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Pagliaro

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[54] **OVERHEAD STACKED FOLDING DOOR**

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[73] Assignee: **Compact Closures, Inc.**, Middletown, Pa.

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[52] U.S. Cl. ..... **160/189**, 16/87 R, 160/193, 160/207

[51] **Int. Cl.** **E05f 11/54**

[58] **Field of Search** ..... 160/207, 206, 189, 160/190, 201; 16/87 R, 91, 90, 94 R, 97, 98, 102

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Primary Examiner—Dennis L. Taylor

Attorney—Anthony A. O'Brien

[57] **ABSTRACT**

Folding door apparatus including a plurality of panels hinged together in accordian fashion are raised and lowered along parallel spaced guide channels by a winding drum and cable; one end of the cable is secured to the winding drum while the other end is fastened to the remotest panel from such drum. In a door open position, the panels are folded and located above the door opening with the panel located closest to the winding drum being stored in an unfolded condition.

14 Claims, 8 Drawing Figures

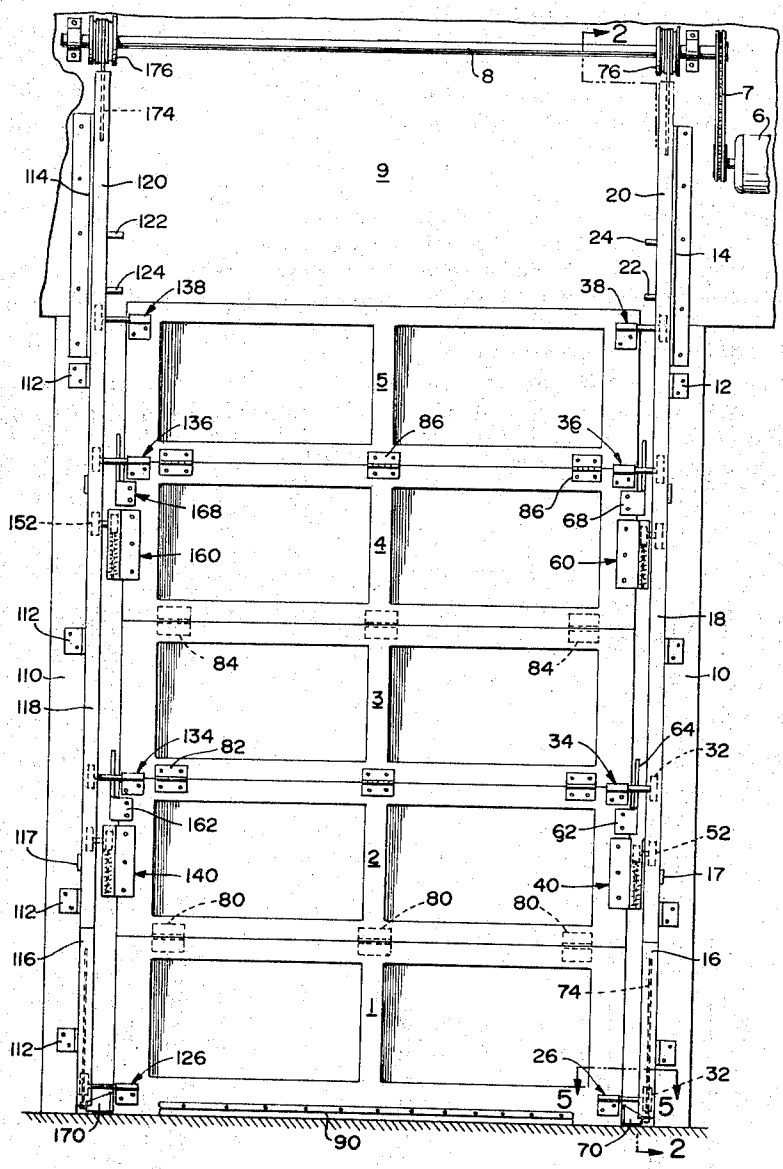
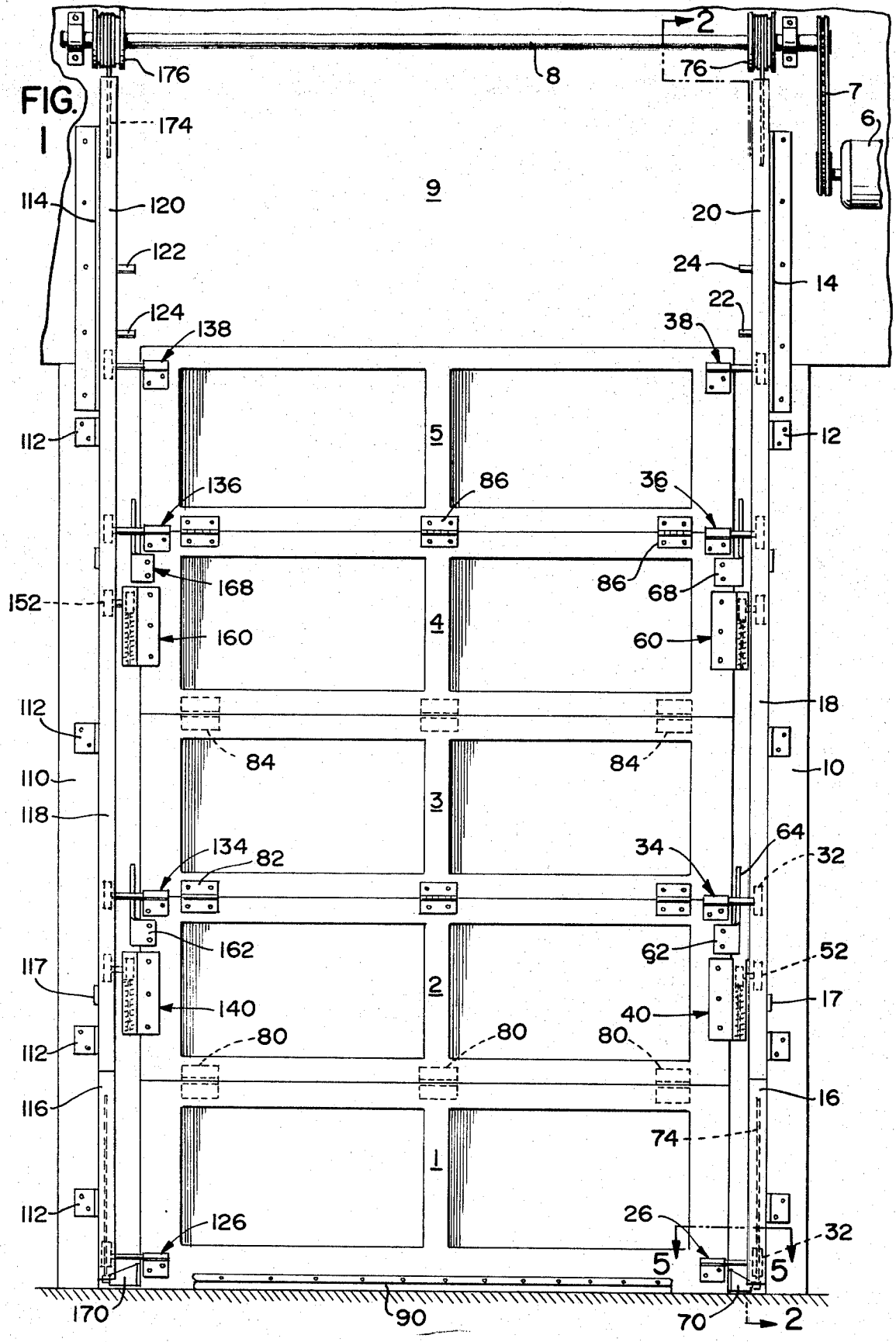


