Feb. 4, 1969 E. M. PETTERBORG 3,425,160

SLIDING DOORS ON SINGLE TRACK

Filed Nov. 14, 1967 Sheet 1 of 3

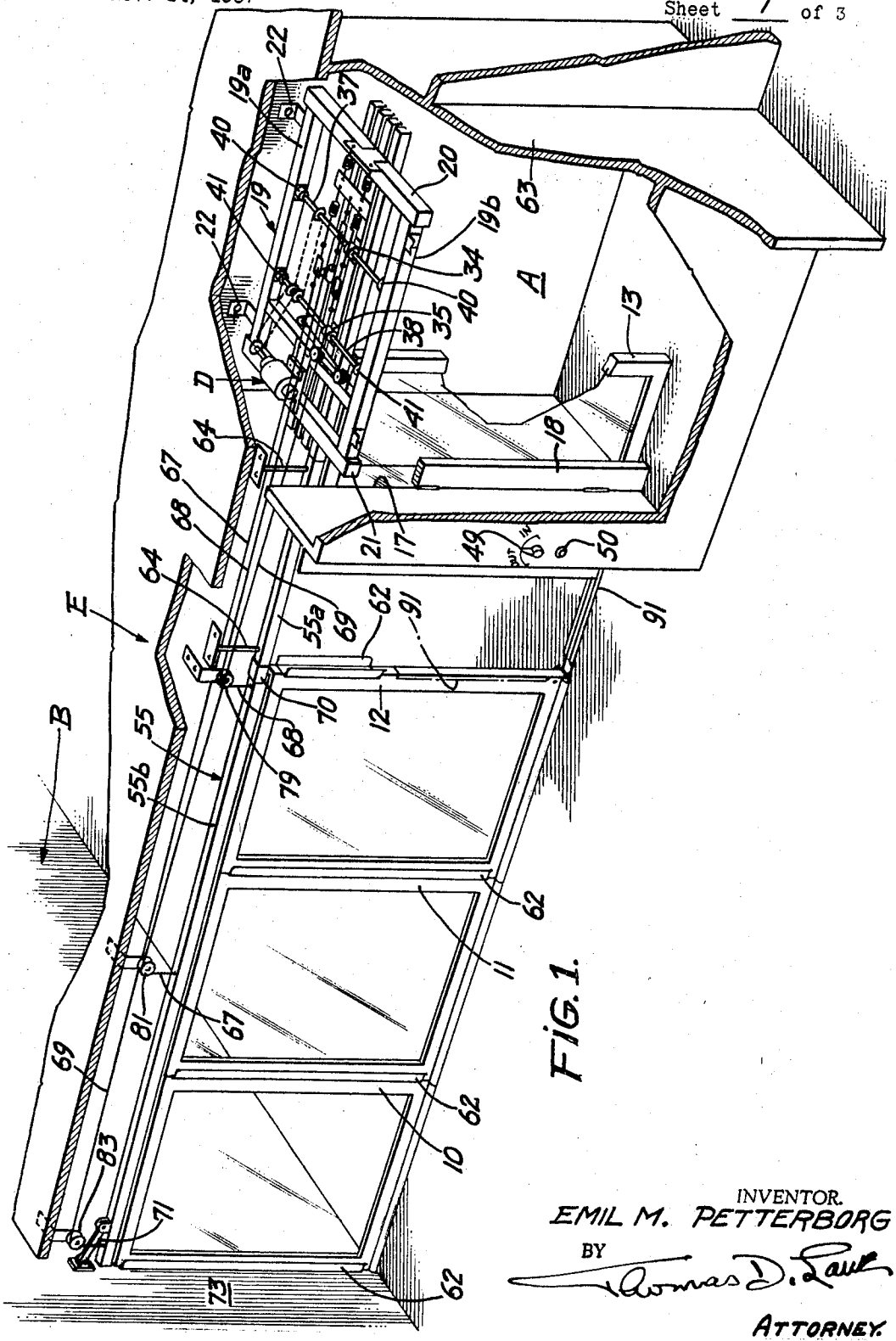



FIG. 1.

