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Mullet

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(54) **NON-BINDING SECTIONAL DOOR AND METHOD OF ASSEMBLY**

(75) Inventor: **Willis J. Mullet**, Gulf Breeze, FL (US)

(73) Assignee: **Wayne-Dalton Corp.**, Mt. Hope, OH (US)

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(52) **U.S. Cl.** **160/229.1**; 160/201; 160/218
(58) **Field of Search** 160/201, 209, 160/229.1, 218, 220, 231.1, 233, 235, 267, 323; 49/383

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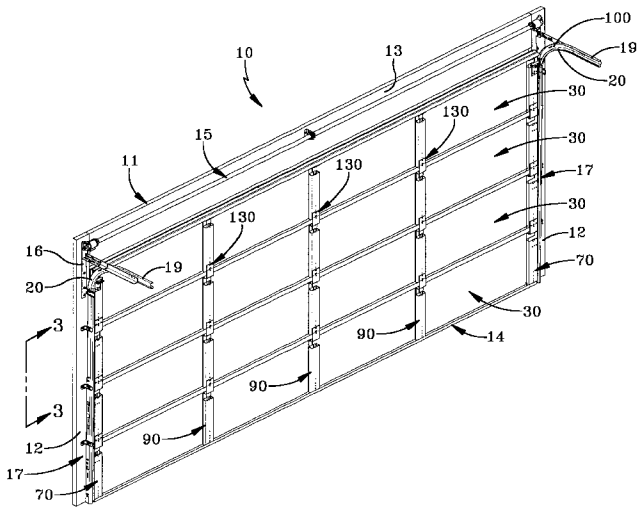
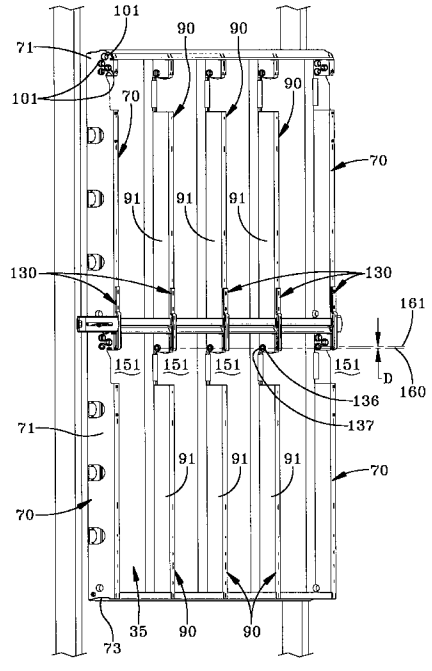
Primary Examiner—Bruce A. Lev
(74) *Attorney, Agent, or Firm*—Renner, Kenner, Greive, Bobak, Taylor & Weber

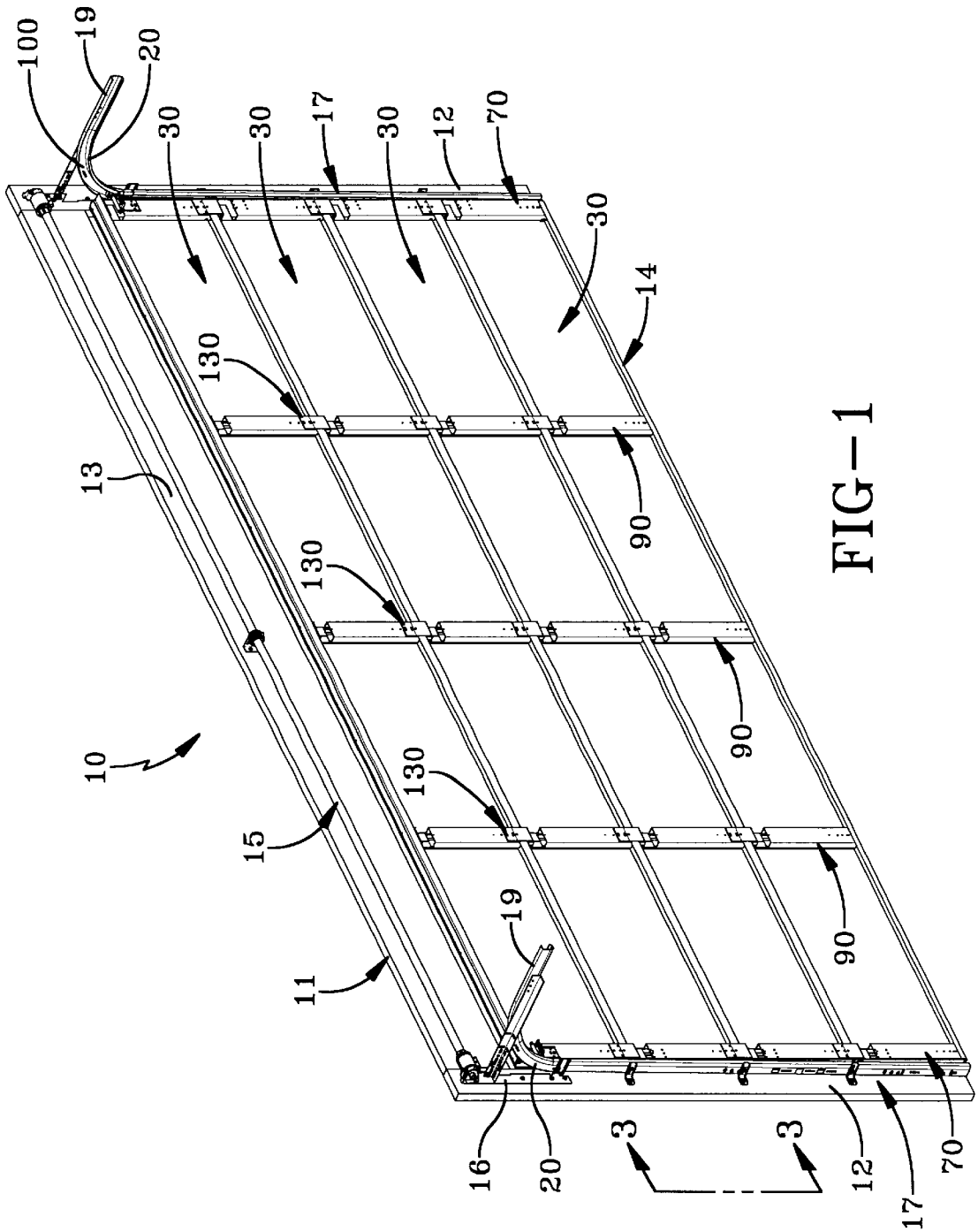
(57) **ABSTRACT**

A sectional door movable between a closed vertical position and an open horizontal position having, a series of adjacent panels, each of the panels having an upper joint member and a lower joint member, the lower joint member having a configuration to establish a clearance with the configuration of the upper joint member of an adjacent panel during angular articulation of the adjacent panels in moving between the closed vertical position and the open horizontal position, end hinge assemblies located proximate the longitudinal ends of the panels and connecting the adjacent panels at a first pivot axis, and at least one center hinge assembly connecting the adjacent panels at a second pivot axis offset from the first pivot axis, whereby a portion of the clearance is maintained irrespective of variations in the deflection of the panels in moving between the closed vertical position and the open horizontal position.