FIG. 1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140
40
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2

FIG. 2

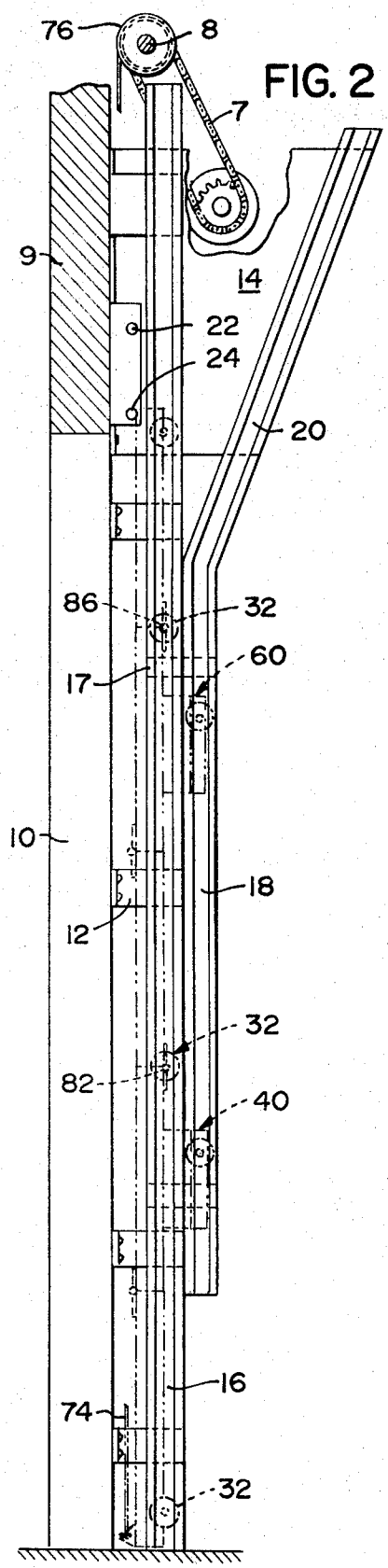
76
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FIG. 3