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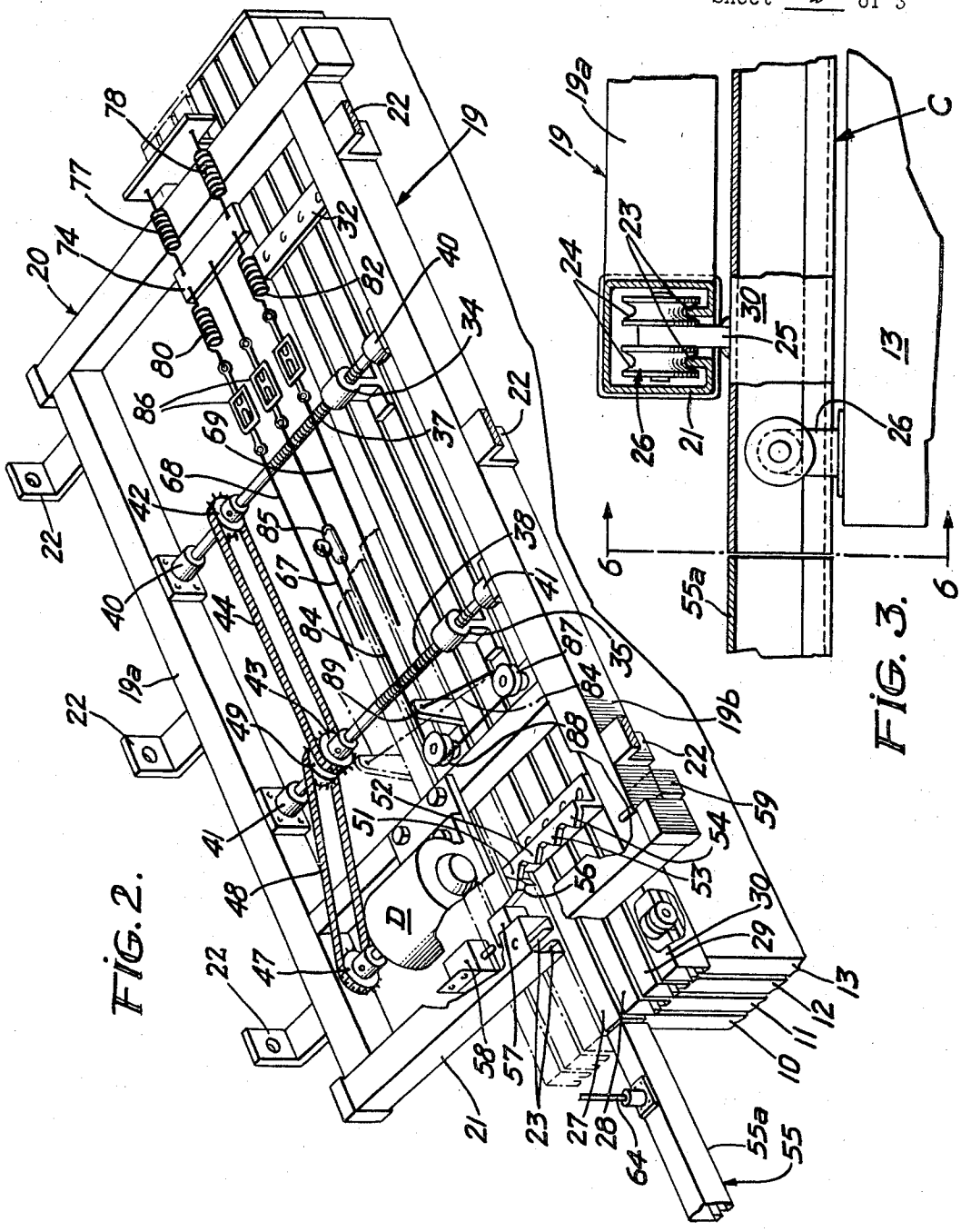


FIG. 2.



FIG. 3.

