Feb. 23, 1943. E. W. SIHVONEN ET AL 2,311,703

FLEXIBLE DOOR AND MECHANISM FOR OPERATING THE SAME

Filed May 16, 1940 2 Sheets-Sheet 1

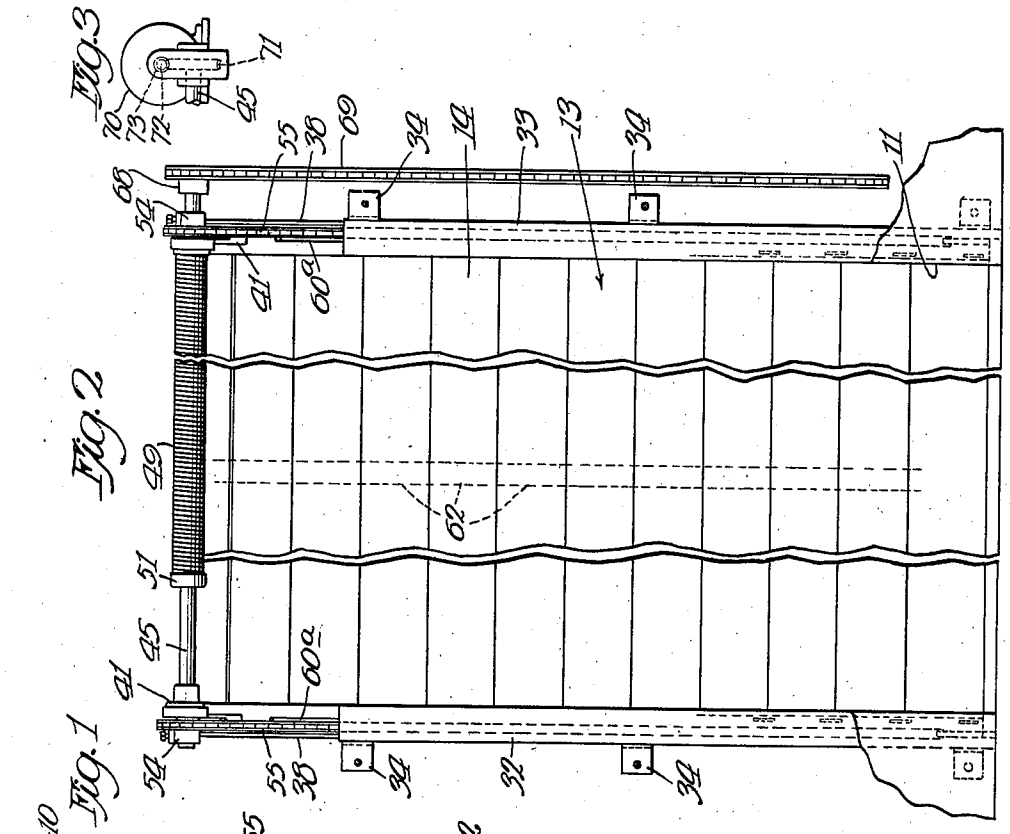


Fig. 3

Fig. 2

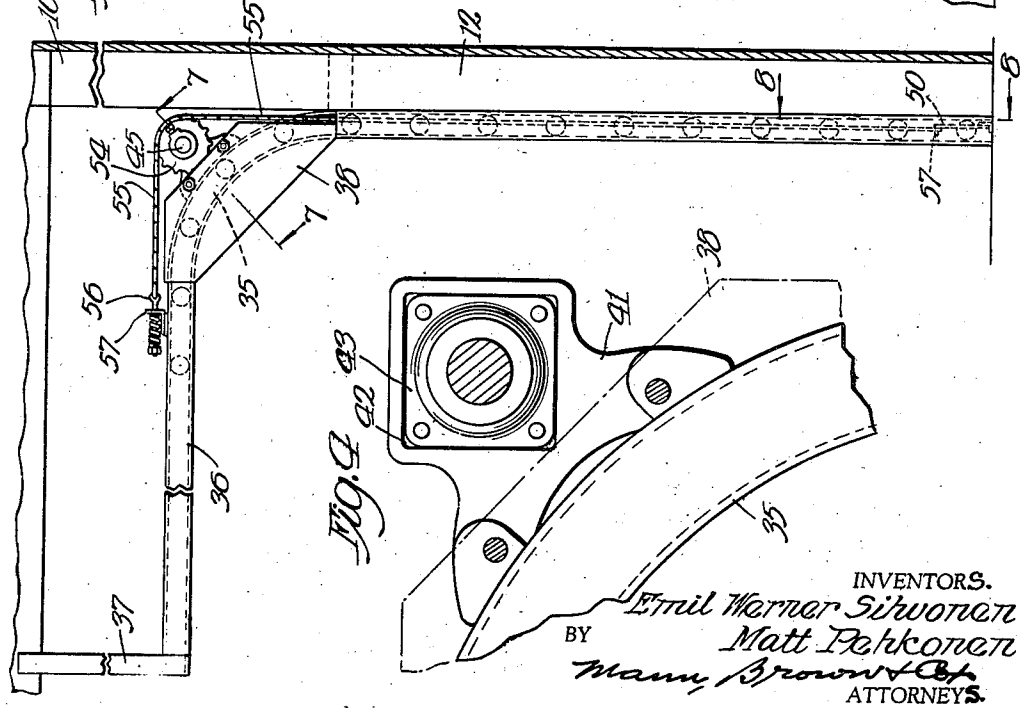


Fig. 1

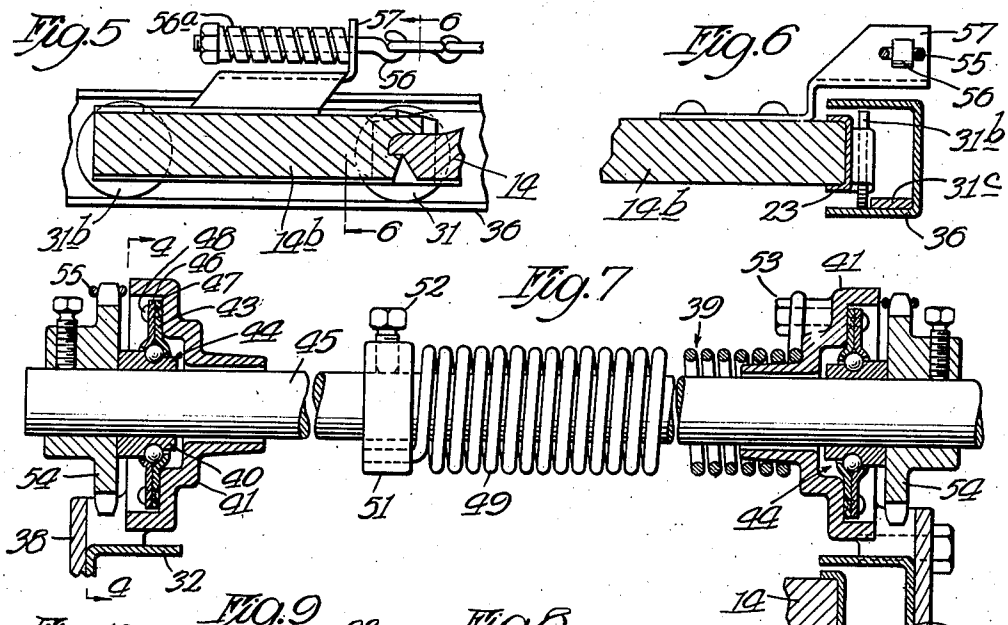
Fig. 4

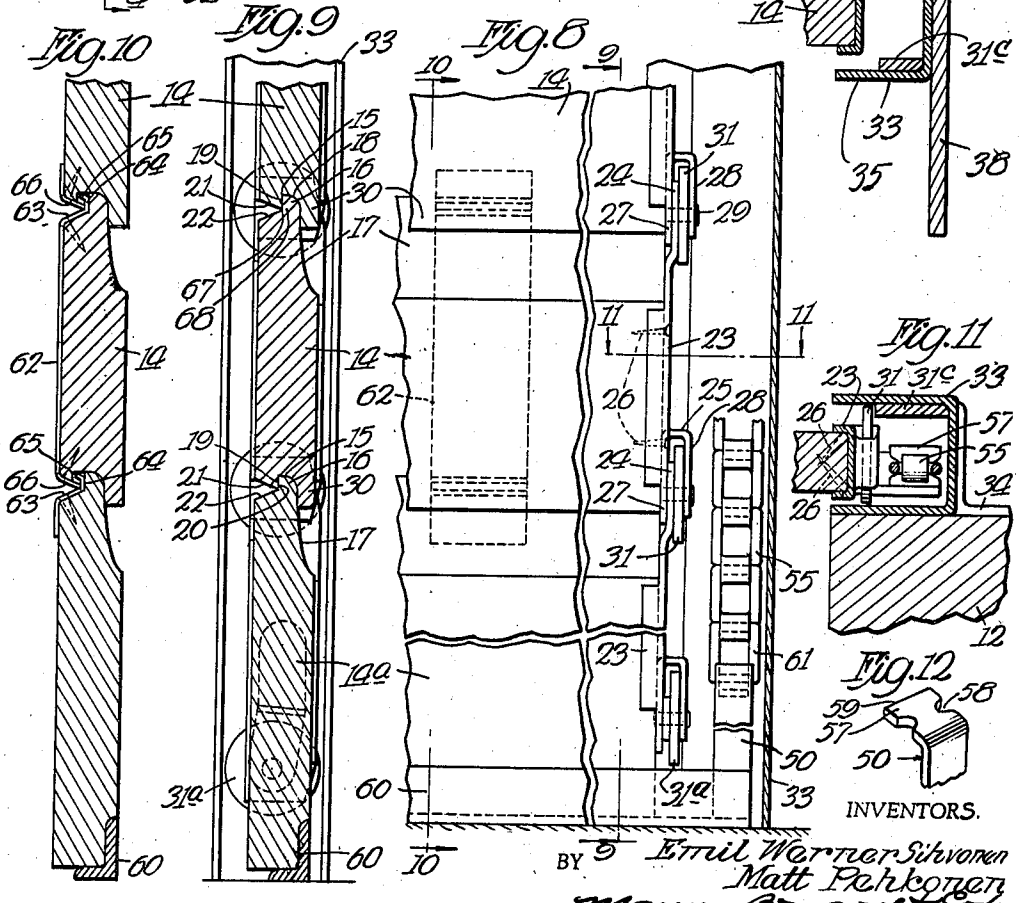
INVENTORS.
Emil Werner Sihvonen
Matt Pekkonen
BY
Mann, Brown & Ch.
ATTORNEYS.

Feb. 23, 1943. E. W. SIHVONEN ET AL 2,311,703

FLEXIBLE DOOR AND MECHANISM FOR OPERATING THE SAME

Filed May 16, 1940 2 Sheets-Sheet 2





INVENTORS.
Emil Werner Sihvonen
Matt Pehkonen
BY Mann, Brown & Mann
ATTORNEYS.

Patented Feb. 23, 1943 2,311,703

UNITED STATES PATENT OFFICE

2,311,703

FLEXIBLE DOOR AND MECHANISM FOR OPERATING THE SAME

Emil Werner Sihvonen and Matt Pehkonen, Detroit, Mich., assignors to Quad Manufacturing Company, a corporation of Michigan

Application May 16, 1940, Serial No. 335,500

10 Claims. (Cl. 160—191)

This invention relates to closures for openings in buildings and more particularly to closures or doors for garages, storehouses and the like.

One of the objects of the invention is the provision of a new and improved flexible door having novel means for forming weatherproof connections between the sections of the door.

Another object of the invention is the provision of a new and improved flexible door together with novel means for flexibly connecting the sections together that form the door.

A further object of the invention is the provision of a new and improved flexible or sectional door for garages and the like having novel anti-friction bearings for the various door sections and provided with improved counterbalancing and elevating means for the door.

A still further object of the invention is the provision of a new and improved vertically movable flexible door that is simple in construction, inexpensive to manufacture, easily assembled, that may be operated manually or by power at an expenditure of a minimum amount of energy and that is efficient in use and that is so constructed as to be weatherproof.