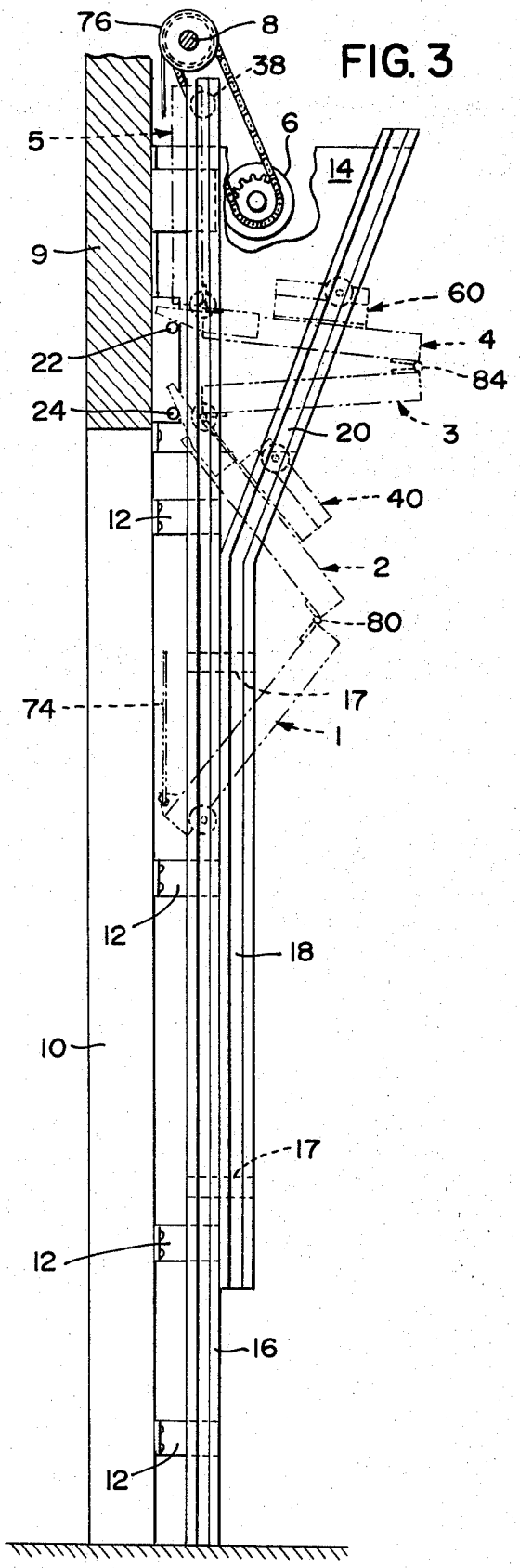
76
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FIG. 4