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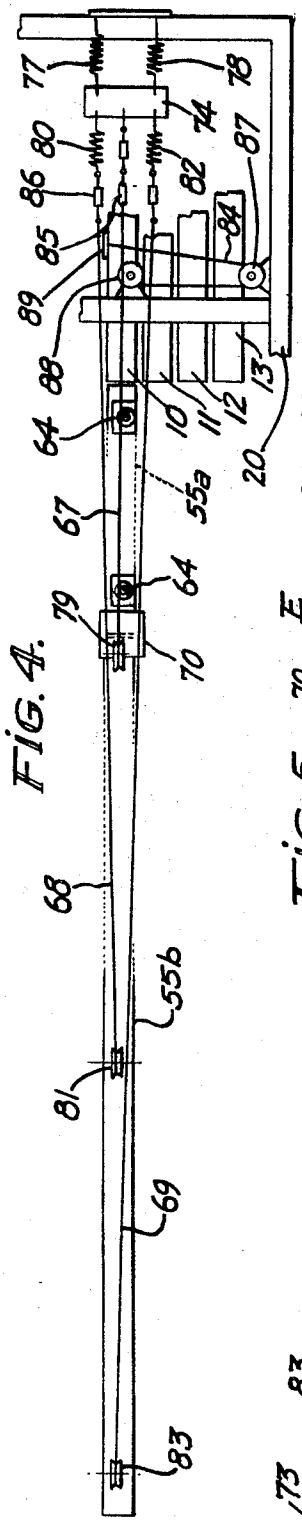


FIG. 4.

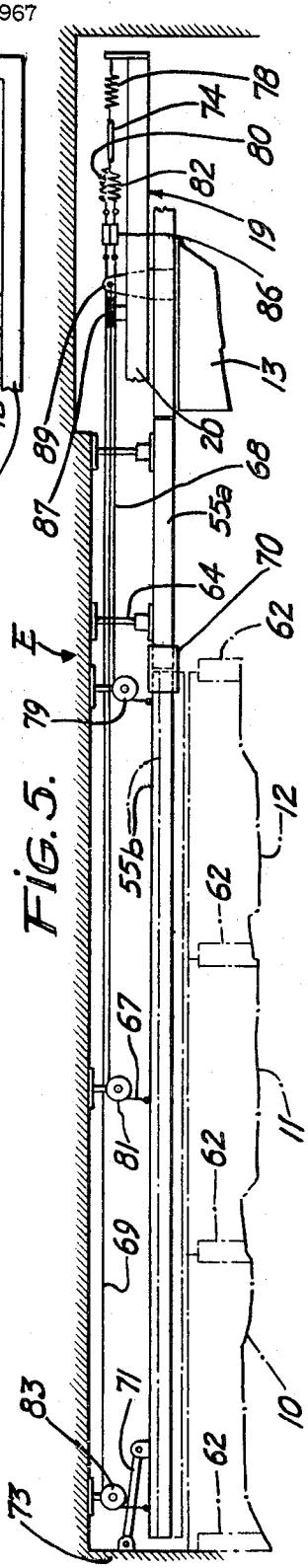


FIG. 5.

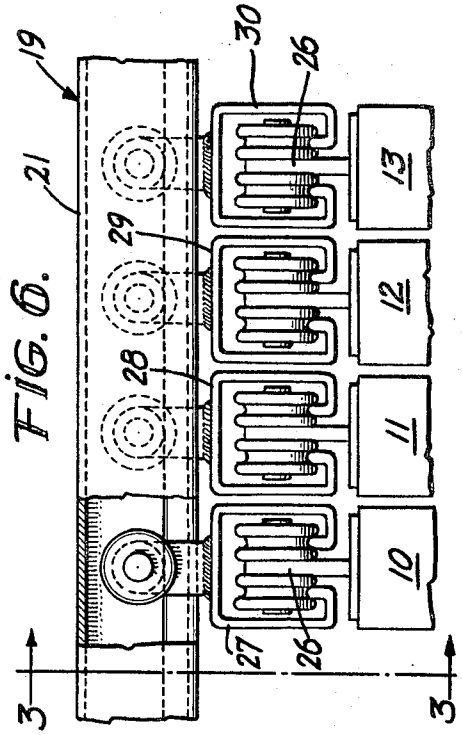


FIG. 6.

