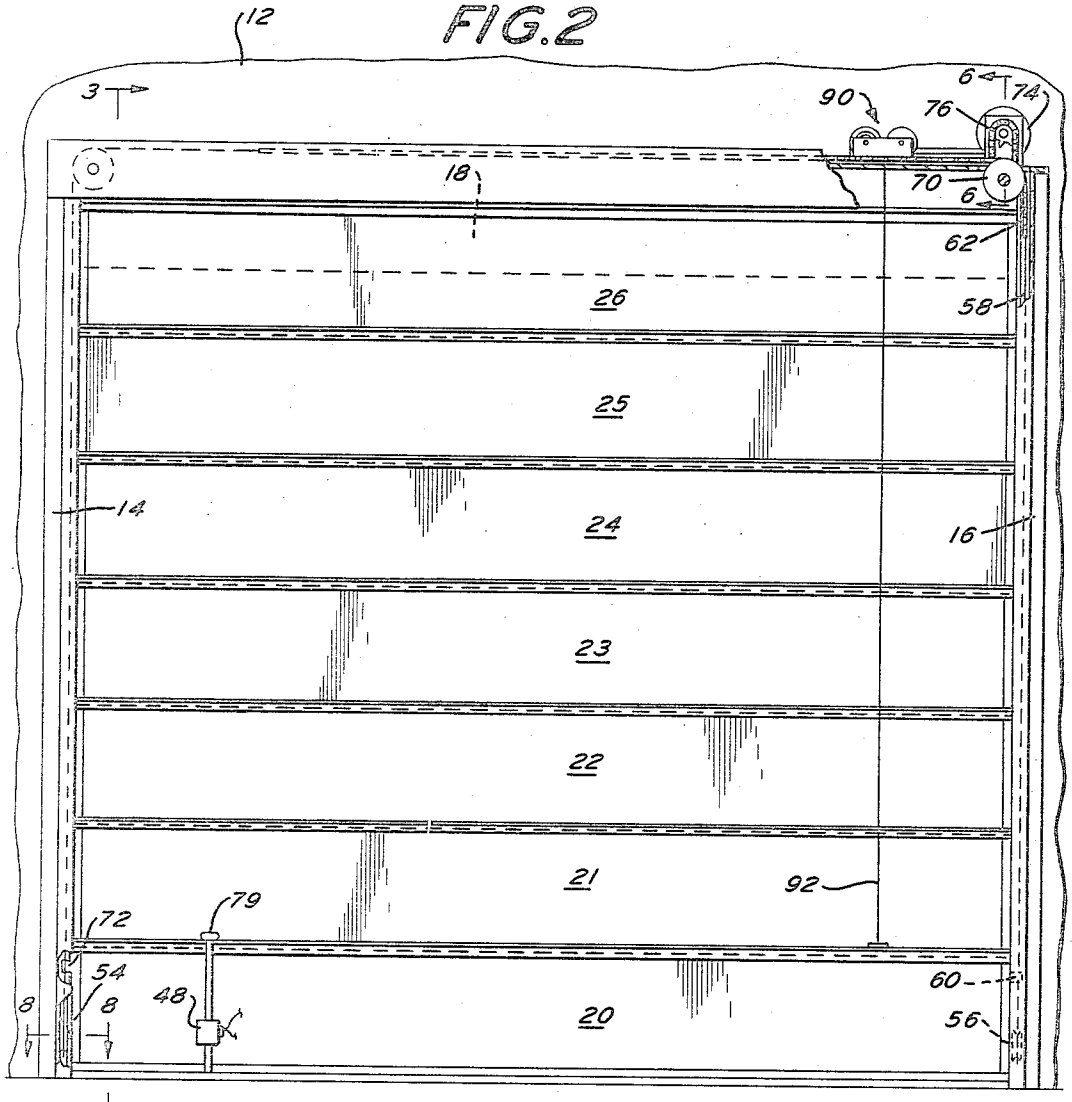
ATTORNEYS.