Other and further objects and advantages of the invention will appear from the following description, taken in connection with the accompanying drawings, in which—

Fig. 1 is a vertical section of a garage through the doorway showing the invention in position therein, with parts broken away;

Fig. 2 is a front elevation of a portion of the garage showing the invention in position thereon, and with parts broken away;

Fig. 3 is a side elevation of the motor and a portion of the operating shaft;

Fig. 4 is a section on the line 4—4 of Fig. 7, with parts broken away;

Fig. 5 is a detail section of a horizontal part of the drawings showing the upper extension of the door and a portion of the operating mechanism broken away;

Fig. 6 is a section on the line 6—6 of Fig. 5;

Fig. 7 is a section on the line 7—7 of Fig. 1, with parts broken away;

Fig. 8 is a section on the line 8—8 of Fig. 1;

Fig. 9 is a section on the line 9—9 of Fig. 8;

Fig. 10 is a section on the line 10—10 of Fig. 8;

Fig. 11 is a section on the line 11—11 of Fig. 8, with parts broken away; and

Fig. 12 is a detail view of a modified form of door guide.

Referring now to the drawings, 10 designates a garage or other building having a doorway 11, a door post or jamb 12 at each side thereof and a sectional or flexible door 13 for closing the opening. The door 13 is adapted to be so mounted that it may be slid upwardly and then horizontally into open position. The door 13 comprises a plurality of boards or sections 14 which may be of any suitable material. In the form of the construction shown, which is by way of example only, wooden boards or sections 14 are employed. These sections are arranged to extend horizontally and interengage along their adjacent edges and are pivotally connected together. The boards or sections 14 are alike except for the upper and lowermost ones and consequently, only one of the intermediate boards or panels need be described.

In the description of the invention, the relative terms "upper" and "lower" and "inner" and "outer" will be used to describe the parts as they appear when the door is closed or in lowered position, as shown in Fig. 1.

The lower edge of each intermediate section is provided with a groove 15, Fig. 9, and the upper edge with a tongue 16. The tongue of one board engages the groove of the next adjacent board above. These tongues and grooves are in the central plane of the boards, as shown in Fig. 9. The upper, outer edge or shoulder of each board or section 14 extends vertically downward from the base of the outer surface of the tongue a substantial distance and then curves outwardly and downwardly as shown at 17 for directing water flowing down onto it from the outer surface of the upper adjacent section outwardly to the outer surface of the board. The upper outer surface of the tongue 16 is curved upwardly and inwardly from its base as at 18 on a radius having a center eccentric to the axis of the hinge so that the tongue and groove will readily separate on bending the door but will tightly engage each other when the sections are in alinement to provide a tight joint against wind and water, as will presently appear.

The inner side of the tongue 16 is vertical as shown at 19, Fig. 9, the groove 15 being correspondingly formed for receiving the tongue. The straight vertical edge 20 of the groove engages the vertical edge 19 of the tongue for limiting the bending of the door sections beyond a vertical plane in one direction. The inner meeting edges of the upper and lower boards or sections are beveled off as at 21 and 22, respectively, Fig. 9, to provide clearance for bending the sectional door in the opposite direction. The outer wall or flange 30, Fig. 9, of the groove is considerably

elongated for overlapping the upper edge of the lower reduced portion of the lower adjacent board a substantial distance so as to insure a tight weatherproof joint under all weather conditions and even should the boards warp. This extension 30 also functions to limit the hinge movement beyond a vertical plane.

The lower section 14a has a plain lower edge. It is preferably, though not necessarily, rabbeted in its outer surface adjacent its lower edge for receiving the vertical flange of an angle bar 60 secured thereto in any suitable manner. The horizontal flange of the angle extends beneath the door, as shown in Figs. 9 and 10. This angle bar extends laterally beyond the side edges of the door into the guideways 32 and 33, as will presently appear. The uppermost section or board 14b is likewise square at its free edge, as shown in Fig. 5.