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# SLIDING DOORS ON SINGLE TRACK

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U.S. Cl. 49—127 5 Claims
Int. Cl. E05d 15/10; E06b 3/92

## ABSTRACT OF THE DISCLOSURE

A door panel supporting carriage has a plurality of parallel door panel tracks thereon, and a door panel is suspended by a pair of roller hangers from each carriage track. The carriage itself is roller-mounted on a pair of horizontal tracks which extend transversely of the carriage tracks across the top portion of a door-receiving compartment located at one side of a wide door opening which is to be closed off by the door panels. A single door-supporting track, hereinafter called the "room track," extends from the compartment across the top of the door opening, and the carriage is movable along its supporting tracks to align succesive ones of carriage door panel tracks with the room track, thereby to permit moving the door panels, one at a time, from their respective carriage tracks onto and along the room track and vice versa. The room track consists of two aligned portions, one portion of which is rigidly mounted, while the other is resiliently supported at selected points throughout its length so as to maintain door panels suspended therefrom clear of the bottom of the door opening while said door panels are being moved along the room track either toward or from the compartment. However, when the carriage is moved into position to align with the room track the carriage track which supports the last door panel to leave the compartment, the resilient support means for said other portion of the room track is rendered inoperative, thereby allowing the full weight of the door panels supported on this other portion of the room track to lower and to rest with their full weight on the floor. Indexing means preferably are provided for aligning successive ones of the carriage tracks with the room track.

*Prior art*

In the past, numerous sliding door structures have been developed whereby a plurality of door panels can be extended to provide a closure across a wide doorway, or for use as a room divider. Most of such prior structures however have involved somewhat intricate mechanism, have been difficult and expensive to install, have required a bottom track, or have not been entirely satisfactory with respect to their operating, storing and sealing mechanism.

*Objects of the invention*

An object of the present invention is to provide an improved, multi-panel, sliding door structure, wherein, when selected ones of the door panels are in transit along a room track mounted to extend across the top of a door opening they are supported clear of the floor, and when a door panel supporting carriage is in position to supply the last door panel to the room track so as to close the opening, the preceding door panels will be lowered so as to rest with their full weight on the floor.

A further object of the invention is to provide an improved, multi-panel door structure having a door supporting carriage mounted at one end of a single, spring-supported, overhead room track which extends across the top of a room opening, the carriage being movable transversely of the room track to bring successive ones of a plurality of door panels supported on the carriage into registering alignment with the room track, so that the door



panels can be moved successively from their respective carriage tracks onto and along the overhead track and into edge-to-edge abutting relationship to close off the opening, and in the latter position are lowered to rest with their full weight on the floor.

The foregoing objects and advantages of the invention will be apparent from the folowing description and the accompanying drawings wherein:

FIG. 1 is a fragmentary, perspective view showing a portion of a building with three of the four overhead suspended door panels in position across the door opening, portions being broken away.

FIG. 2 is an enlarged, perspective view of the carriage and its supporting frame, together with the upper portions of the four door panels, portions being broken away, the the dot-dash lines showing an alternate position of the carriage.

FIG. 3 is a further enlarged, fragmentary, sectional view taken along line 3—3 of FIG. 6.

FIG. 4 is a somewhat diagrammatic, top plan view of the door panel support carriage in its door-retracted position and the room track with its spring-suspension mechanism.

FIG. 5 is a side elevational view of FIG. 4.

FIG. 6 is a sectional view taken along line 6—6 of FIG. 3, a portion of a side flange of one of the carriage tracks being broken away.

Referring to the drawings in detail, a door storage compartment A (FIG. 1) is constructed at one side of a wide opening B which is to be closed off by a pluarlity of aligned door panels **10**, **11**, **12** and **13**. Since the required structural details of the compartment A will be apparent to any ordinarily skilled architect, draftsman or builder desiring to employ the invention, and since they are not a feature of the invention such details are not set forth herein.

An access door **14** (FIG. 1) to the compartment A is hingedly mounted at one side of an access opening **15**, and is of a width slightly less than that of the opening **15** so as to leave a gap **17**, when the door **14** is closed, of sufficient width to permit the door panels to pass in and out therethrough, one at a time. A flap **18** of sufficient width to close this gap **17** is hingedly mounted on the free end of the access door **14** to swing inwardly into the compartment.