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DOOR STRUCTURE

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FIG. 2



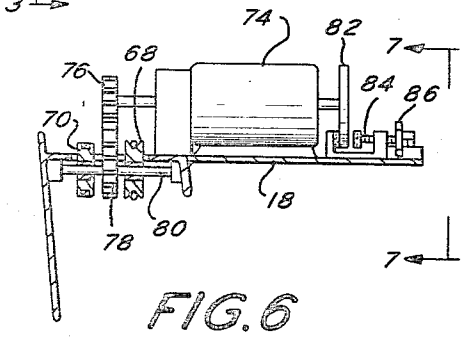
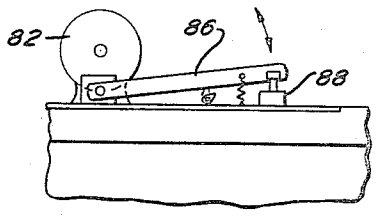


FIG. 6

FIG. 7



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DOOR STRUCTURE

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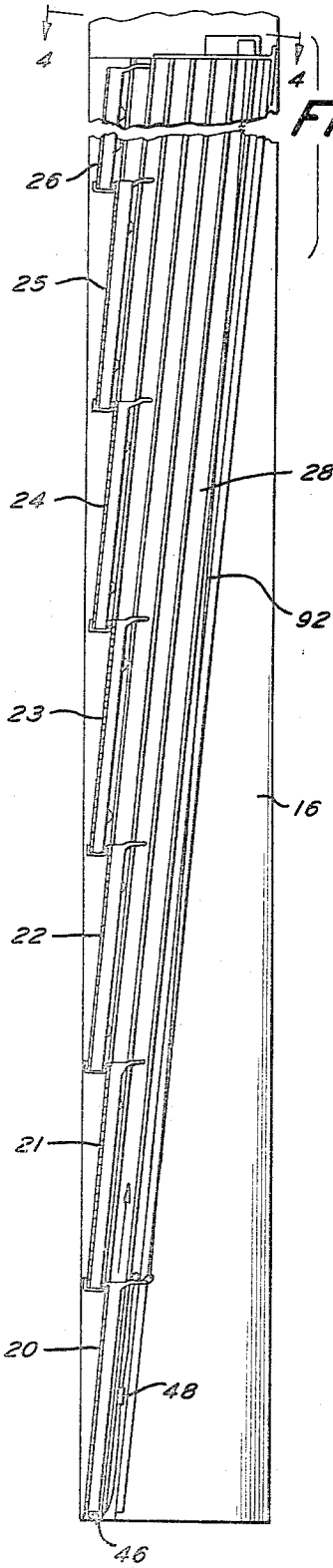