26 Claims, 5 Drawing Sheets



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14
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3
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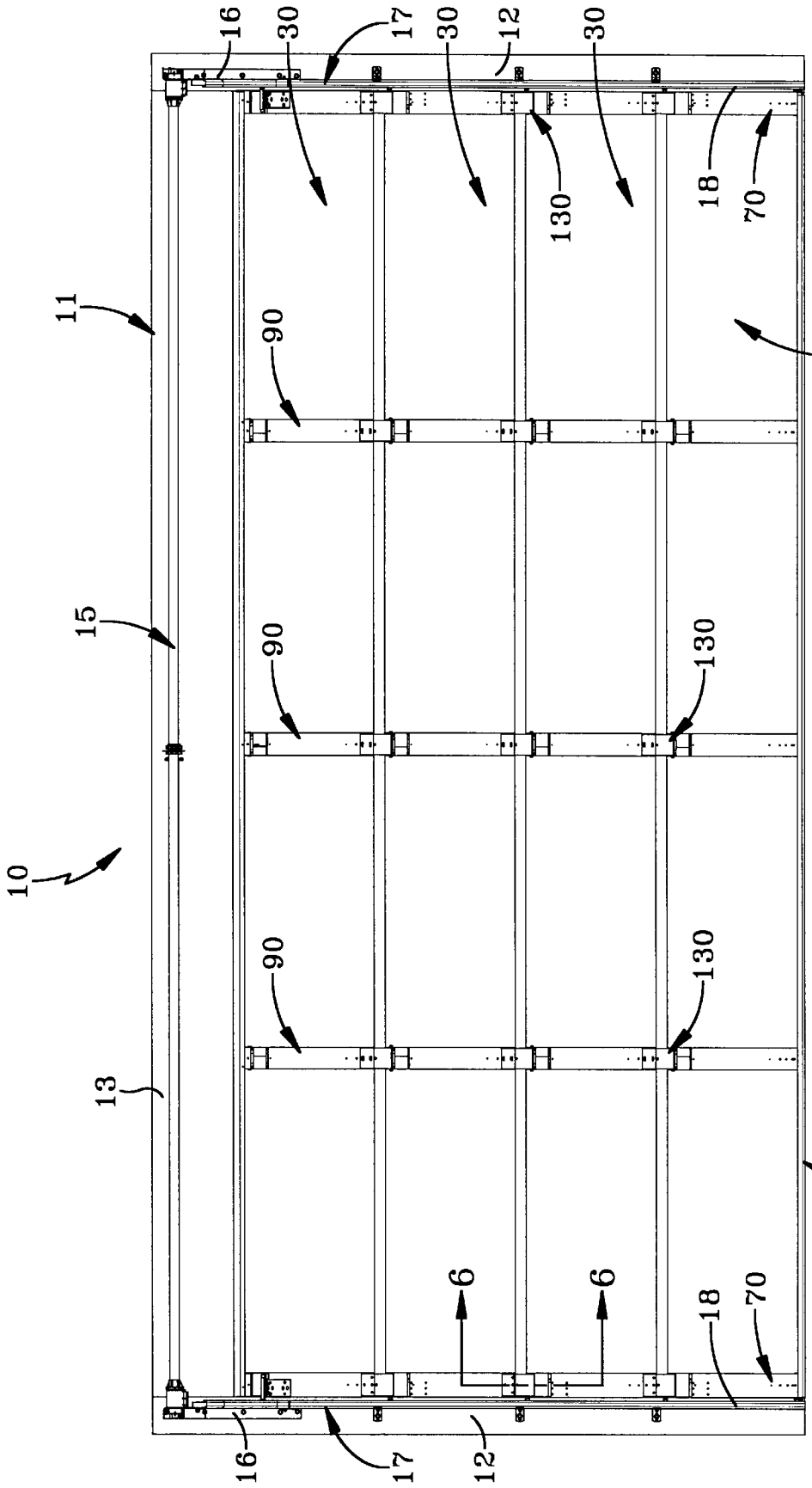
12
17
70

FIG-1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130
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6
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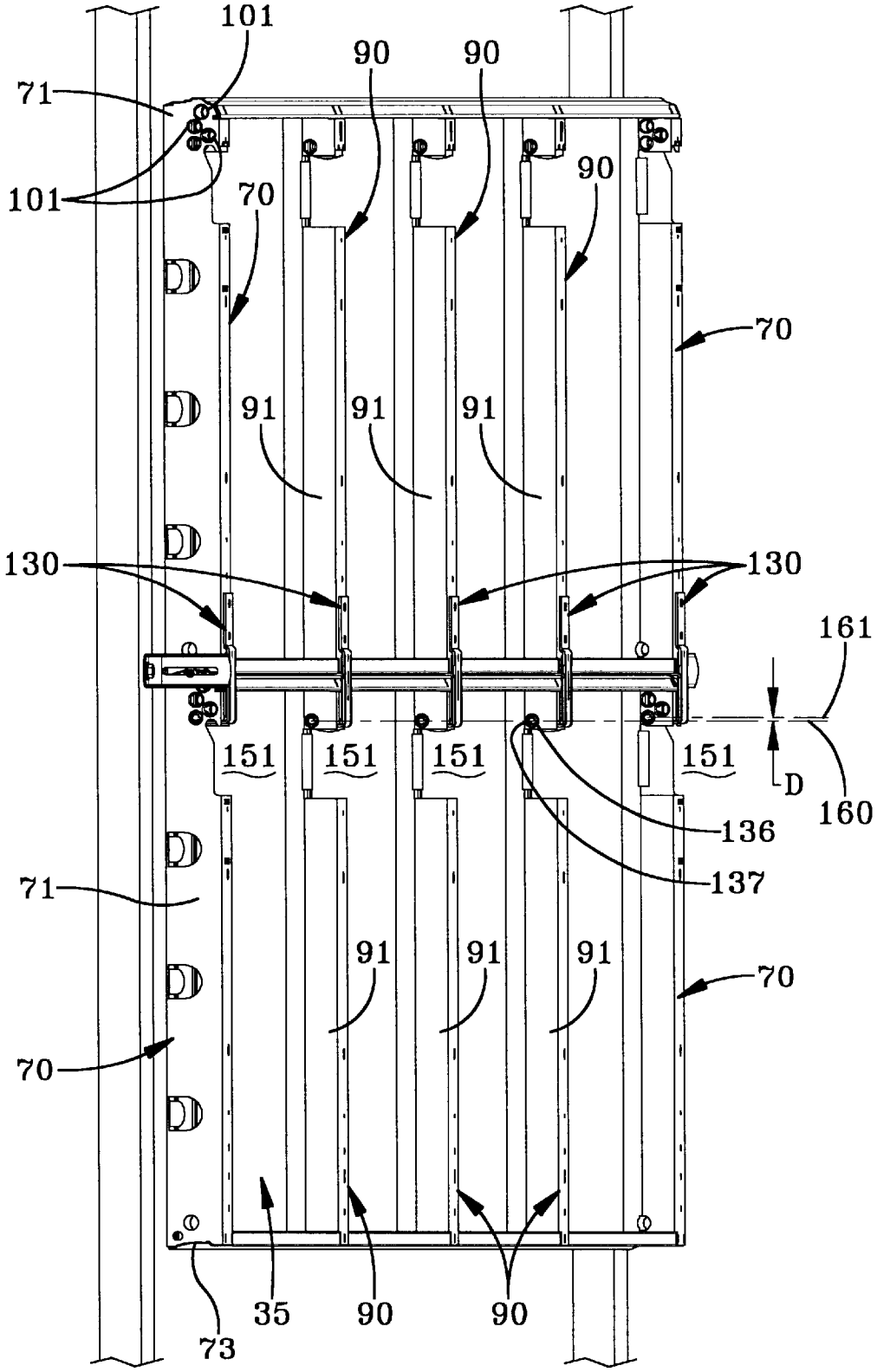
16
17
12