A door carriage support frame **19**, having a pair of parallel, transverse carriage support tracks **20** and **21** thereon, is mounted, as by wall brackets **22**, in the upper portion of the compartment A with the carriage support tracks **20** and **21** horizontal. The carriage support tracks **20** and **21**, as well as the other tracks employed in the illustrative embodiment of the invention, are of conventional, downwardly open, channel-track structural steel. The cross-sectional shape of the illustrative track channel stock is best shown in FIGS. 2, 3 and 6, and comprises a rectangular channel portion with a pair of reversely bent, inturned, roller support flanges **23**, one of which is formed on the free edge of each channel side flange, to support a pair of grooved rollers **24** mounted one on each side of the hanger strap **25** of a hanger **26**.

A door panel support carriage C comprises four panel support tracks **27**, **28**, **29** and **30** for supporting, respectively, the four door panels **10**, **11**, **12** and **13**. The carriage tracks are rigidly interconnected in parallel relation by a cross bar **32** and the base of a four-lobe indexing cam **33**, and are spaced apart sufficiently to provide side-by-side clearance for the door panels suspended therefrom by the roller hangers **26**.

For propelling the track carriage C transversely back and forth along its support tracks **20** and **21** within the compartment A, a pair of similar, threaded standards **34** and **35** are secured to the carriage C, and a pair of similar carriage drive screws **37** and **38** are mounted in bearings

40 and 41, respectively, one pair for each drive screw on the side frame members 19*a* and 19*b* of the carriage support frame 19. The carriage drive screws 37 and 38 are parallel to each other and to the carriage frame tracks 20 and 21 and are threadedly inserted in the threaded standards 34 and 35, respectively.

Similar chain sprockets 42 and 43 are secured on the carriage drive screws 37 and 38, respectively, and a chain 44 is passed around these sprockets to insure synchronous rotation of the two drive screws. A reversible electric motor D, provided with suitable, conventional speed control or gear reduction mechanism as required, has a sprocket 47 thereon, and a drive chain 48 is passed around this sprocket 47 and also around a second sprocket 49 on the drive screw 37. A reversing switch 49 (FIG. 1) controls the direction of motor rotation, and a push button 50 actuates the motor by means of a simple electrical circuit.

Indexing means, best shown in FIG. 2, comprises the cam 33, having four pointed lobes 51, 52, 53 and 54 thereon. The cam 33 is mounted on the carriage C parallel to the carriage support tracks 20 and 21, and the four cam lobes thereof are spaced apart by the center-to-center spacing of the four carriage tracks 27, 28, 29 and 30. A micro-switch 57, having a cam 56 on the free end of its switch arm, is mounted on the transverse carriage track 21 in position to be actuated successively by each of the cam lobes 51, 52, 53 and 54 as the respective carriage tracks 27, 28, 29 and 30 are aligned successively with a room track 55 which extends across the top of the opening B to be closed off by the door panels 10–13. End limit switches 58 and 59 are also mounted on the carriage support track 21, and are positioned to be actuated, by engagement with the carriage C to stop the motor D in the event the carriage should overrun its intended limit in either direction.

The four-point cam 33 actuates the micro-switch 57 each time a door panel track on the carriage C is aligned with the room track 55. Actuation of this micro-switch 57 may be employed if desired to merely actuate a signal indicating alignment of the tracks. However, a simple, locking-type electrical circuit (not shown) may readily be provided, if desired, which will cause the motor D to run upon actuation of the push button 50 (FIG. 1) until the switch arm cam 56 is free of the cam point upon which it may be resting, and thereafter, upon release of the push button 50 the motor D will continue to run until the switch arm cam 56 is again actuated by engagement of the switch arm cam 56 by the next adjacent cam lobe of the cam bar. Since the provision of such a circuit may readily be provided by any designer, engineer or electrician familiar with electrical circuitry, and since the details of the indexing circuit are not per se features of the present invention, such details thereof are not illustrated or described herein.