FIG. 3

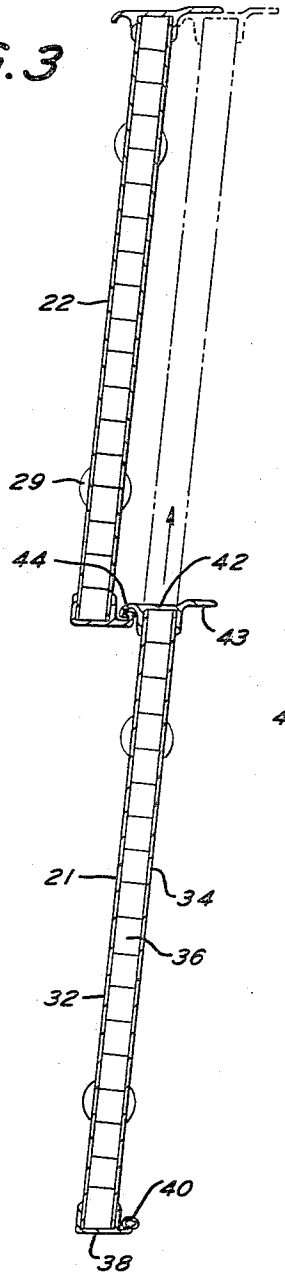


FIG. 5

FIG. 8

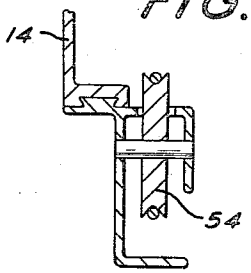


FIG. 9

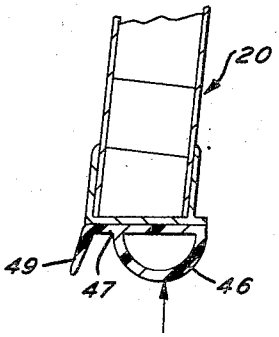
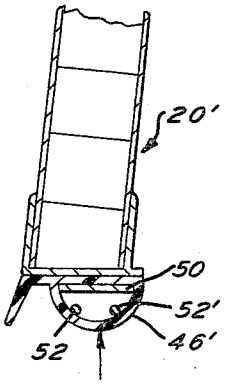


FIG. 10



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DOOR STRUCTURE

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FIG. 11

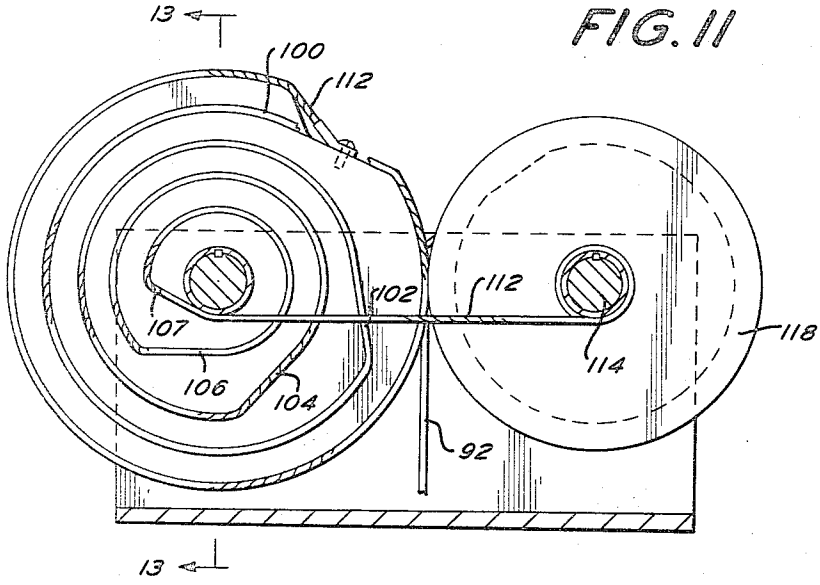
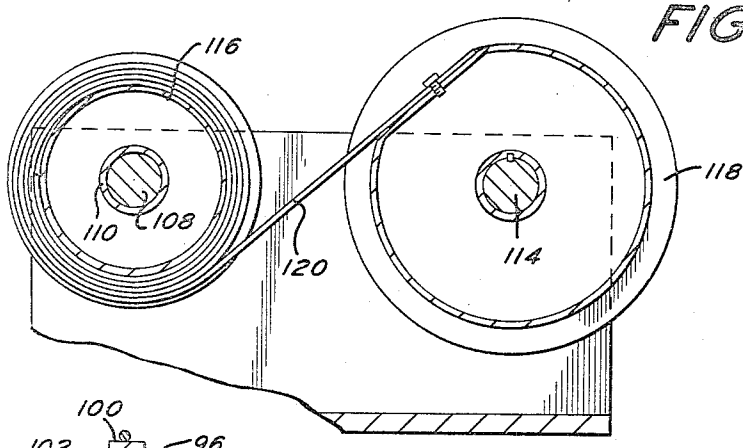


FIG. 12



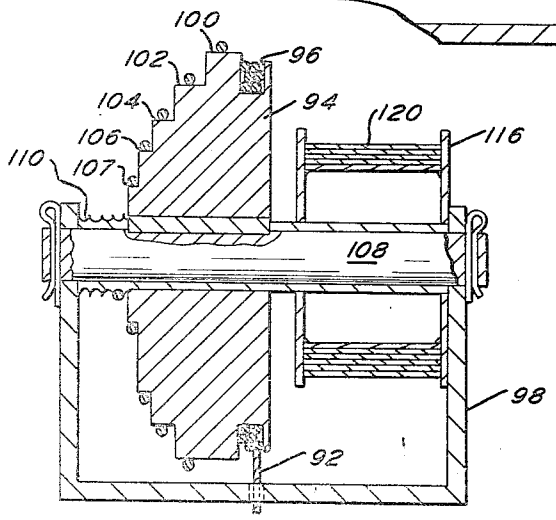


FIG. 13

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United States Patent Office 3,313,338 Patented Apr. 11, 1967