The boards or sections are adapted to be pivoted or hinged to each other so that they are free to flex inwardly a predetermined distance. Any suitable mechanism may be employed for this purpose. In the form of the construction shown, each panel at each edge thereof is provided with a channel-shaped bracket 23, Fig. 8, having an upper offset extension 24 and a bifurcated lower extension 25 having the inner and outer arms 27 and 28. The intermediate portion of the bracket 23 is adapted to receive the intermediate portion of the end of the panel in said channel and is secured thereto in any suitable manner as by means of the screws 26 which extend diagonally into the sections, as shown in Fig. 11. These channel members 23 protect the edges of the boards against cracks and splitting of the boards. The projection 24 of one panel is offset laterally to overlap the inner arm 27 of the bifurcated lower projection 25 as shown more clearly in Fig. 8 of the drawings. The arms 27 and 28 of one panel and the overlapping extensions 24 of the adjacent lower panel are provided with aligned openings through which pivot pins 29 extend for pivotally connecting the two sections together.

Suitable antifriction rollers 31 are rotatably mounted on the pivot pins 29 between the arm 28 and the projections 24 at each side edge of the board. The lower section 14a is provided adjacent its lower edge with rollers 31a, Fig. 9, and likewise the upper section 14b, Fig. 5, is also provided adjacent its free edge with rollers 31b. The diameters of the rollers are the same and are such as to support the sections free of the flanges of the track channels, as will presently appear.

Suitable means are provided for guiding the door in its upward and horizontal movement. As shown on the drawings, channel members, guideways or runways 32 and 33, Fig. 2, are employed for this purpose. The flanges of these channels extend toward each other and are secured to the door posts 12 by any suitable means such as the brackets 34.

The tracks, guideways or channels 32 and 33 extend upwardly and are then curved inwardly as shown at 35. The horizontal portion of the channel member may be of less depth than the lower portion because the lower portion has the operating cable therein, as will presently appear. The horizontal portion 36 of each track is adapted to be supported by flexible bars 37 which will automatically adjust the tracks under all climatic conditions. A suitable brace or web member 38, Fig. 1, is provided at the bend for reinforcing the track at this point. Guide bars 31c may be secured to the channel bars for engaging the side edges of the rollers 31 for preventing lateral movement of the door.

Suitable means are provided for counter-balancing the weight of the door and for materially assisting in elevating the same. Any suitable mechanism may be employed for this purpose. As shown on the drawings, spring operated mechanism 39, Fig. 7, is employed for this purpose. Mounted on the channel at the bend 35 thereof, Fig. 4, are the brackets 41 at each side of the door and these brackets are provided with angular recesses 42 for receiving the outer race 43 of a ball bearing 44, Figs. 4 and 7. The inner race 40 of the ball bearing 44, Figs. 4 and 7, is adapted to be secured to a shaft 45 which extends from one channel bar across the doorway to the other channel bar. The race 43 of the ball bearings 44 comprises a pair of rectangular plates 46 and 47 which are adapted to be held together by rivets 48 or the like extending through the plates. These plates are loosely mounted in the recesses 42 as shown more clearly in Figs. 4 and 7 of the drawings. The plates 46 and 47 have alined openings with the marginal edges about the openings bent in the opposite directions to form the outer ball race. This arrangement provides means whereby the ball bearings may be readily and easily assembled and attached. They are so constructed that the ball bearing not only functions as a radial antifriction bearing but also as a thrust bearing for counteracting the thrust of the shaft due to the spring thereon. The plates fit loosely in the recess 42 thereby permitting free alinement of the parts. The shaft 45 has a torsion spring 49 extending about the same, one end of which is secured to a collar 51 which in turn is rigidly secured to the shaft 45 as by means of a set screw 52. The collar 51 and set screw 52 will cause the tensioning of the spring 49 when the shaft is rotated in lowering the door. The opposite ends of the spring 49 are anchored to the bracket 41 as by means of a bolt 53 which extends through an eye in the spring and is tapped into said bracket.