Each of the door panels 10, 11, 12 and 13 is suspended by two of the roller-type hangers 26 mounted on the upper edge thereof to ride on a selected one of the carriage tracks and the room track 55. Also, each of the door panels, except the one 13 which is the first one into the storage compartment A when closing the doors, and the last one out when opening them, has an astragal 62 (FIG. 1) fitted and secured to its inboard edge, i.e. the edge thereof toward the back wall 63 (FIG. 1) of the storage compartment A. An astragal 62 also is affixed to the outboard wall 73 of the door opening B (FIG. 1). Each astragal is of a size to receive therein the outboard edge of the next adjacent inboard door panel. The astragals provide decorative strips which give the appearance of mullions when the door panels are closed, they seal off the joints between the door panels to prevent drafts, and they resist the insertion of prying tools by anyone attempting to gain unauthorized entry.

The room track 55 across the top of the opening B is divided into two sections. One track portion 55*a* (FIGS. 1, 4 and 5) of the room track is of a length equal to the width of the last door panel 13 to leave the storage compartment A when closing the doors, and is located immediately adajacent the storage compartment A. This track portion 55*a* is rigidly fastened, as by adjusting screws 64, to the overhead structure E of the building.

The other portion 55*b* of the room track 55 (FIGS. 1, 4 and 5) is aligned co-extensively with the rigid track portion 55*a*, and is supported by a plurality of spring-biased cables 67, 68 and 69.

The inboard end of the cable-supported track portion 55*b* is guided for limited vertical movement by a short length 70 of oversize channel material, which is welded onto the outboard end of the fixed room track portion 55*a* and retains the inboard end of the cable-supported track portion 55*b* therein during limited up-and-down movement of the latter track portion.

A thrust link 71 (FIGS. 1 and 5) extends from the outboard end of the cable-supported track portion 55*b* to the wall 73 defining the outboard end of the opening B to prevent longitudinal movement of the cable-supported track portion 55*b*.

The spring biasing means for the supporting cables 67, 68 and 69 comprises a plate 74 of rigid material such as, for example, 16 gauge steel, attached by two primary coil springs 77 and 78 to the inboard track 20 of the carriage support frame 19. The track suspension cable 68 is connected from the center of the outboard edge of the spring-biased plate 74 to the inboard end of the cable-supported track portion 55*b*, said cable 67 passing over a pulley block 79 mounted on the overhead building structure E.

The inboard end of the track suspension cable 67 is attached to a secondary coil spring 80, which, in turn, is attached to one end of the outboard edge of the cable biasing plate 74. The outboard end of the cable 67 is attached to a medial portion of the cable-supported track portion 55*b*, passing over a second, similar pulley block 81.

The inboard end of the cable 69 is attached to a coil spring 82, which, in turn, is attached to the other end of the outboard edge of the cable biasing plate 74. The outboard end of the cable 69 is attached near the outboard end of the cable-supported track portion 55 and passes over a third, similar pulley block 83.

The tensions required for the various coil springs attached to the spring-mounted plate 74 will be apparent from the description of the operation of the mechanism as set forth later herein, and may be adjusted as required by turnbuckles 86 provided, one in each of the cables 67, 68 and 69.

For relieving the tension on all three of the cables 67, 68 and 69 when the three outboard door panels 10, 11 and 12 are supported on the cable-supported track portion 55*b* as shown in FIG. 1, a tension-release cable 84 is attached, as by a cable clamp 85, to the cable 68 and thence passes around a pair of pulley blocks 87 and 88 mounted on the carriage support frame 19, the other end of the tension-release cable 84 being attached to an anchor 89 on the door panel carriage C. The tension-release cable 84 is of such a length that it is slack in all positions of the door panel carriage C wherein any of the carriage tracks 27, 28 or 29 are aligned with the room track 55. However, as the door panel carriage C is moved into position to align with the room track 55 the carriage track 30, upon which is mounted the last door panel 13 to leave the compartment C, the tension-release cable 84 is tautened and draws the cable-biasing plate 74 outwardly, or toward the left as viewed in FIGS. 1, 2, 4 and 5. This action by the tension-release cable 84 slacks off the three track-supporting cables 67, 68 and 69, thereby allowing the three door panels 10, 11 and 12 on the cable-mounted track portions 55*b*, as shown in FIG. 1, to rest with their full weight on the floor 90 beneath the door opening B. A combined threshold and guide track 91

(FIG. 1) for the last door panel **13** to leave the compartment A is hingedly mounted on the inboard edge of the door panel **12**, and swings from its stowed position as shown in dot-dash lines in FIG. 1 on the inboard edge of the door panel **12** to its lowered, solid line position of FIG. 1. When all three of the door panels **10, 11** and **12** are in their outermost positions, and the last carriage track **30** and the door panel **13** supported thereon are aligned with the room track **55** as shown in FIG. 1, the door panel **13** may then be moved back and forth along the rigid track portion **55***a* and the threshold **91** in the manner of an ordinary sliding door.