3,313,338

DOOR STRUCTURE

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Filed Oct. 7, 1964, Ser. No. 402,211
2 Claims. (Cl. 160—189)

This invention relates to door structure, and more particularly, to door structure having a plurality of panels guided by end frame members and adapted for successive movement in a substantially upright direction.

A vertical sliding sectional door has been proposed heretofore. For example, see Patent 2,574,760. For a variety of reasons, vertical sliding sectional doors having a plurality of individual panel have not been commercially adopted on a wide scale. It is a principal object of the present invention to provide door structure which overcomes the disadvantages and/or undesirable features of the doors proposed heretofore.

The door structure in accordance with the present invention includes the provision of a resilient seal between adjacent panels to render the same airtight, provide for quietness of operation, absorb the shock as one panel engages the next adjacent panel, and prevent rattling of the panels by wind or the like. The panels are preferably hollow with honeycomb insulation thereby rendering the panels light in weight, while at the same time reducing loss of heat.

The lowermost panel is coupled to a motor means only at its ends. Heretofore, it has been proposed to couple a motor means to the lowermost panel at two points intermediate the ends of the lowermost panel. When the lowermost panel contacted an obstruction, the motor means generally in the nature of a cable or chain enabled the lowermost panel to tilt and thereby jam in the end frame members. Such jamming is not possible due to the manner in which the lowermost panel of the present invention is coupled to a motor means. Further, the lowermost panel of the present invention is provided with a weather stripping seal and hollow resilient means adapted to immediately stop the motor means when the lowermost panel contact an obstruction. The motor means is preferably of the reversing type so that the next time the motor means is actuated, it will move in an opposite direction.

The door structure of the present invention also includes a counter-balance for the panels which is in the nature of a constant torque spring motor means. The last-mentioned means applies a constant biasing force on the panels to overcome the force of gravity on the panels thereby enabling a light motor to be utilized for raising and lowering the panels.

It is an object of the present invention to provide novel door structure.

It is another object of the present invention to provide a novel panel door structurally interrelated in a manner so as to provide for efficient operation while being safer than those proposed heretofore.

It is another object of the present invention to provide door structure which is quiet, lightweight, and sufficiently insulated so as to be utilized in conjunction with heated buildings and the like.

Other objects will appear hereinafter.

For the purpose of illustrating the invention, there are shown in the drawings forms which are presently preferred; it being understood, however, that this invention is not limited to the precise arrangements and instrumentalities shown.

FIGURE 1 is a front elevation view of a building having the door structure of the present invention.

FIGURE 2 is a rear elevation view of the door structure in FIGURE 1.

FIGURE 3 is a view taken along the line 3—3 in FIGURE 2.

FIGURE 4 is a view taken along the line 4—4 in FIGURE 3.

FIGURE 5 is a sectional view through two engaging panels.

FIGURE 6 is a view taken along the line 6—6 in FIGURE 2.

FIGURE 7 is a view taken along the line 7—7 in FIGURE 6.

FIGURE 8 is a view taken along the line 8—8 in FIGURE 2.

FIGURE 9 is an enlarged detail view of the lowermost edge of the lowermost panel in FIGURES 1–3.

FIGURE 10 is a view similar to FIGURE 9 but illustrating another embodiment of the same.

FIGURE 11 is a view taken along the line 11—11 in FIGURE 4.

FIGURE 12 is a view taken along the line 12—12 in FIGURE 4.

FIGURE 13 is a view taken along the line 13—13 in FIGURE 11.

Referring to the drawing in detail, wherein like numerals indicate like elements, there is shown in FIGURE 1 door structure designated generally as **10** mounted within an opening in a wall of a building **12**.