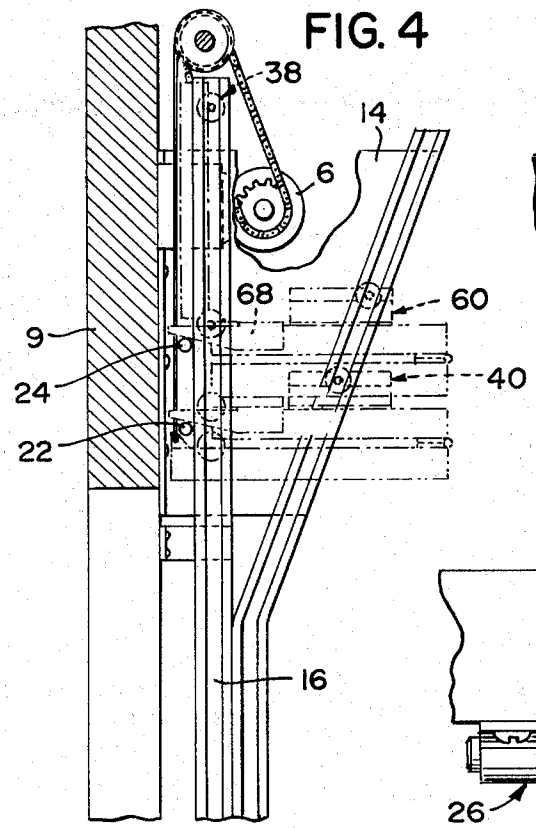


FIG. 8

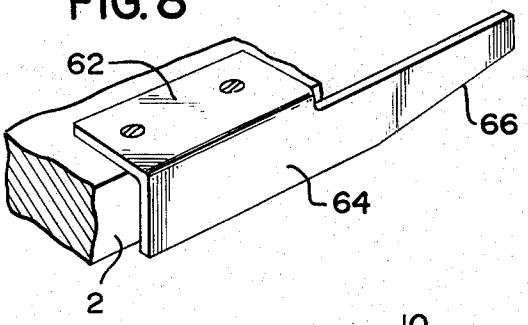


FIG. 5

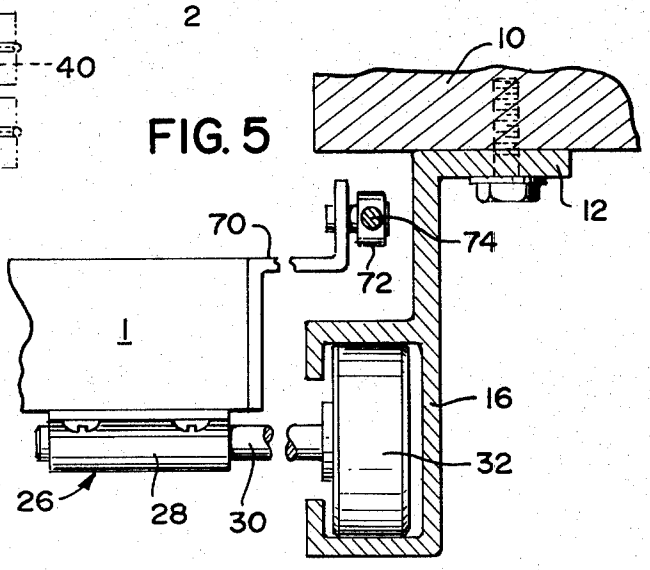


FIG. 6

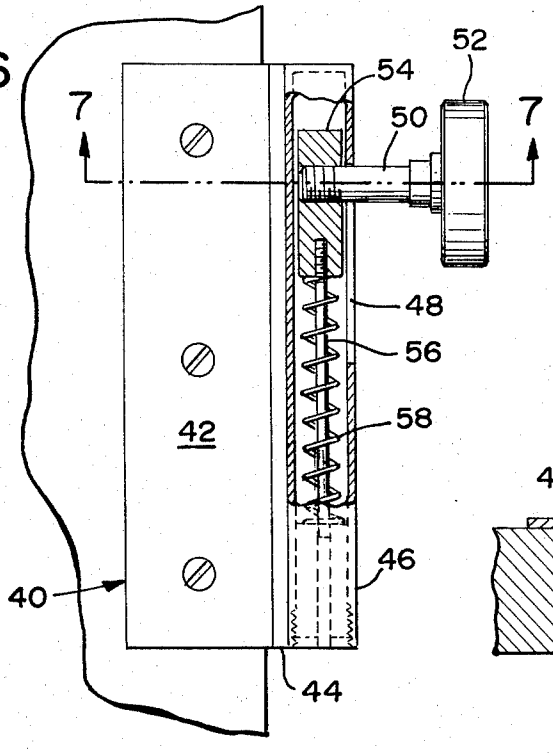
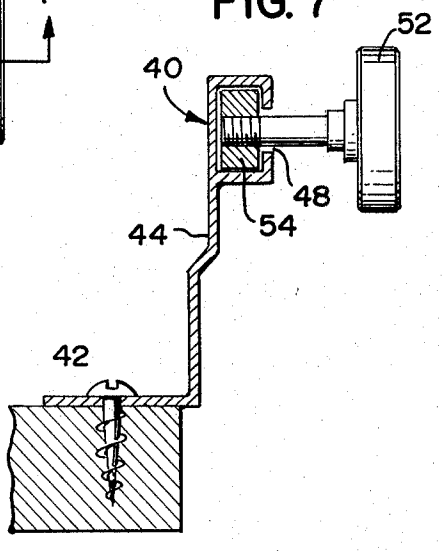


FIG. 7



OVERHEAD STACKED FOLDING DOOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to folding door apparatus and, in particular to such apparatus having a plurality of hinged panels movable between folded and unfolded positions relative to an opening in building.