The door panel support carriage C and the rigid track portion **55***a* are installed and adjusted to a height which supports any of the door panels **22–25** thereon approximately one-half of three-quarters of an inch off the floor **90**, as is also the cable-mounted track portion **55***b* in its spring-elevated condition.

*Operation*

Assume, as a starting point, that all four of the door panels **10, 11, 12** and **13** are stored on their respective tracks **27, 28, 29** and **30** of the track carriage C in the compartment A as shown in FIG. 2, and that the access door **14** and the door flap **18** are closed. The carriage track **17**, from which is suspended the last door panel **10** to enter the compartment A and the first to leave it, remains aligned with the room track **55**.

To move the door panels **10, 11** and **12** from the compartment A to their closed condition as shown in FIG. 1, the narrow door flap **18** is opened, and, by inserting one's hand through the gap **17** thus provided, the door panel **10** may be withdrawn from the storage compartment A and moved along the room track **55** all the way across the door opening B to its position shown in FIG. 1.

Assume further that the door panels **10, 11** and **12** weigh 60 pounds each, that the cable-supported track portion **55***a* has an adjusted, spring-supported height which would support door panels thereon three-fourths of an inch off the floor **90**, and that each of the primary cable springs **77** and **78** has an adjusted tension of 90 pounds at three-fourths of an inch extension. Also, that each of the secondary cable springs **80** and **82** has an adjusted tension of 62 pounds at three-quarters inch extension. When the first door panel **10** is moved to the outboard end of the cable-supported room track portion **55***b*, the inboard end of said door panel, under the combined extension of the springs **78** and **82**, will lower gently onto the floor while the inboard end thereof will remain in slightly raised position above the floor **90**, since the 60 pound weight of the door panel is not sufficient to overcome the tension of the primary springs **77** and **78**.

The reversing switch **49** is then moved to its "out" position and the motor start button **50** is depressed to actuate the motor D sufficiently to bring the carriage track **28** into alignment with the room track **55**.

For the purpose of the present description the indexing means will be ignored, since the one operating the mechanism can observe through the gap **17** when a selected carriage track is in alignment with the room track.

The second door panel **11** is then withdrawn from its track **28** and is moved along the room track **55** into abutment with the first door panel **10**. When the weight of the second door panel **11** is added to that of the first door panel **10**, their combined weight is sufficient to lower the inboard end of the first panel **10** and the outboard end of the door panel **11** lightly onto the floor, the inboard end of the panel **11** remaining suspended clear of the floor.

The motor start button **50** is then again depressed to actuate the motor D for a sufficient length of time to align the carriage track **29** carrying the third door panel **12** with the room track **55**. This third door panel **12** is then withdrawn and moved along the room track **55** into abutting relation with door panel **11**. The 60 pound weight of the third door panel **12**, added to the weight of the first two door panels **10** and **11** is sufficient to permit the inboard end of the door panel **11** and the outboard end of the third door panel **12** to lower onto the floor **90**.

The motor start button **50** is again depressed for a sufficient length of time to align the final track **30** of the carriage with the room track **55**. As the panel support carriage C approaches this final position, the tension-release cable **84** becomes taut, and, passing around the pulleys **87** and **88**, draws the cable-biasing plate **74** outboard, or toward the left as shown in FIGS. 1 and 2, overcoming the tension of the primary springs **77** and **78** and slacking off on all three of the cables **67, 68** and **69**, thereby allowing the cable-supported track portion **55***b* to lower three-fourths of an inch so that all three of the door panels **10, 11** and **12** rest with their full weight on the floor **90**.