Door structure **10** includes side frame members **14** and **16** interconnected across their upper ends by top frame member **18**. The side frame members **14** and **16** reciprocally support a plurality of spaced parallel panels **20**, **21**, **22**, **23**, **24**, and **25**. The uppermost panel **26** is stationary.

The side frame members **14** and **16** are identical. Hence, only side frame member **16** will be discussed in detail. As shown more clearly in FIGURE 3, side frame member **16** is provided with a track **28**. A track **30** is provided on the side frame member **14**. The tracks **28** and **30** comprise a plurality of channels of increasing length. Each of the panels **20–25** are disposed in one of one of the channels and guided thereby for reciprocatory parallel movement. Each of the panels terminates in rollers **29**, disposed within one of the channels for guiding movement of the panels during reciprocatory movement thereof.

Each of the panels **20–25** are identical in cross section. Hence, only panel **21** will be described in detail. Panel **21** includes an outer skin member **32** and an inner skin member **34**. Members **32** and **34** may be of a non-corrosive lightweight material such as sheet aluminum. Members **32** and **34** are adhesively bonded to a honeycomb cellular structure **36** which may be paper-like material, foam polymeric resins, etc.

The panel **21** is provided at its lower edge with a bottom end member **38** embracing the skin members **32** and **34**. Member **38** is provided with an upwardly directed projection to which is snapped on a shock absorbing member in the nature of a resilient strip **40**. A top end member **42** embraces the skin members **32** and **34** and has a recessed portion **44** adapted to cooperate with the resilient strip on the bottom end member of panel **22**. Top end member **42** also includes a projection **43** which will cooperate with the top end member on panel **20** to facilitate simultaneous movement of panels **20** and **21** as is well-known to those skilled in the art to which the present invention pertains. The seal effected by resilient strip **40** and portion **44** on two adjacent panels provides for quietness of operation, absorbing shock, reduces leakage of air between the panels thereby reducing loss of heat

and rendering the door structure 10 more weatherproof, etc.

As shown in FIGURE 9, the bottom end member on the panel 20 does not have an upwardly projecting portion to which a resilient strip 40 may be secured. Instead, a hollow resilient strip 46 is secured to the lowermost surface of the bottom end member on panel 20. Strip 46 may be adhesively secured in place. Alternatively, fastener attachment means such as screws or the like may extend through the web 47 into the bottom end member on the panel 20. Web 47 is disposed between the hollow portion of strip 46 and the weather seal 49.

The hollow strip 46 is adapted to contact the floor or other mating structure on the floor in the doorway. When hollow strip 46 is compressed, the air therewithin actuates a switch 48 on the lowermost panel 20. Switch 48 is adapted to immediately stop a motor as will be made clear hereinafter.

In FIGURE 10, there is illustrated an alternative resilient strip means on the lowermost surface of a panel 20' which corresponds to the lowermost panel 20. Thus, panel 20' may be provided with a hollow resilient strip 46' having a contact plate 50 therewithin and electrical conductors 52 and 52' spaced therefrom. When resilient strip 46 is compressed by contact with any obstruction or the floor in the doorway, conductors 52 and 52' will contact plate 50 and actuate a switch on panel 20' corresponding to the switch 48.

An actuator means is provided for successively raising and lowering the panels 20–25 in a manner which obviates the occurrence of cocking or tilting of the panels when the lowermost panel contacts an obstruction. Thus, actuator means includes a pulley 54 supported at the lowermost end of the side frame member 14 and a pulley 56 supported at the lowermost end of the side frame member 16. Pulleys 54 and 56 rotate about an axis parallel to the skin members 32 and 34. An endless flexible member is provided for raising and lowering the panels successively. The endless member includes a cable 58 and a chain 62. One end of cable 58 is coupled to one end of chain 62. From said one end, cable 58 is connected to a lug 60 on panel 20, extends around pulley 56, extends upwardly around pulley 68, across the top frame member 18 around pulley 66, down to lug 72 to which it is connected on panel 20, around pulley 54, back up around pulley 64 and then connected to the other end of chain 62.