FIG-2


101
90
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71
101
70
90
70
91
91
91
130
130
161
151
151
151
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D
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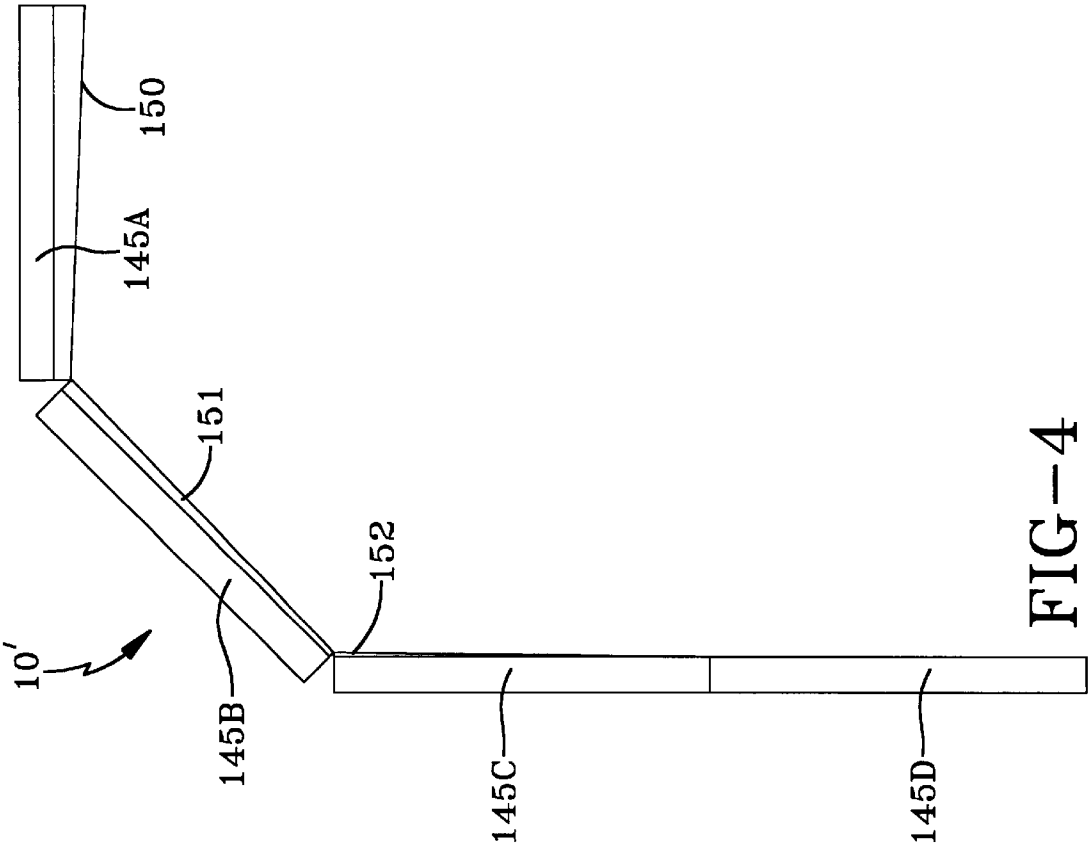
71
91
91
91
70
70
35
90
90
73

FIG-3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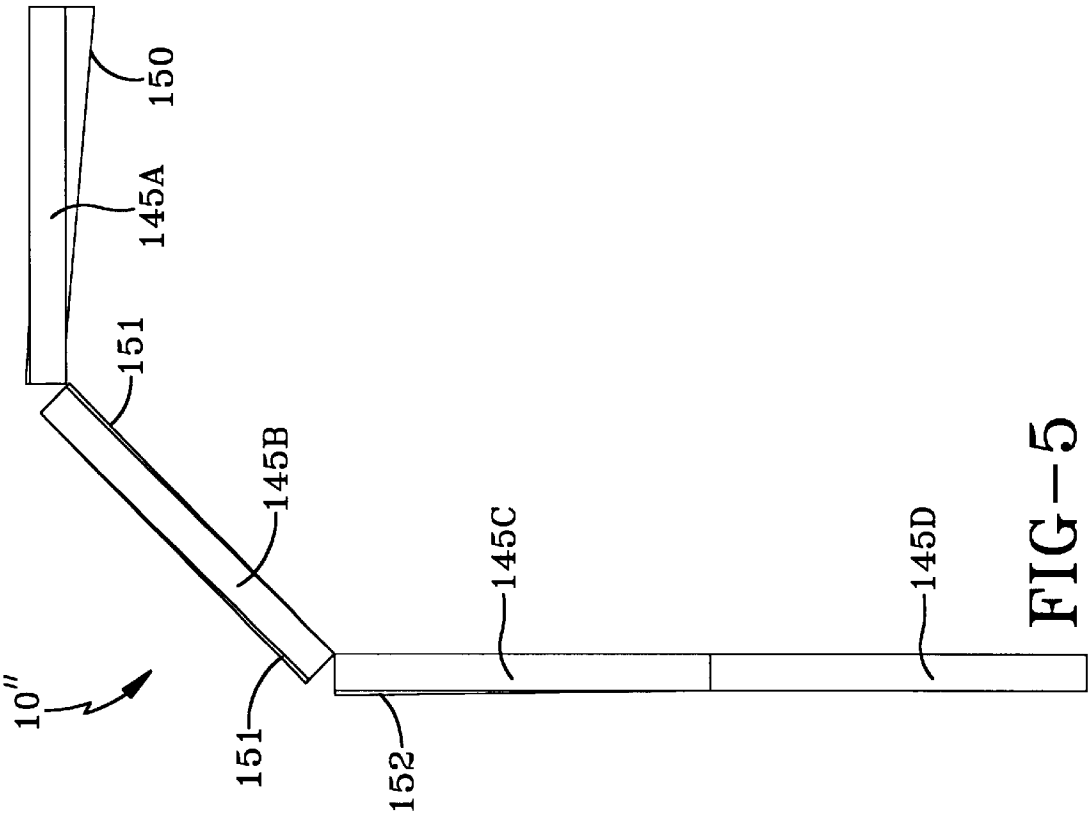
151
152
10'
145B
145C
145D