Rotating members and cables are provided for causing the raising and lowering of the door when the shaft 45 is rotated. In the form of the mechanism shown, a sprocket and chain arrangement is employed for this purpose. Mounted on the ends of the shaft 45 outwardly of the bearings are suitable sprockets 54 over which are trained a pair of sprocket chains or cables 55. The upper ends of these chains are attached to spring pressed bolts 56 carried by brackets 57 secured to the upper board of the sectional door, as shown in Figs. 1 and 5 of the drawings. The lower ends of these chains are secured to the lower section 14a of the door by any suitable means as by means of the brackets 50. The brackets are rigidly secured to the outer ends of the angle bar 60 by suitable fastening means such as rivets, spot welds, or the like, and the upper ends of the brackets extend inwardly, as shown at 57, Fig. 11. The inward extension 57 is provided with notches or recesses 58 on each edge which form a head 59. The chain or cable 55 which is provided with rectangular links 61 may be attached to the bracket 56 by first turning the links sidewise, slipping the same over the head 59 and then turning them vertically so that the vertical portions of the links will engage in the notches 58 and anchor the chain to the bracket.

The chains 55 extend downwardly within the

channel guide members 32 and 33 laterally of the ends of the door sections. The outer flanges of the channel track members 32 and 33 are cut away or provided with openings 60a at the bends of the track above the vertical portion of the tracks through which the chains 55 extend, as shown in Figs. 1 and 2. The springs 56a on the bolts 56 will take up the slack in the chain 55. The tension of the springs may be adjusted, if desired.

The parts are so constructed that the spring 49 is under a slight initial tension when the door is in its uppermost position. When the door is lowered, the rod 45 will be rotated and the spring placed under tension thereby counter-balancing the weight of the door. This tension may be varied by adjusting the collar 51 on the shaft 45.

Appropriate means are provided for assisting in holding the central portions of the boards in proper positions and to assist in preventing warping of the sections. In the form of the construction selected to illustrate one embodiment of the invention, metallic hinge members are provided for this purpose. For the intermediate sections of the door, these members are identical and each comprises a rather wide metallic plate 62, Fig. 10, that extends along the interior of the board and has its upper end bent inwardly along the inclined shoulder 22 as at 63, then vertically upwardly as at 64, along the vertical surface 19 of the tongue 16 and then inwardly and diagonally upwardly to form a hook like projection 65. The lower end of the plate 62 is bent inwardly along the inclined shoulder 21 to form a lip 66 in contact with the hook like projection 65 on the upper edge of the adjacent lower section. The parts are so constructed that the hook cannot be disengaged except by flexing the joint further than necessary to move around the curves in the tracks. The vertical portion 64 is somewhat extended so that if the boards warp vertically, it will not affect the hinge. The lip 66 acts as a fulcrum for forcing the tongue 16 against the projection 30 when the boards are brought into vertical alinement. These hinge members extend the full height of the door forming a vertical row of hinges and as many rows as desired may be employed. As shown, a single row along the central portion of the door is employed.

Referring to Fig. 9, it will be noted that the axis of the hinges is at the point where the planes of the surfaces 19 and 22 intersect, at 67, whereas the center for the radius for the curve 18 for the tongue 16 is slightly forwardly of 67 so that when the sections are flexed, the parts readily pull apart but are wedged together when the sections are moved to a common plane.

Any suitable mechanism may be employed for rotating the shaft 45 for raising and lowering the door. The door may be raised and lowered manually, if desired. If the door is to be raised and lowered manually, a sprocket 68 is mounted on the shaft 45 over which is trained the upper loop of an endless sprocket chain 69. By pulling on one side of the loop, the shaft 45 is rotated and this rotates the sprockets 54 for lowering the chains and with them, the door; and, by pulling on the other, the door is raised. Any other appropriate means may be employed, as, for instance, bevel gears and an operating crank and rod may be used. A reversible motor 70 may be provided for rotating the shaft 45, as shown in Fig. 3 of the drawings, if desired. In this event, the shaft 45 is provided with a worm gear 71 and the motor shaft 72 may be provided with a worm 73 for engaging the gear for rotating the shaft 45.

It will thus be seen that a door constructed as described above is flexible in one direction, is held rigid against flexing beyond a vertical plane in the opposite direction, that the joints between the sections are tight against wind and rain, and that rain or water falling on the outer surface of the door will be deflected outwardly from the joints and will flow down the outside of the door. It will also be noted that all parts of the operating mechanism and all parts of the construction, except the sections or boards themselves, are protected from the weather. This is considered an important feature of the invention.