The chain 62 is coupled to a sprocket 70 on shaft 80. Shaft 80 is selectively rotated by a reversible motor 74. The output shaft on motor 74 is coupled to a sprocket 76 which in turn is coupled to a sprocket 78 on shaft 80.

Motor 74 is a double-ended motor having a second output shaft coupled to a brake disk 82. Disk 82 is adapted to be selectively braked by a threaded member 84 threadedly supported by a bracket. The end of member 84 remote from disk 82 is fixedly secured to an elongated lever arm 86. Lever arm 86 is spring-biased to the position illustrated in FIGURE 7 and adapted to be actuated in a clockwise direction in FIGURE 7 by solenoid 88 to cause the free end of member 84 to contact disk 82 thereby stopping the motor 74. The switch 48 on the lowermost panel 20 is coupled by a conductor to the solenoid 88 and a suitable source of electricity such as a battery or the like. Thus, when the lowermost panel 20 contacts an obstruction or the floor in the doorway, motor 74 will be immediately braked thereby stopping the descent of the panels. Panel 20 is also provided with a bulb of resilient material 79 on its uppermost surface which is adapted to contact a mating surface on the top frame member 18 when the lowermost panel 20 is in its uppermost position. Compression of resilient material 79 compresses the air therewithin thereby actuating switch 48 to likewise effect a stoppage of motor 74 in the same manner described above. The brake disk 82 serves as a lock. Thus, brake disk 82 prevents the motor 74 from rotating sprocket 78 and therefore prevents cable 58 from being moved. As a result the door may be locked in any position.

In order to efficiently utilize the actuating means described above, and to utilize small light motors and other components, the panels are provided with a counterbalance in the nature of a constant torque spring motor means to off-set the effect of gravity while taking into consideration that the potential energy of the panels will vary as the height of the panels changes. Such means is designated generally as 90 and illustrated in FIGURE 4 and shown more clearly in FIGURES 11–13. A cable 92 has one end secured to the lowermost panel 20. The upper end of the cable 92 is secured to a drum 94 having a channel 96. The portion of cable 92 wound around drum 94 is disposed within channel 96. Drum 94 is rotatably supported by a housing 98 secured to the top frame member 18.

The drum 94 is provided with a plurality of cam steps 100, 102, 104, 106 and 107. The drum 94 is rotatably supported from the housing 98 by shaft 108. A sleeve 110 surrounds shaft 108 and is provided with recesses on its outer periphery adjacent cam step 107 to facilitate winding and unwinding of cable 112 onto step 107 by maintaining the cable close to the drum. One end of cable 112 is anchored to the drum 94. The other end of the cable 112 is wound around and secured to a shaft 114.

Shaft 114 is rotatably supported at its ends by housing 98 and disposed parallel to the shaft 108. A pulley 116 is supported by and rotatable on sleeve 110. A pulley 118 is supported by and rotatable with shaft 114. One end of a constant force spring band 120 of suitable length is wound onto pulley 116 in its free or natural state but is not secured to it. The opposite end of spring 120 is bent backward, against its natural bias, wound on and secured to a larger pulley 118 in its stressed condition. Shaft 114 is connected directly to pulley 118 and rotates with it. Spring 120 tries to return to its natural bias on pulley 116 which results in a constant counterclockwise twisting force on pulley 118. Hence shaft 114 is subject to the same twisting force as pulley 118 creating a constant pull on cable 112. Pulley 116 is on the shaft 108 as is drum 94 but operates independently from it.

The cam steps on the drum 94 are correlated with respect to the positions of the panels so that the biasing force on the panels is increased as they move upwardly due to the transfer of the cable 112 from a smaller cam step to a larger cam step. As the bottom panel is raised cable 92 is wound around the drum 94 in channel 96 during upward movement of the panels, cable 112 is unwound from around the successively disposed increasingly larger cam steps and wound onto shaft 114. A variety of known constant torque devices may be provided. For example, constant torque devices as illustrated in one or more U.S. Patents including 2,609,191, 2,609,192, 2,609,193, etc. may be utilized. Since it is believed that such constant torque devices are well-known to those in the spring art and commercially available from the Hunter Spring Co. of Lansdale, Pa., a more detailed explanation is not deemed necessary.