FIG-4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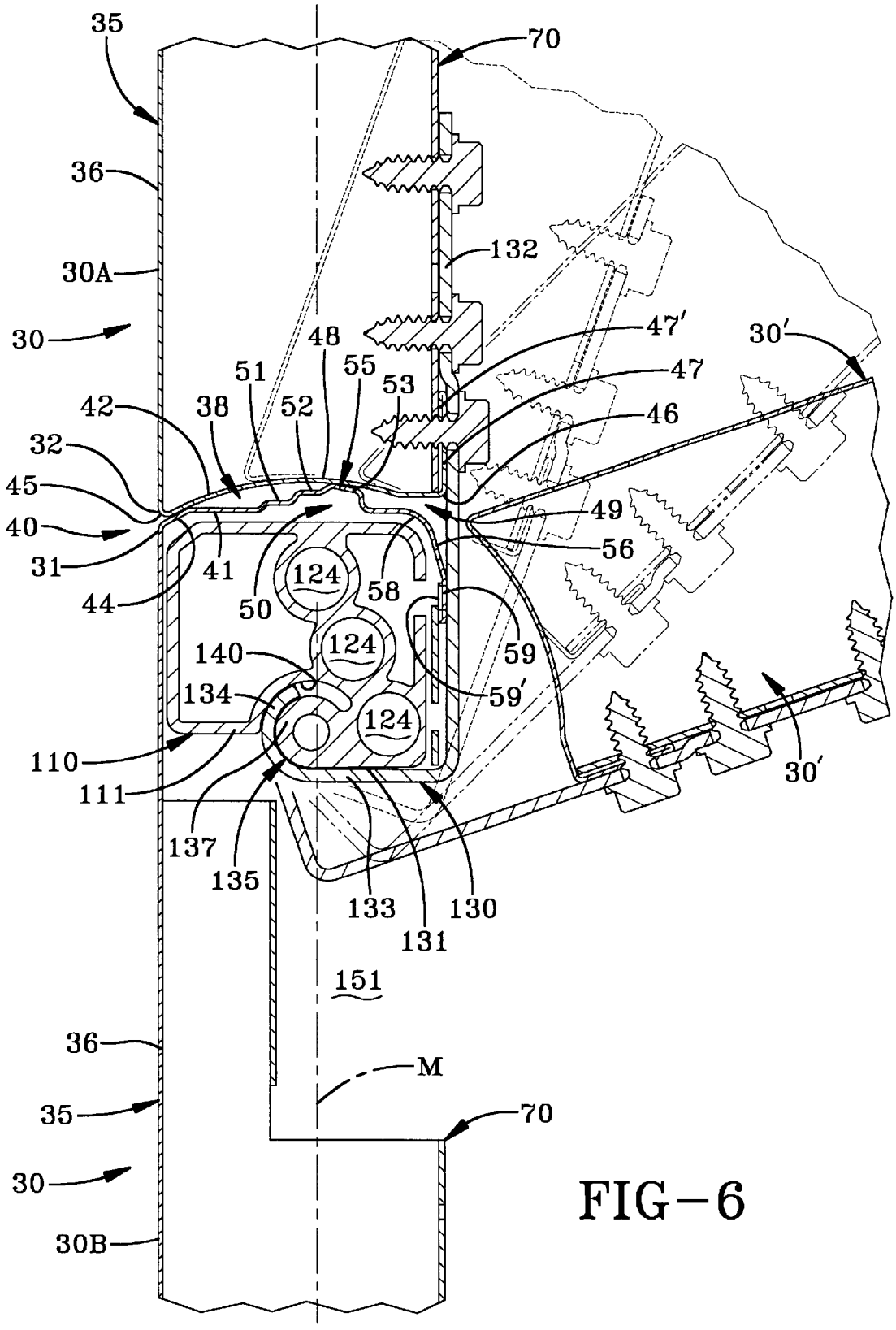
145C
145D
10"
151
152

FIG-5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70
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132
30A
30
47'
30'
48
51
55
53
47
42
38
52
46
32
45
40
49
31
41
56
124
58
44
50
124
59
140
59'
134
124
110
30'
111
137
135
133
130
131
151
36
M
35
70
30
30B

FIG-6

NON-BINDING SECTIONAL DOOR AND METHOD OF ASSEMBLY

TECHNICAL FIELD

The present invention relates generally to sectional doors which move between a closed vertical position and an open horizontal position. More particularly, the present invention relates to a non-binding sectional door and a method of assembly which compensates for the bowing of sectional door panels during movement between the vertical and horizontal positions. More specifically, the present invention relates to a door and method for locating the hinges between panels of such sectional doors to whereby the adjacent panels do not contact and bind when moving on tracks between the closed vertical position and the open horizontal position.

BACKGROUND ART

It is known that sectional door panels of the type employed in garages or other buildings that move between a closed vertical position and an open horizontal position will necessarily deflect or sag when in the open horizontal position. This is because of the panel construction and the fact that the panels are supported in such position solely by rollers at each end of the panels. When two adjacent panels are both in the horizontal position in the horizontal track sections, there is potentially no problem, inasmuch as the sag at the adjacent panel edges is essentially identical. Similarly, there is essentially no problem when adjacent panels are in the vertical closed position, as there is essentially no sag in a direction perpendicular to the face of the panel. A problem arises, however, when adjacent panels are passing through the curved transition track section between the vertical section and the horizontal section. In that instance, the horizontally disposed panel is approaching its maximum deflection while the adjacent panel in the curved transition track section is undergoing a substantially lesser deflection which may produce rubbing contact or even binding at the mating edges of the panels. The extent of this deflection varies with the angular position relative to vertical of adjacent panels passing through the curved transition track section.

While it is impractical to totally eliminate deflection in such sectional door panels, the amount of deflection varies greatly depending upon the width of the door, the thickness of the surface material, the presence or absence of a backer, the presence or absence of foamed reinforcement, and the presence or absence and design of rails, struts or other reinforcing members proximate the panel edges. Normally, deflection or sagging is most critical in pan doors without any of the strengthening or reinforcing features alluded to above. Absent unusual reinforcing in a door panel, the maximum deflection is normal to the face of the door at substantially the center point intermediate the panel ends. Industry specifications indicate that the deflection or sagging can be up to 1/120 of the door width and be considered acceptable. Thus, in the case of a standard 16 foot double car door, the deflection can be as much as approximately 41 mm and remain within industry standards.

For a number of years, it was common to employ door edge profiles with varying gaps in the panel to adjacent panel interfaces. This was accomplished with the use of flexible hinges or other constructions which permit varying the gaps between the panel at differing locations during their travel between the closed vertical position and the open horizontal position. In other instances, the panel-to-panel edges develop greater spacing therebetween when adjacent panels are at greater angularity, as when passing through the curved transition track section between the vertical track sections and the horizontal track sections. With this type of a varying gap panel spacing as a function of relative adjacent panel angularity, the deflection can be accommodated without binding or even rubbing or other contact between adjacent panel edges.

More recently, the design of the section interfaces have gone to pinch resistant configurations which will neither allow fingers to be inserted in the interface nor allow the interface to close down on fingers by maintaining a clearance or gap of less then 9 millimeters at all times during door movement. Even more desirably, maintaining the clearance or gap at less then 4 millimeters prevents pinching the skin such as to create a "blood blister". Since these pinch resistant configurations must maintain a minimal clearance or gap throughout its operating range such creates a serious problem in efforts to design an anti-pinch door without the inherent sag or deflection of the door panels producing rubbing or binding of the mating joints. This is because the deflection can greatly exceed the required and desired clearance for pinch resistant configurations.

In the instances of pinch resistant designs, binding can be encountered to an extent that an undesirable amount of force is required to move the panel interfaces through the curved transition track section for a door. Further, the force varies at different locations through the transitional track section and is not constant, such that it creates a surging condition in door operation. The surging can be recognized as erratic movement caused by rapid acceleration and deceleration of the door motion during its travel between the closed vertical position and the horizontal open position. Doors which employ openers or operators often use a control system that monitors force required to move the door as a function of door travel as a method to determine entrapment may be unable to respond to the surging of the door or the additional force required to overcome binding. This may result in false stops where a control system senses entrapment of a foreign object or other erratic operation of the control system and thus, the motorized operation of the door.