2. Description of the Prior Art

The prior art is generally cognizant of accordian type folding panels for door apparatus having various arrangements for raising and lowering the panels along spaced vertical guide channels defining the opening of a structure. While such conventional apparatus may have been satisfactory to meet particular requirements for which they were designed, certain disadvantages involving complexity of operation and expensively manufactured trackways were associated with such conventional apparatus. For example, in apparatus using a cable connected to the lowermost panel, such cable is exposed and extends beyond the door panels into an open area where it is a hazard interfering with the movement of people and/or equipment. Another disadvantage of prior art apparatus relates to the number of panels that may be utilized in accordian type folding door apparatus; i.e., such apparatus requires an even number of panels which results in dimensional limitations and/or the use of an unnecessary number of panels for a particular opening.

SUMMARY OF THE INVENTION

The present invention is summarized in that folding door apparatus is constructed to include a pair of guide channels disposed in spaced parallel relation to each other, each channel having inner and outer trackways, a plurality of panels adapted for vertical movement along the channels, horizontal hinge means connecting adjacent edges of adjacent panels in accordian fashion, winding drum means disposed adjacent upper end portions of the guide channels, and cable means extending between the winding drum means and the remotest panel in spaced relation to and behind said inner trackways whereby the cable means is displaced from any interfering objects.

It is an object of the present invention to construct an accordian type folding door apparatus with hoisting cable means that eliminates hazardous interference with other items.

This invention has another object in that the trackways for folding door apparatus may be simply and economically manufactured from straight sections.

A further object of the present invention is to utilize an odd number of panels in an accordian type folding door apparatus.

Other objects and advantages of the present invention will become apparent from the following description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a rear elevation of folding door apparatus as viewed from the inside of a building;

FIG. 2 is a cross section taken along the line 2—2 of FIG. 1 with door panel components added in phantom lines;

FIG. 3 is a cross section similar to FIG. 2 but showing the door panel components during a door opening operation;

FIG. 4 is a cross section similar to FIG. 3 with parts removed but showing the door panel components in an open stacked position;

FIG. 5 is a partial cross section taken along the line 5—5 of FIG. 1;

FIG. 6 is a front elevation with parts broken away and parts in section of a detail of FIG. 1 on an enlarged scale;

FIG. 7 is a cross section taken along line 7—7 of FIG. 6, and

FIG. 8 is partial perspective view of a detail of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention is embodied in folding door apparatus of the type for use as a closure for a large opening found in warehouses, garages, hangars, etc. As is shown in FIG. 1, the folding door apparatus includes a plurality of panels, referenced consecutively with numerals 1 through 5 commencing with panel 1 at the ground or floor level. While only five panels are illustrated any suitable number of panels may be utilized in accordance with the requirements of a particular installation. The folding door apparatus may be operated manually but is shown with automatic operation by means of an electric motor 6 and a chain drive 7 extending between the electric motor 6 and a driven shaft 8 disposed above the opening.

The vertical dimension of the building opening is defined by the building floor and a horizontal cross bar or lintel 9 disposed in spaced parallel relation to such floor and extending between a pair of spaced vertical studs. The horizontal dimension of the building opening is substantially the same as the width of the panels 1–5, and the vertical studs are fastened to the adjacent wall portions (not shown) of the building. As viewed in FIG. 1, the right hand stud is designated as 10 and the left hand stud is designated as 110; similarly, in the following description, only the right hand components are being described in detail, while the identical left hand components are merely being identified with 100 added to the reference numerals of the right hand components.

As is illustrated in FIGS. 2 and 3, vertically disposed roller channels are secured to the stud 10 by a plurality of spaced angle brackets 12 and to the stud 10 and lintel 9 by a gusset plate 14. The roller channels include an inner trackway 16 and an outer trackway 18 integrally united as by horizontal tie brackets 17. The brackets 12 may be separate elements or may be integral with the inner trackway 16 as shown in FIG. 5 and serve to space the inner trackway 16 from the stud 10. The inner trackway 16 extends vertically from the floor surface to a point just below the driven shaft 8 (see FIG. 1), and the outer trackway 18 extends vertically from a point adjacent the top edge of panel 1 to a point adjacent the center line of panel 5, at which point it has an angular extension 20 disposed at an angle of approximately 22 ½° from the inner trackway 16. The upper end of trackway extension 20 terminates adjacent the top edge of the gusset plate 14, to which such extension is secured as by welding.