Thus, it will be seen that I have provided a novel door structure which is airtight, free from rattles, lightweight, insulated, easy to raise and lower, and provided with safety features so that the door will immediately stop when hitting an obstruction without becoming cocked or jammed in the door frames. By providing a constant torque spring motor means for counter-balancing the weight of the panels, a small, light and inexpensive motor may be utilized to raise and lower the door panels successively beginning with the lowermost panel. Since the strips 46 and 46' effect the stopping of the movement of the panels, the hollow strips are sealed at their ends. It is believed that it will be obvious to those skilled in the art that other means may be provided for arresting the upward movement of the panels in place of the means illustrated. In view of the provision for a counter-

balance on the panels and a continuous cable means for driving the panels, the panels are controlled and driven in both directions.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof and, accordingly, reference should be made to the appended claims, rather than to the foregoing specification as indicating the scope of the invention.

It is claimed:

1. A door structure comprising a plurality of laterally disposed panels in substantially parallel planes, side frame members having a plurality of spaced channels of progressively increasing length, each panel being disposed in a separate one of said channels, whereby each panel is displaceable along its respective channel by an amount determined by the length of the channel, engagement means on each panel for engaging the next adjacent panel when a displaced panel has been moved to a position substantially equidistant with said adjacent panels from a fixed end panel, means for reciprocably displacing the panels successively beginning with the end panel opposite said fixed panel, said displacing means including an endless flexible member having one portion coupled to one side of said opposite end panel and a second portion coupled to the other side of said opposite end panel, motor means for driving said endless member, said motor means being mechanically coupled to said endless member to drive it, brake means for arresting the displacement of said panels at any position, said brake means including a hollow flexible member extending along the end of said end panel, switch means responsive to the distortion of said flexible member for closing an electric circuit, said switch being connected in circuit relation with a solenoid having a mechanical actuator, said mechanical actuator being connected to a pivotally mounted lever, said lever being connected for rotating a threaded member threadably supported by a bracket, a brake disc connected to and rotatable with said motor means, said threaded member being mounted with one of its ends adjacent said disc, whereby rotation of said threaded member by said lever causes said one end to be longitudinally displaced to frictionally engage said disc.

2. A door structure in accordance with claim 1 including a counterbalance for opposing the successively

increasing weight of the panels as they are displaced, said counterbalance including a first cable secured to said opposite end panel, said first cable being secured to and wound about a rotatably supported drum, a plurality of cam steps of successively increasing diameter formed on said drum, a second cable fixed to said drum and wound continuously about said cam steps from the step of largest diameter to the step of least diameter, said second cable extending from said drum to a rotatably mounted cable pulley, said second cable being fixed to and wound about said cable pulley, a first rotatably mounted spring pulley, a constant force spiral spring wound about said first spring pulley in its natural state, the outer end of said spring being connected to a second spring pulley rotatable with said cable pulley for being wound thereon against its natural bias, said first and second cable being wound so that the bias of said spring on said cable pulley tends to wind said second cable off said cam steps and onto said second cable and to wind said first cable onto said drum, thereby applying counterbalancing force of increasing value to said opposite end panel.

References Cited by the Examiner

UNITED STATES PATENTS

13,251	7/1855	Bixler	160—170
301,429	7/1884	Boeckelmann	160—193
952,966	3/1910	Volk et al.	160—188
1,771,554	7/1930	Bollheimer	160—132
2,574,760	11/1951	Rohrman	268—59
2,758,836	8/1956	Purdy	268—59
2,882,044	4/1959	Ginte	268—59
2,893,076	7/1959	Herts	20—35 X
2,924,861	2/1960	Viets	20—35
3,086,584	4/1963	Houmere	160—176 X
3,096,815	7/1963	May	160—188
3,190,345	6/1965	Rothwell	160—132

FOREIGN PATENTS

1,072,943	1/1960	Germany.

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