Thus, there remains a need for a non-binding door design which does not possess the reinforcing features and attendant costs normally associated with pinch resistant doors.

DISCLOSURE OF THE INVENTION

Accordingly, it is an object of the present invention to provide a sectional door wherein the panel interfaces maintain a minimal gap during movement between a closed vertical position and an open horizontal position satisfying pinch resistant specifications. Another object of the present invention is to provide such a sectional door which eliminates rubbing and possible binding between interfaces of adjacent panels even during moving through the curved transition track section between the vertical track section and the horizontal track section. An additional object of the invention is to provide such a sectional door that eliminates or at least minimizes surging such that successful use with conventional powered openers or operators and control systems therefor is assured. A further object of the present invention is to provide such a sectional door wherein the clearance or gap between the joints of adjacent sections be maintained with a gap or clearance of less than 1 millimeter without rubbing or binding during movements between the closed vertical position and open horizontal position of the door.

Another object of the present invention is to provide a sectional door which has essentially minimal constant gap panel interfaces which do not require special design profiles on the joints forming the interfaces between adjacent panels. Yet another object of the present invention is to provide such a sectional door which does not require the presence of rub strips or barriers at the interfaces between adjacent panels. Another object of the present invention is to provide such a sectional door which does not require any additional or modified components. A further object of the present invention is to provide such a door which is readily operable with counterbalance systems, operators or openers, and control systems that are conventionally designed for a door configuration.

It is yet another object of the present invention to provide such a sectional door which can exceed both mandatory and desired pinch resistant specifications recognized in the industry. A further object of the present invention is to provide such a sectional door having no additional manufacturing costs above those for a comparable door not incorporating the present invention. Yet a further object of the present invention is to provide such a sectional door which does not require any additional labor input to effect the manufacture, assembly, or installation of doors embodying the present invention as compared with an identical conventional door.

In general, the present invention contemplates a sectional door movable between a closed vertical position and an open horizontal position having, a series of adjacent panels, each of the panels having an upper joint member and a lower joint member, the lower joint member having a configuration to establish a clearance with the configuration of the upper joint member of an adjacent panel during angular articulation of the adjacent panels in moving between the closed vertical position and the open horizontal position, end hinge assemblies located proximate the longitudinal ends of the panels and connecting the adjacent panels at a first pivot axis, and at least one center hinge assembly connecting the adjacent panels at a second pivot axis offset from the first pivot axis, whereby a portion of the clearance is maintained irrespective of variations in the deflection of the panels in moving between the closed vertical position and the open horizontal position.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a fragmentary rear perspective view of an overhead sectional door system incorporating the concepts of the present invention and depicting a plurality of door panels making up the sectional door shown in conjunction with a track system for controlling movement of the door between a closed vertical position and an open horizontal position and a counterbalance system for the door;

FIG. **2** is a rear plan view showing additional details of the door of FIG. **1**;

FIG. **3** is a fragmentary side elevational view seen from a vantage rotated through an angle of approximately 5° about the right hand side of the door depicted in FIG. **2** to show the relative placement of the hinges on the end stiles and center stiles;

FIG. **4** is a schematic side elevational view with demonstrative depictions of a maximum deflection situation with the hinges conventionally mounted in alignment;

FIG. **5** is a schematic side elevational view with demonstrative depictions of a maximum deflection situation with the end hinges conventionally mounted in alignment and with the center hinges staggered or offset mounted according to the present invention;

FIG. **6** is a fragmentary sectional view through an end stile taken substantially along the line **6—6** of FIG. **2** depicting details of the hinges.

BEST MODE FOR CARRYING OUT THE INVENTION

An upward acting insulated or uninsulated sectional door system embodying the concepts of present invention is generally indicated by the numeral **10** in FIGS. **1** and **2** of the drawings. The door system **10** is positioned and mounted for opening and closing movement in a building, trailer or other structure by a peripheral door frame, generally indicated by the numeral **11**. The frame **11** consists of a pair of spaced vertical jambs **12**, that, as seen in FIGS. **1** and **2**, are generally parallel and extend vertically upwardly relative to a supporting surface such as the ground, a floor, or the bed of a trailer (not shown). The vertical jambs **12, 12** are spaced and joined proximate their vertical upper extremity by a header **13** to thereby define the generally inverted U-shaped frame **11** for mounting a door, generally indicated by the numeral **14**. The frame **11** may be constructed of wood, metal, or other relatively high-strength, rigid material for purposes of reinforcement, attachment to a building or vehicle, and facilitating the attachment of elements involved in supporting and controlling the door **14**.

The header **13** may advantageously mount a counterbalance system, generally indicated by the numeral **15** that interacts with the door **14** to facilitate raising and lowering of the door **14** in a manner well known to persons skilled in the art. The counterbalance system **15** may be in accordance with the characteristics of a counterbalance system according to Applicant's Assignee's U.S. Pat. No. 5,419,010, which is shown for exemplary purposes and the disclosure therein incorporated herein by reference. It will be appreciated that any of a variety of counterbalancing systems may be employed.

As seen in FIGS. **1** and **2**, flag angles **16** mounted on frame **11** are provided to partially support roller track assemblies, generally indicated by the numerals **17, 17**, which are positioned to either side of the door **14**. Each of the roller track assemblies **17, 17** include a vertical track section **18**, a horizontal track section **19**, and a transition track section **20** interposed therebetween. The roller track assemblies **17, 17** support and direct travel of the door **14** in moving from the closed vertical position, depicted in FIGS. **1** and **2**, associated with vertical track sections **18, 18** of roller track assemblies **17, 17**, through transition track sections **20, 20** to an open, horizontal position associated with horizontal track sections **19, 19**. The ends of horizontal track sections **19, 19** displaced from the door **14** are joined and supported by back bars (not shown) attached directly or indirectly to the ceiling or walls of a structure in which the door system **10** is installed.

A four-panel sectional door **14** is shown for exemplary purposes in FIG. **1** of the drawings. However, it will be appreciated that additional panels may be employed in sectional doors of this type depending upon the height of the door opening, the width of the panels, and related considerations. As depicted, the door **14** has a plurality of panels or sections, generally indicated by the numeral **30**. Each of the panels **30** has generally the same configuration, and thus for exemplary purposes, only a single panel **30** will be discussed in detail.

As shown particularly in FIG. **6**, door system **10** includes door **14** which for exemplary purposes is a type of "pan door". Door **14** is detailed in Applicant's Assignee's copend-

ing U.S. application Ser. No. 10/132864, filed contemporaneously on Apr. 24, 2002, entitled "Sectional Door System" which is incorporated by reference herein. Insofar as pertinent the present invention door **14** has as a primary structural member a facer, generally indicated by the numeral **35**, having a front surface **36** which may be essentially planar and extend substantially the height and width of panel **30**. Joint assemblies, generally indicated by the numeral **40**, extend rearward of front surface **36** at the top **31** and bottom **32** of panel **30**. Joint assemblies **40** may include a first joint member **41** and a second joint member **42** shown, as an example, at the top and bottom **31** and **32**, respectively, of the facer **35**. Stacking of panels **30** in the vertical, closed configuration of door **14**, depicted in FIG. **1**, causes respective first and second joint members **41**, **42** on adjacent panels **30** to mate to form an interface, generally indicated by the numeral **38** in FIG. **6** between adjacent panels. At the juncture of facer **35** and first joint member **41**, facer **35** transcends into an upwardly sloping shoulder portion **44** defining an offset that provides a seat for a projecting nose **45** formed between the front surface **36** and the second joint member **42** on a superjacent panel **30**A. In this respect, when adjacent panels **30**A, **30**B are in a planar orientation, as when the door **14** is in a closed position (FIG. **1**), the nose **45** laps over the shoulder **44**, in sealing relation of adjacent panels **30** at interface **38**. This cooperative engagement of the nose **45** and shoulder **44** also aids in reinforcing panels **30** in their resistance to wind loads.