The hingedly mounted threshold and guide track **91** (FIG. 1) is then swung downwardly onto the floor from its stowed, broken line position of FIG. 1 to its solid line position in the latter figure.

The various door panels are of a combined length such that when they are all withdrawn from the compartment A, and the outboard ends of the door panels are fitted into their respective astragals **62**, the door panels will just fill the door opening B and will allow the small flap **18** to be closed to close the gap **17**.

To move the door panels back into the storage compartment A so as to leave the door opening B unobstructed, the foregoing procedure is reversed.

Convenient locking means (not shown) may be provided for the door panel **13**, or in fact for any or all of the door panels as desired, but since such locking means and the manner of installing them are well known and form no part of the present invention they are not illustrated or described herein.

In the illustrative form of the invention all of the door panels are suspended from overhead tracks, in which case no track or other obstruction is required along the floor of any opening which the door panels are designed to close. This invention is particularly satisfactory, therefore, as a room divider and elsewhere where it is desired to have the flooring, or floor covering, extend unbroken through the door opening.

The invention provides an improved, simple and compact multi-panel, sliding door mechanism, which can be easily installed any place where room is available for the necessary storage compartment alongside a desired opening to be closed off by the doors. The mechanism is of utility not only for a new construction but can be readily installed in existing structures, both residential and business.

While I have illustrated and described a preferred embodiment of the present invention, it will be understood, however, that various changes and modifications may be made in the details thereof without departing from the scope of the invention as set forth in the appended claims.

Having thus described the invention, what I claim as new and desire to protect by Letters Patent is defined in the following claims.

I claim:

**1.** A multi-panel sliding door mechanism comprising, in combination with a building having a wide opening therein and a door panel compartment at one end of such opening

a plurality of door panels of a height corresponding to that of the opening and of a combined width to close the opening when placed in edge-to-edge abutting relation therein,

a door-supporting room track extending lengthwise across the opening for supporting the door panels in such edge-to-edge abutting relation, said room track comprising

a first portion of said room track, rigidly supported from a portion of the building defining the top of the opening,

a second portion of said room track aligned with the first portion and supported for limited up-and-down movement from the portion of the building defining the top of the opening,

means resiliently biasing the second track portion upwardly,

a door panel support carriage mounted in the compartment for movement transversely of the room track,

a plurality of door supporting tracks on the carriage, one for each of the door panels, said carriage being mounted for movement transversely of the room track for selective alignment of each of the carriage tracks with the room track,

means for moving the carriage transversely within the compartment for alignment of successive ones of the carriage tracks with the room track, and

release means actuated by movement of the carriage into position to align, with the room track, the carriage track for the last door panel to leave the compartment upon closing the doors, said release means, when so actuated, overcoming the biasing means for the second track portion to thereby lower all door panels carried by the second track portion onto the portion of the building defining the bottom of said opening.

2. A multi-panel sliding door mechanism as claimed in claim 1 wherein the door-biasing means comprises a plurality of cables attached at selected points to the second track portion, and means biasing each of the cables in a direction to urge upwardly the portion of said second track portion to which said each cable is connected.

3. A multi-panel sliding door mechanism as claimed in claim 2 wherein one of the cables is provided for each door panel to be supported on the second track portion, and the biasing force on a selected one of the cables, when extended sufficiently to lower the second track portion a distance sufficient to bring a door panel mounted thereon into contact with the portion of the building defining the bottom of the opening, is at least as great as the weight of one of the door panels.

4. A multi-panel sliding door mechanism as claimed in claim 2 wherein a spring-biased plate is attached at one side thereof by spring means having a biasing force equal substantially to the weight of all of the door panels to be supported on the second track portion, and each of the cables is attached to the other side of the plate, a selected one of the cables having spring means interposed between said selected cable and the plate.

5. A multi-panel sliding door mechanism as claimed in claim 4 wherein at least one of the cables is attached directly to said other side of the spring biased plate, and the means for releasing the biasing force on the cables comprises a member operatively interconnecting the carriage and the directly connected cable when the carriage is moved into position to align with the room track the carriage track for the last door panel to leave the compartment when closing the doors, thereby to draw the spring biased plate toward the cables a sufficient distance to slack off the cables and remove the upwardly biasing force on the second track portion.

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