A pair of panel stacking rods **22** and **24** are fixed to the stud **10** above the top edge of the panel **5**; the rods **22** and **24** project transversely from the stud **10** inwardly toward the vertical center line of the panels but terminate so as to provide a clearance for the side edge of the panel **1** as viewed in FIG. **1.** Thus, the rods **22** and **24** are located behind the inner trackway **16** and project into the transverse space defined by such inner trackway **16** and the side edges of the panels **1–5.**

A roller assembly, indicated generally at **26** in FIGS. **1** and **5,** includes a journal bracket **28** affixed adjacent the lower side edge of panel **1** and receiving one end of an axle **30,** the opposite end of which carries a roller **32** disposed in the inner trackway **16.** Similarly constructed roller assemblies **34, 36** and **38** are affixed adjacent the upper side edges of panels **2, 4** and **5,** respectively. A spring biased roller assembly, indicated generally at **40** in FIGS. **1, 6** and **7,** includes a generally L-shaped mounting bracket **42** fastened to the panel **2** adjacent its side edge and intermediate its top and bottom surfaces. The long leg **44** on the mounting bracket **42** is intermediately offset and terminates in an elongated housing section **46** which is slotted at **48** along a portion of its length. A roller axle **50** is movably disposed in the slot **48** and has a roller **52** on one end disposed in the outer trackway **18;** the opposite end of the axle **50** is threaded into a slide block **54** in the housing section **46.** One end of a guide shaft **56** is threaded into the slide block **54** while its opposite end protrudes out of the bottom wall of the housing section **46;** a coil spring **58** encircles the guide shaft **56** and is mounted in compression between such bottom wall and the slide block **54.** A second spring biased roller assembly **60,** similarly constructed as the spring biased roller assembly **40** is fastened to the panel **4** adjacent its side edge and intermediate its top and bottom surfaces.

A stacking bracket **62** is fastened adjacent the top side edge of the panel **2** (FIG. **8**) and has an extension **64** along such side edge and disposed under the axle **30** of the roller assembly **34;** a sloping surface **66** on the extension **64** protrudes alongside the bottom side edge of the adjacent panel **3.** Thus, the sloping surface **66** is disposed in the space between the side edge of the panels and the inner trackway **16** as viewed in FIG. **1.** A similarly constructed stacking bracket **68** is fastened adjacent the top side edge of the panel **4.**

A squared Z-shaped bracket **70** is fastened to the lowermost side edge of panel **1** (see FIG. **5**) so as to have one leg disposed in the space between the stud **10** and the inner trackway **16.** A cable clamp **72** is secured to such one leg to provide an anchoring attachment for the end of a hoisting cable **74.** As is shown in FIG. **2,** the hoisting cable **74** extends vertically along the stud **10** with its opposite end being wound on a winding drum **76** that is keyed to the driven shaft **8** for unitary rotation therewith.

The panels **1–5** are hingedly connected to each other by any suitable means to effect an accordian type movement therebetween. For example, a plurality of spaced horizontal hinges **80** are fastened to the top edge of panel **1** and the bottom edge of panel **2;** such hinges **80** are visible from outside the building but are not visible from inside the building as viewed in FIG. **1.** A plurality of spaced horizontal hinges **82** are fastened to the top edge of panel **2** and the bottom edge of panel **3** and are visible from inside the building as viewed in FIG. **1.** The top edge of panel **3** and bottom edge of panel **4** are connected by a plurality of spaced horizontal hinges **84** in the same manner as the adjacent edges of panels **1** and **2;** similarly, the top edge of panel **4** and the bottom edge of panel **5** are connected by a plurality of spaced horizontal hinges **86** in the same manner as the adjacent edges of panels **2** and **3.**

Any type of suitable weatherstripping **90** (FIG. **1**) may be utilized on the bottom edge of the lowermost panel **1** to engage the floor surface of the building. A similar weatherstrip (not shown) may also be utilized on the exterior surface of the uppermost panel **5** along its top edge to engage the adjacent surface of the lintel **9.** Side edge weatherstrips (not shown) may also be provided on the edge of studs **10** and **110** (see FIG. **2**) to engage the exterior side surfaces of the panels.