The second joint member **42** of panel **30**A transcends a generally semicircular arc **48** extending from the nose **45** to a heel **46** formed between the second joint member **42** and tab **47** extending inwardly relative to the joint member **42** in a direction generally parallel to facer **35** and constituting the lower rear surface of panel **30**. The tab **47** may have a return hem **47'** to impart additional strength and rigidity to the panels **30**. Heel portion **46** may be planar, as shown in FIG. **6**, or transcend a downwardly projecting arc similar to nose **45**. In either case, heel portion **46** provides a clearance at **49** for the first joint member **41** throughout its range of motion.

First joint member **41** may include a raised portion, generally indicated by the numeral **50**, received within the umbrella of second joint member **42** and generally intermediate of the nose **45** and heel **46** thereof. The raised portion **50** may extend the entire length of panel **30**, or as will be appreciated, may be provided at one or more portions of the top surface of the panel **30**. Raised portion **50** extends upwardly to an extent necessary to contact second joint member **42**, when the panels **30** are oriented in a planar vertical position associated with the closed door condition, as shown in FIG. **1**.

Raised portion **50** may be integrally formed in first joint member **41**, as by the first joint member **41** transcending an upwardly extending profile, which may be gradual or include a stepped increase in the height of the first joint member **41** defining a raised portion **50** having one or more tiers. In the embodiment shown in FIG. **6**, a multi-tiered structure may include a first tier **51**; a second tier **52** extending upwardly from the first tier **51**; and a third tier **53**, which is, in this example, the uppermost tier, extending upward from the second tier **52**. Third tier **53** may have a generally planar top surface **54** which may contact the second joint member **42** in substantially a medial position relative to the front facer **36** and rear tab **47**. The area of contact, generally indicated by the numeral **55**, between the first joint member **41** and second joint member **42** at raised portion **50** may be located at any intermediate point on first joint surface **41**, such as, a point just rearward of the midline M, as shown in FIG. **6**.

To facilitate contact between the raised portion **50** and second joint member **42** when the door panels **30** are in the closed position, the top surface **54** of raised portion **50** may be given a slope so that planar top surface **54** is substantially tangential to arc **48** of second joint member **42** at the contact area. From uppermost tier **53**, first joint member **41** descends at **58** to substantially its initial level. As at the front surface **35** of panel **30**, first joint member **41** provides a clearance for free relative rotation between adjacent panels **30**. For example, first joint member **41** may extend downward and rearward in a linear fashion forming a sloped offset surface **56** that bridges first joint member **41** and tab **59** extending generally parallel to facer **35** and constituting the upper rear of panel **30**. The tab **59** may have a return hem **59'** to impart additional strength and rigidity to the panels **30**.

If desired, to reduce temperature transfer through the door **14** and/or to reduce noise transmission, insulating material (not shown) maybe carried or formed on or within panels **30**. The insulating material may be a foam body which may be of any of a variety of polyurethane or polystyrene foaming materials commonly employed in the insulation of garage doors and the like.

To help support the door **14** and improve its rigidity, various vertical support members, such as stiles may be used in connection with the door panel **30**. For example, end stiles, generally indicated by the numeral **70**, maybe located at the lateral extremities of panels **30**. If necessary or desirable, one or more center stiles, generally indicated by the numeral **90**, may be located intermediate of the lateral extremities of panels **30**. The end stiles **70**, are generally elongate members that extend between the top **31** and bottom **32** of the panels **30**. Stiles **70**, **90** are adapted to fit within the confines of panels **30** and may be retained within facer **35**. End stile **70** generally includes a stile body **71**, which may be hollow and have a box-like section as shown in FIG. **3**. Stile body **71** may be contoured at its top **72** and bottom **73** to substantially conform to the joint surfaces **41**, **42** of the panels **30** and provide additional support thereto.

The center stiles **90**, which may be similar to end stiles **70**, are provided at one or more locations intermediate the end stiles **70**. Since center stile **90** is similar to end stile **70**, like numbers will be used to describe like portions of center stile **90**. A single center stile **90** may be used, and it may be located at any point intermediate of end stiles **70**, including a point near the center of the door's width. Similarly, multiple center stiles **90** may be placed at any position along the width of a panel **30**. When multiple center stiles **90** are used, as shown for example in FIG. **1**, center stiles **90** may advantageously be substantially evenly spaced from each other and for end stiles **70**. However, variations in stile placement may be made to accommodate windows or other door design features. Center stile **90**, like end stile **70**, may have a box-like stile body **91** extending vertically between the top and bottom **31**, **32** of panels **30** (FIG. **3**). Like end stile **70**, center stile **90** may be provided with a profile similar to the first and second joint surfaces **41**, **42**.

Rollers, generally indicated by the numeral **100** in FIG. **1**, for supporting and guiding the door **14** are positioned outwardly of the end stiles **70**. The end stiles **70** may support rollers **100**, and, thus, be provided with openings **101** for receipt of roller shafts **102** (FIG. **3**). The openings **101** may be formed near the vertical extremities of end stiles **70** of each panel **30** near the interface **38** of adjacent panels **30**. As shown, multiple openings **101**, or a single opening that accommodates multiple roller positions, such as a slot, may be formed in end stiles **70** such that the roller may be moved on end stile **70** to accommodate the angularity of vertical

track sections **18**, **18** relative to vertical jambs **12**, **12** commonly employed in the art.

Referring to FIG. **6**, a roller carrier, generally indicated by the numeral **110**, may be fitted within end stile **70** to secure the roller **100** thereon. Referring to FIGS. **1**A, **2** and **2**A, the roller carrier **110** may include a hollow, block-like member or roller block **111** having an exterior surface that conforms to the interior of end stile **70** and may be inserted within the stile body **71** as indicated in FIG. **6**. Roller block **111** defines one or more openings **124** in which a roller **100** may be received.

Hinge assemblies, generally indicated by the numeral **130** in FIGS. **3** and **6**, pivotally connect panels **30**, and may include various commercially available hinge that acts to help support and pivot the panels **30** as they travel from the vertical, closed position to the horizontal, open position. Each hinge assembly **130** may include a single leaf hinge **131**. The single leaf hinge **131** is a unitary member, which may have any shape capable of coupling adjacent panels, and a pivot point located to allow proper articulation of the panels **30**. Single leaf hinge **131** may, as shown, take the form of a generally L-shaped member having a first leg **132** extending adjacent the rear tabs **59** and **47** of the panel **30**B and **30**A, respectively, of FIG. **6** and shorter second leg **133** extending inward toward the front face **36** of the panel **30**. The shorter leg **133** may have an end **134** that interacts with the door **14** in a pivoting fashion, as described more completely below.