Instead of using the guide bars for preventing lateral movement of the door, two of the sections such as the top and bottom may have attached to each end thereof antifriction rollers 31d that extend longitudinally outwardly in the planes thereof for engaging the webs of the guide channels for preventing lateral movement of the door.

It is thought from the foregoing, taken in connection with the accompanying drawings, that the construction and operation of our device will be apparent to those skilled in the art and that changes in size, shape, proportion and detail may be made without departing from the spirit and scope of the appended claims.

We claim as our invention:

1. In a flexible door for use in garages, a plurality of sections extending horizontally edge to edge and having their meeting edges interengaging, means for hingedly connecting said sections together to hinge about horizontal axes, rollers of greater diameter than the thickness of said sections rotatably mounted on said means at opposite ends of said sections, the interengaging portions of said sections being so constructed as to enable the door sections to hinge in one direction only and to prevent hinge movement beyond the common plane of the sections in the opposite direction, the adjacent edges of the said sections having a tongue and groove connection, the upper outer edge of said tongue being substantially vertical and the upper forward edge of said tongue being on a curve slightly eccentric to the axis of said first-named means whereby a water-tight joint is formed between adjacent sections when the same are in a vertical plane.

2. A flexible door for garage buildings and the like comprising a plurality of sections, interengaging tongues and grooves between the meeting edges of said sections, means at the ends of said sections for pivotally connecting the sections together, anti-friction rollers carried by said means and coaxial therewith, the axes of said means and rollers being in the planes of said tongues, the upper inner surfaces of said tongues being substantially vertical and the upper outer surface of said tongues being curved about axes slightly in advance of the axes of said pivotal means, and the inner shoulders of adjacent sections being beveled off whereby said door may flex in one direction only and the tongues be wedged in the grooves to form a weatherproof joint between them when the adjacent sections are moved into a common plane.

3. In a building having a door opening, a door jamb at each side of said opening, channel runways attached to the inner sides of said door jambs and having their upper portions curved inwardly, a flexible door having its sections extending horizontally, hinge members at each side edge of the door for pivotally connecting said sections together, the lower section having its upper

edge in the form of a tongue with its upper surface curved on its outer side and engaging in a corresponding recess in the lower edge of the adjacent upper section, the inner face of said tongue being vertical for engaging a vertical marginal wall of said groove and the outer flange or wall of said groove being extended for engaging the outer surface of the lower adjacent board for preventing flexing the sections beyond the vertical in one direction, the axis of curvature of the upper surface of said tongue being eccentric to the axis of the corresponding hinge for wedging said tongue in said recess when said door is in lowered position, means carried by hinge members for engaging the flanges of said channel runways for guiding said door and for holding the door sections in vertical alignment when the door is in lowered position, and means for raising and lowering said door.

4. A flexible door comprising a plurality of comparatively narrow horizontal sections having their meeting edges interengaging, overlapping hinge members on the vertical edges of said sections at the ends thereof, hinge pivots for connecting said members together, rollers on said pivots, hinge elements having hook-like metallic members on the upper edges of said sections and extending between said interengaging edges, and other hinge elements having downwardly and outwardly extending projections on the adjacent sections above for engaging said hook-like elements on the adjacent section below for hinging the central portions of said sections together and for preventing warping of said sections.

5. In a building having a door opening therein, a flexible vertically movable door for said opening, means for raising and lowering said door, said door comprising sections arranged edge to edge, the meeting edges of said sections having a tongue and groove engagement at their adjacent edges, the tongue being on the lower section and having its upper edge curved inwardly on a predetermined radius and engaging in a corresponding groove, means for pivotally connecting said sections together to swing about an axis eccentric to the curvature of said tongue for providing a wedging action between the tongue and groove for forming a water-tight joint, the outer shoulder of said tongue being cut away in a curve whereby water flowing down from the outer side of the next adjacent board above said tongue will be directed by such curved surface to the outer plane surface of the lower section.

6. In a building having a door opening therein, a flexible vertically movable door for said opening, means for raising and lowering said door, said door comprising sections arranged edge to edge, the meeting edges of said sections having an interlocking connection between said sections so constructed that when the sections are in alinement the interlocking connection will fit snugly together to form a weather-tight joint and capable of being flexed only in one direction, and hinge members secured to said sections at their central portions, said members comprising an extension on one section engaging a hook-like projection on the adjacent section, said extension having a limited vertical sliding movement on said hook-like member for compensating for vertical warping of said sections and for preventing undue warping thereof, said hook-like projection extending between the parts of said interlocking connection.