The relative positions of the door panels and their components are represented in FIGS. **1** and **2** when the assembly is in its closed position. To commence a door opening operation, a switch (not shown) is actuated, effecting energization of the electric motor **6** whereupon the chain drive **7** rotates the driven shaft **8** and its winding drums **76–176** in a cable winding direction. The hoisting cables **74–174** are thus retracted onto their respective drums **76–176** causing upward movement of the five panels by the upward force exerted on the remotest panel.

During initial upward movement of the door assembly, the five door panels move vertically as a unit until the roller assemblies **60–160** enter the angular extensions **20–120** of the outer trackway. Since the uppermost panel **5** has inner roller assemblies **38–138** adjacent its top side edges, and the next panel **4** also has similar inner roller assemblies **36–136,** the uppermost panel **5** does not fold or pivot into a stacking position but is merely raised to an overhead vertical position as shown in FIGS. **3** and **4.** This arrangement has the particular advantage of utilizing an odd number of door panels in order to satisfy dimensional requirements for particular installations.

The continued upward movement of the remotest panel **1** along the roller guide channels after the roller assemblies **60–160** enter the trackway extensions **20–120** causes panel **4** to pivot counterclockwise (as viewed in FIG. **3**) about the horizontal hinges **86.** It should be noted that the entry of the roller assemblies **60–160** into such extensions **20–120** does not occur until after the leading edges of the sloping surfaces on the stacking brackets **68–168** clears the stacking rods **22–122.** The subsequent pivoting of the door panel **4** also causes the lower edge of panel **4** and the upper edge of panel **3** to pivot toward each other about the horizontal hinges **84.** As is apparent from FIG. **3,** before the door panels **3** and **4** are completely folded against each other, the inner roller assemblies **34–134** on the top side edges of panel **2** move upward in the inner trackways **16–116** and the outer roller assemblies **40–140** move angularly upwardly in the outer trackways **18–118.** Because of the spring bias arrangement (FIG. **6**) of the outer roller assemblies **40–140,** the movement into the angular sections **20–120** is facilitated and continued movement therein is accomplished without binding between the rollers and the trackway.

The door assembly continues its upward movement from its position in FIG. **3** to that in FIG. **4** where panel **5** is vertically positioned and the panels **1–2** and **3–4** are folded in accordian fashion with stacking brackets **62–162** and **68–168** resting on the stacking rods

22–122 and 24,124, respectively. The electric motor 6 is now automatically deenergized and the door panels will remain in an overhead stacked and folded position until the electric motor 6 is again energized for a door closing operation whereupon the above sequence of operation is reversed.

In accordance with the present invention, the particular arrangement of the overhead stacked folding door apparatus results in a universal door which need not be specifically designed for various sized openings but may be simply and economically manufactured for universal application. For instance, the height of any door may be adjusted by selecting the proper number of door panels. In addition, the width of any door may be adjusted by inserting or removing panel sections (not shown) along the panel width; such a width adjustment is made possible by mounting all the hardware, brackets and roller assemblies, on the panels adjacent the side edges thereof. The particular structures of the stacking brackets, the inner roller assemblies, and the outer roller assemblies with offset housings for spring biasing the rollers, are arranged so that there is no possibility of interference among such structures. Since such hardware is secured to the interior surface of the door panels, any individual item is available for maintainance purposes such as being removable for repair and/or replacement without disassembly of the entire apparatus.

Inasmuch as the present invention is subject to many changes in detail, variations and modifications, it is intended that all matter contained in the foregoing description or shown in the accompanying drawings, shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. Folding door apparatus comprising
a pair of spaced, vertically disposed guide channels,
each guide channel including inner and outer trackways with the inner trackway adapted to be mounted adjacent a building structure and with the outer trackway mounted next to the inner trackway,
mounting means for securing each guide channel to the building structure with its inner trackway being spaced therefrom,
a plurality of panels adapted for vertical movement along said trackways,
horizontal hinge means connecting said panels in accordian fashion with adjacent panels being hinged at their adjacent edges,
winding drum means disposed adjacent upper end portion of said guide channels, and
hoisting cable means extending between said winding drum means and the remotest one of said panels in spaced relation to and behind said inner trackways whereby said cable means are displaced from any interfering objects.

2. Folding door apparatus as claimed in claim 1 wherein said guide channels include stacking rod means and said plurality of panels includes stacking bracket means cooperating with said stacking rod means when said plurality of panels are disposed in a door open position.