Referring to FIG. **6**, second leg **133** of hinge leaf **131** may extend toward the front surface **36** of facer **35** and attach to the door **14** beneath the interface **38** of adjacent panels **30**A and **30**B. The end **134** of second leg **133** may be pivotally attached to panel **14** or an end receiver assembly, generally indicated by the numeral **135** in FIG. **6**. As shown in FIG. **6**, end-receiving assembly **135** has an arcuate slot **140** to receive end **134** of hinge leaf **131**. The slot **140** has a length sufficient for pivoting of the hinge **130** through the range of motion necessary for proper movement of the door panels **30** between the open and closed positions. For example, as shown in FIG. **6**A, the operating range of a panel may include travel from the vertical aligned position to a maximum angled position **30**'. In the center stiles **90** end **134** of hinge leaf **131** may pivot about a pivot pin **136** of the hinge mounted in an aperture **137** in body **91** (FIG. **3**).

With second leg **133** pivotally attached, as by sliding end **134** laterally into slot **134**, first leg **132** is attached to the adjacent panel **130** to couple adjacent panels **30** to each other. As shown in FIG. **6**, for example, first leg **132** of hinge leaf **131** extends upwardly a sufficient extent to allow attachment of the first leaf **132** to a superjacent panel **30**A. First leg **132** may be conventionally attached to stiles **70**, **90** with fasteners **150** or suitable adhesives.

As best shown in FIG. **3**, a clearance area **151** may be provided below second leg **133** to facilitate rotation of the hinge leaf **131**, during operation of the door **14**. As best shown in FIGS. **3**, for example, rotation of the hinge leaf **131** causes second leg **133** to rotate in a clockwise fashion toward the stile **70**, **90**. Clearance area **151** is provided below hinge leaf **131** such that second leg **133** may rotate as the door **14** moves from a generally vertical, closed position to a generally horizontal, open position. It is to be appreciated that the configuration of the joint assemblies **41**, **42** and the location of the pivot axis of hinge assemblies **130** combine to define the spacing between panels **30**A and **30**B and particularly nose **45** and second joint member **42** during the entire operating range of the angular articulation between adjacent panels.

The present invention is directed toward compensating for deflection or sag existing when a door panel **30** is horizontally positioned, or nearly so, in roller track assemblies **17**, **17**. FIG. **4** demonstrates a conventional door construction and assembly of the type described above. The door is schematically indicated by the numeral **10**' with an upper panel **145**A, upper intermediate panel **145**B, lower intermediate panel **145**C and bottom panel **145**B. As shown, the center surface **150** of panel **145**A has the right hand side depicted in FIG. **4** at essentially a maximum deflection. The left hand edge of panel **145**A is tending to effect a maximum deflection but is restrained by the hinge assemblies connecting panel **145**A with panel **145**B. Panel **145**B in residing in an angular position undergoes a lesser defection with the center surface **151** deflected as shown in FIG. **4**. The upper center surface **152** of panel **145**C, which is in a nearly vertical position, is deflected primarily only due to the influence of panel **145**B. With appreciable deflections at the center surface **150** and **154** at the juncture of panels **145**A and **145**B, there is commonly contact or binding between panels **145**A and **145**B. This produces a tendency for hinge assemblies **130** at the panel edges to pull out or loosen or for panel damage medially thereof by fatigue failure. This is because each time the door is raised or lowered, the junctures between panels **145**A and **145**B, **145**B and **145**C, and **145**C and **145**D, move through essentially the curved transition track sections **20**, **20** which produce the deflection conditions depicted in FIG. **4**.

The present invention contemplates offsetting the pivot axis **160**, which is the center of pivot pins **136** of center stiles **90**, the distance D below the pivot axis **161** of hinge assemblies **130** of the end stiles **70** of the door **10** as seen in FIG. **3** of the drawings. The distance of the offset is a variable which is a function of the length of the door panels, the weight of the panels, the rigidity of the panels, and other variables. In a test door constructed according to the invention, a center of a door panel for a 16-foot door deflected approximately 25 mm. It was empirically determined that with an offset distance D of 3 mm contact and binding between the panels **30** during articulation of the door was totally eliminated. The offset distance D may vary from approximately 1 mm to approximately 10 mm, depending upon the weight of a garage door, the length or span of the door panels and other factors. In this respect, shorter span, lighter weight doors normally require a lesser offset distance D, while longer, heavier panels **30** would require a greater offset distance D. Significantly, providing substantially the requisite offset distance D eliminates or at least minimizes surging such that successful operation with conventional powered openers or operators and control systems therefor is assured.

As can be seen in FIG. **5**, offsetting the pivot axis **160** of the hinge pins **136** of center stiles **90** below the pivot axis **161** of hinge assemblies **130** of the end stiles **70** of door **10**" produces an entirely different deflection profile in the same position of the door **10**' depicted in FIG. **4**. As seen in FIG. **5**, bottom center surface **150** of panel **145**A has a maximum deflection at the right side of the panel, whereas the left side center deflection is essentially negligible or even slightly raised due to the offset of the pivot axis **160** of the hinges of the center stiles **90** relative to the pivot axis **161** of the end stile **70**. At the same time, only minimal deflections of center surfaces **151** and **152** take place in the panels **145**B and **145**C of FIG. **5**.

While approximations of an appropriate offset distance D for a given door can be made based upon the above considerations, it may be necessary to empirically determine

the exact offset distance D for each individual door. In the example discussed above, a clearance or gap between panels during articulation of less than 1 mm may be achieved without rubbing or binding between adjacent panels **30**. This is substantially less than the pinch resistant configuration standards of less than 9 mm to prevent finger insertion or clamping and even the less than 4 mm necessary to prevent pinching of the skin to create a "blood blister". While it is preferred that each of the center stiles **90** of a door **14** be provided with a hinge pin interconnecting adjacent panels **30**, there may be instances where only the middle center stile or the two center stiles most closely proximate the center of a panel **30** be provided with hinges.

Thus, it should be evident that the non-binding sectional door and method of assembly disclosed herein carries out one or more of the objects of the present invention set forth above and otherwise constitutes an advantageous contribution to the art. As will be apparent to persons skilled in the art, modifications can be made to the preferred embodiment disclosed herein without departing from the spirit of the invention, the scope of the invention herein being limited solely by the scope of the attached claims.

What is claimed is:

1. A sectional door movable between a closed vertical position and an open horizontal position comprising, a series of adjacent panels, each of said panels having an upper joint member and a lower joint member, said lower joint member having a configuration to establish a clearance with the configuration of the upper joint member of an adjacent panel during angular articulation of said adjacent panels in moving between the closed vertical position and the open horizontal position, end hinge assemblies located proximate the longitudinal ends of said panels and connecting said adjacent panels at a first pivot axis, and at least one center hinge assembly connecting said adjacent panels at a second pivot axis offset from said first pivot axis, whereby a portion of said clearance is maintained irrespective of variations in the deflection of said panels in moving between the closed vertical position and the open horizontal position.

2. A sectional door of claim **1**, wherein said center hinge assembly is located substantially medially between said end hinge assemblies.

3. A sectional door according to claim **1**, wherein said second pivot axis is offset vertically below said first pivot axis when the door is in the closed vertical position.

4. A sectional door of claim **3**, wherein said offset is a distance of from approximately 1 mm to 10 mm.

5. A sectional door according to claim **3**, wherein said offset is a distance of approximately 3 mm.

6. A sectional door according to claim **1**, wherein said panels have end stiles proximate said longitudinal ends of said panels on which said end hinge assemblies are attached.