7. In a building having a door opening, channel guideways at each side of said opening extending upwardly and then curved to extend horizontally, a flexible door having its side edges movable in said channel guideways, said flexible door comprising a plurality of comparatively narrow horizontally arranged sections, hinges at the ends of the sections for connecting them together, the adjacent edges of said sections interengaging and wedged together when the door is in operative position, said interengaging portions of said sections having a portion on a curve slightly eccentric to the axis of said hinges whereby the interengaging edges are wedged together when the door is in vertical position, rollers mounted on the hinges of said sections and engaging in said channel guideways for holding said sections in vertical alignment with said meeting edges wedged together when the door is in lowered position.

8. In a building having a door opening, channel guideways at each side of said opening extending upwardly and then curved to extend horizontally, a flexible door having its side edges movable in said channel guideways, said flexible door comprising a plurality of comparatively narrow horizontally arranged sections, hinges at the ends of the sections for connecting them together, the adjacent edges of said sections interengaging and wedged together when the door is in operative position, said interengaging portions of said sections having a portion on a curve slightly eccentric to the axis of said hinges whereby the interengaging edges are wedged together when the door is in vertical position, rollers mounted on the hinges of said sections and engaging in said channel guideways for holding said sections in vertical alignment with said meeting edges wedged together when the door is in lowered position, a rotating shaft, a sprocket on each end portion of said shaft above said channels, a sprocket chain extending along each side edge of the door within said channels and attached to the ends of said door and extending over said sprockets, and a spring interposed in each chain for maintaining the same taut for holding said interengaging portions of said sections in tight engagement in all positions of said door.

9. In a building having a door opening, channel guideways at each side of said opening extending upwardly and then curved to extend horizontally, a flexible door having its side edges movable in said channel guideways, said flexible door comprising a plurality of comparatively narrow horizontally arranged sections, hinges at the ends of the sections for connecting them together, the adjacent edges of said sections interengaging and wedged together when the door is in operative position, said interengaging portions of said sections having a portion on a curve slightly eccentric to the axis of said hinges whereby the interengaging edges are wedged together when the door is in vertical position, rollers mounted on the hinges of said sections and engaging in said channel guideways for holding said sections in vertical alignment with said meeting edges wedged together when the door is in lowered position, a rotating shaft, a sprocket on each end portion of said shaft above said channels, a sprocket chain extending along each side edge of the door within said channels and attached to the ends of said door and extending over said sprockets, a spring interposed in each chain for maintaining the same taut for holding said interengaging portions of said sections in tight engagement in all positions of said door, and spring means for resiliently resisting the rotation of said shaft when said door is lowered.

10. In a building having a door opening, channel guideways at each side of said opening extending upwardly and then curved to extend horizontally, a flexible door having its side edges movable in said channel guideways, said flexible door comprising a plurality of comparatively narrow horizontally arranged sections, hinges at the ends of the sections for connecting them together, the adjacent edges of said sections interengaging and wedged together when the door is in operative position, said interengaging portions of said sections having a portion on a curve slightly eccentric to the axis of said hinges whereby the interengaging edges are wedged together when the door is in vertical position, rollers mounted on the hinges of said sections and engaging in said channel guideways for holding said sections in vertical alignment with said meeting edges wedged together when the door is in lowered position, a rotating shaft, a sprocket on each end portion of said shaft above said channels, a sprocket chain extending along each side edge of the door within said channels and attached to the ends of said door and extending over said sprockets, a spring interposed in each chain for maintaining the same taut for holding said interengaging portions of said sections in tight engagement in all positions of said door, spring means for resiliently resisting the rotation of said shaft when said door is lowered, and means for raising and lowering said door, said means comprising mechanism for rotating said shaft whereby in both raising and lowering said door said interengaging portions of said sections will be forced toward each other.

EMIL W. SIHVONEN.
MATT PEHKONEN.