3. Folding door apparatus as claimed in claim 2 wherein said stacking bracket means includes stacking brackets for each pair of panels and each stacking bracket includes a sloping surface to facilitate engagement with said stacking rod means.

4. Folding door apparatus comprising
a pair of spaced, vertically disposed guide channels,
each channel including inner and outer trackways,
a plurality of panels adapted for vertical movement along said trackways,
horizontal hinge means connecting said panels in accordian fashion with adjacent panels being hinged at their adjacent edges,
winding drum means disposed adjacent upper end portions of said guide channels, and
hoisting cable means extending between said winding drum means and the remotest one of said panels in spaced relation to and behind said inner trackways whereby said cable means are displaced from any interfering objects,
said plurality of panels including five panels of which the first and fifth panels have inner rollers mounted adjacent their respective bottom and top edges and extending into said inner trackways, and the second and fourth panels have inner rollers mounted adjacent their top edges extending into said inner trackways and have outer rollers mounted intermediate their top and bottom edges and extending into said outer trackways.

5. Folding door apparatus as recited in claim 4 wherein said outer trackways have upper angular portions causing said outer rollers to effect accordian movement of the first, second, third and fourth panels.

6. Folding door apparatus as recited in claim 5 wherein said fifth panel is vertically moved along said inner trackways to a stored vertical position when said first, second, third and fourth panels are in stored folded positions.

7. Folding door apparatus comprising
a pair of spaced, vertically disposed guide channels,
a plurality of panels extending between said guide channels adapted for vertical movement in accordian fashion along said guide channels,
each guide channel including an inner trackway and an outer trackway,
bracket means on each guide projecting from its inner trackway in a direction opposite to its outer trackway for mounting each guide channel to a support structure in spaced relation thereto,
inner roller means for a first pair of panels disposed in said inner trackway,
outer roller means for a second pair of panels disposed in said outer trackway,
winding drum means disposed adjacent upper end portions of each guide channel, and
cable means having one end secured to said winding drum means and an opposite end secured to a lowermost one of said first pair of panels and being vertically disposed adjacent said inner trackway in spaced relation thereto whereby said cable means is displaced from any interfering objects.

8. Folding door apparatus as recited in claim 7 wherein each of said outer trackways has an angular section, and wherein said outer roller means includes mounting bracket means fastened to one of said second pair of panels, a slotted housing in said mounting bracket means, a slide block in said slotted housing, an axle for said slide block slidably protruding through said slotted housing and having a one end secured to said slide block and having a roller mounted on another end for rolling engagement in said outer trackway, and

a spring biasing said slide block whereby said roller is easily moved along said angular section.

9. Folding door apparatus as claimed in claim **7** wherein said plurality of panels includes an even number of panels with inner roller means for a third pair of panels and with outer roller means for a fourth pair of panels.

10. Folding door apparatus as claimed in claim **9** wherein said second pair of panels includes one of said first pair of panels, wherein said third pair of panels includes one of said second pair pf panels, and wherein said fourth pair of panels includes one of said third pair of panels.

11. Folding door apparatus as claimed in claim **7** wherein said plurality of panels includes an odd number of panels with inner roller means for an odd numbered panel.

12. Folding door apparatus comprising

a pair of spaced, vertically disposed guide channels,

a plurality of panels extending between said guide channels adapted for vertical movement in accordian fashion along said guide channels,

each guide channel including an inner trackway and an outer trackway,

inner roller means for a first pair of panels disposed in said inner trackway,

outer roller means for a second pair of panels disposed in said outer trackway,

winding drum means disposed adjacent upper end portions of said guide channels, and

cable means having one end secured to said winding drum means and an opposite end secured to a lowermost one of said said first pair of panels and being vertically disposed adjacent said inner trackway in spaced relation thereto whereby said cable means is displaced from any interfering objects,

said plurality of panels including at least five panels, said first pair of panels including the first and second of said five panels, said second pair of panels including the second and third of said five panels, a third pair of panels comprises the third and fourth panels of said five panels, and a fourth pair of panels comprises the fourth and fifth panels of said five panels.

13. Folding door apparatus as claimed in claim **12** wherein said guide channels includes stacking rod means for each pair of said panels, and said each pair of said panels includes stacking bracket means engaging its respective stacking rod means when said panels are in a door open position.

14. Folding door apparatus as claimed in claim **13** wherein said stacking bracket means, said inner roller means and said outer roller means are each attached to exposed surfaces of their respective panels so as to be accessible for maintainance purposes.

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