7. A sectional door according to claim **6**, wherein said panels have at least one center stile and said center hinge is located on said center stile.

8. A sectional door according to claim **6**, wherein said panels have an odd number of center stiles positioned between said end stiles with said center hinge assembly being located on the medial one of said center stiles.

9. A sectional door according to claim **6**, wherein said panels have an odd number of center stiles with one of said center hinge assemblies located on each of said center stiles.

10. A sectional door according to claim **6**, wherein said panels have an even number of center stiles positioned between said end stiles with one of said center hinge assemblies mounted on the two center stiles in closest proximity to a midpoint between said end stiles.

11. A sectional door according to claim **6**, wherein said panels have an even number of center stiles positioned between said end stiles with one of said center hinge assemblies located on each of said center stiles.

12. A sectional door according to claim **1**, wherein said end hinge assemblies and said center hinge assembly are single leaf hinges.

13. A sectional door according to claim **1**, wherein said clearance between said joint members during angular articulation does not exceed 9 mm.

14. A sectional door according to claim **1**, wherein said clearance between said joint members during angular articulation does not exceed 4 mm.

15. A sectional door according to claim **1**, wherein said clearance between said joint members during angular articulation does not exceed 1 mm.

16. A sectional door according to claim **1**, wherein said upper joint member and said lower joint member define a pinch resistant configuration.

17. A method for compensating for deflection of sectional door panels suspended by rollers movable in tracks between a closed vertical position and an open horizontal position comprising the steps of:

locating a plurality of the panels in adjacent longitudinal edge to longitudinal edge relationship;

attaching end hinge assemblies proximate the ends of the panels with the pivot axis thereof located such as to maintain the distance between the longitudinal edges of the ends of adjacent panels at less than a specified maximum clearance without contact during articulation attendant moving the door between the closed vertical position and the open horizontal position; and

attaching at least one center hinge assembly intermediate the ends of the panels with the pivot axis thereof offset from said pivot axis of said end hinge assemblies, whereby a distance less than said specified maximum clearance is maintained between edges of adjacent panels without contact over the entire length irrespective of variations in the deflection tendencies of said panels in moving between the closed vertical position and the open horizontal position.

18. The method of claim **17** including, providing an offset of approximately 1 mm to approximately 10 mm.

19. The method of claim **17** including, providing an offset of approximately 1 mm to approximately 3 mm.

20. The method of claim **17** further comprising the steps of,

mounting end stiles on said panels; and

attaching said end hinge assemblies to said end stiles.

21. The method of claim **20** further comprising the steps of,

mounting center stiles on said panels; and

attaching said center hinge assemblies to said center stiles.

22. The method of claim **21** including the step of,

employing single leaf hinges as said end hinge assemblies and said center hinge assemblies.

23. The method of claim **21** including the steps of,

boring apertures in said center stiles; and

inserting pivot pins in said apertures for constituting the pivot axis of said center hinge assemblies.

24. The method of claim **23** including the step of,

colinearly locating the pivot axis of all of said center hinge assemblies.

25. A sectional door movable between a closed vertical position and an open horizontal position comprising, a series

of adjacent panels, each of said panels having an upper joint member and a lower joint member, said lower joint member having a configuration to establish a clearance with the configuration of the upper joint member of an adjacent panel during angular articulation of said adjacent panels in moving between the closed vertical position and the open horizontal position, end hinge means located proximate the longitudinal ends of said panels and connecting said adjacent panels at a first pivot axis, and center hinge means connecting said adjacent panels at a second pivot axis offset from said first pivot axis, whereby a portion of said clearance is maintained irrespective of variations in the deflection of said panels in moving between the closed vertical position and the open horizontal position.

26. A sectional door of claim **25**, wherein said end hinge means and said center hinge means are single leaf hinges.

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United States Patent
Mullet

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(45) **Certificate Issued: Aug. 28, 2012**

(54) **NON-BINDING SECTIONAL DOOR AND METHOD OF ASSEMBLY**

(75) Inventor: **Willis J. Mullet**, Gulf Breeze, FL (US)

(73) Assignee: **Overhead Door Corporation**, Lewisville, TX (US)

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(51) **Int. Cl.**

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E06B 3/32	(2006.01)
E05D 15/16	(2006.01)
E05D 15/24	(2006.01)

(52) **U.S. Cl.** **160/229.1**; 160/201; 160/218

(58) **Field of Classification Search** ..... None
See application file for complete search history.

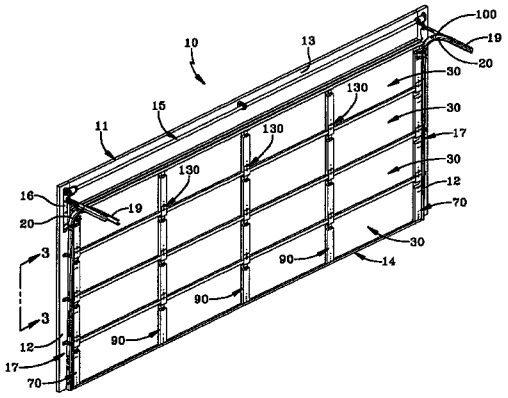
(56) **References Cited**

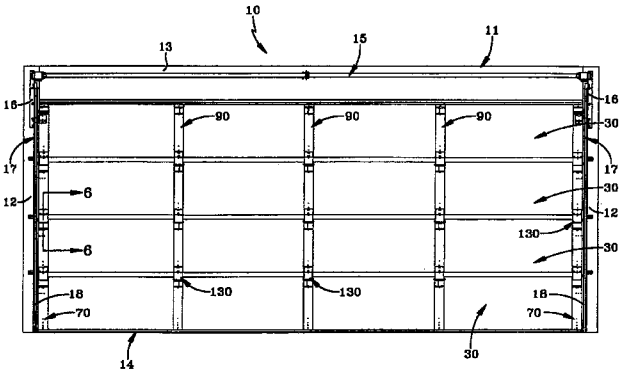
To view the complete listing of prior art documents cited during the proceeding for Reexamination Control Number 95/000,304, please refer to the USPTO's public Patent Application Information Retrieval (PAIR) system under the Display References tab.

Primary Examiner—Jeffrey L. Gellner

(57) **ABSTRACT**

A sectional door movable between a closed vertical position and an open horizontal position having, a series of adjacent panels, each of the panels having an upper joint member and a lower joint member, the lower joint member having a configuration to establish a clearance with the configuration of the upper joint member of an adjacent panel during angular articulation of the adjacent panels in moving between the closed vertical position and the open horizontal position, end hinge assemblies located proximate the longitudinal ends of the panels and connecting the adjacent panels at a first pivot axis, and at least one center hinge assembly connecting the adjacent panels at a second pivot axis offset from the first pivot axis, whereby a portion of the clearance is maintained irrespective of variations in the deflection of the panels in moving between the closed vertical position and the open horizontal position.





INTER PARTES REEXAMINATION CERTIFICATE ISSUED UNDER 35 U.S.C. 316

NO AMENDMENTS HAVE BEEN MADE TO THE PATENT

AS A RESULT OF REEXAMINATION, IT HAS BEEN DETERMINED THAT:

The patentability of claims **1-22**, **25** and **26** is confirmed.

Claims **23** and **24** were not reexamined.

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