

Dec. 27, 1932.

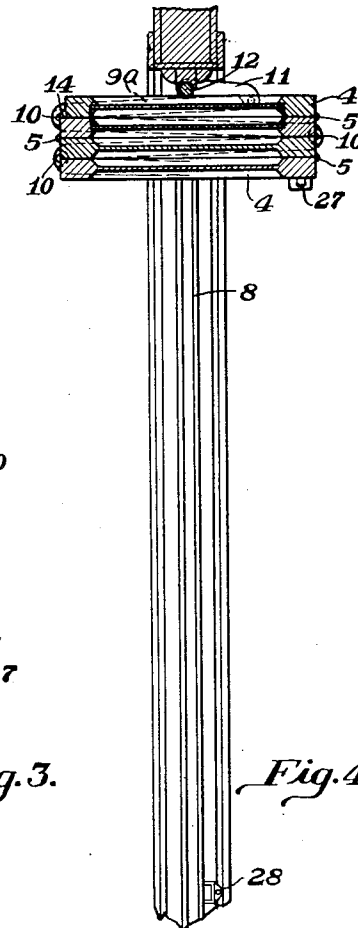
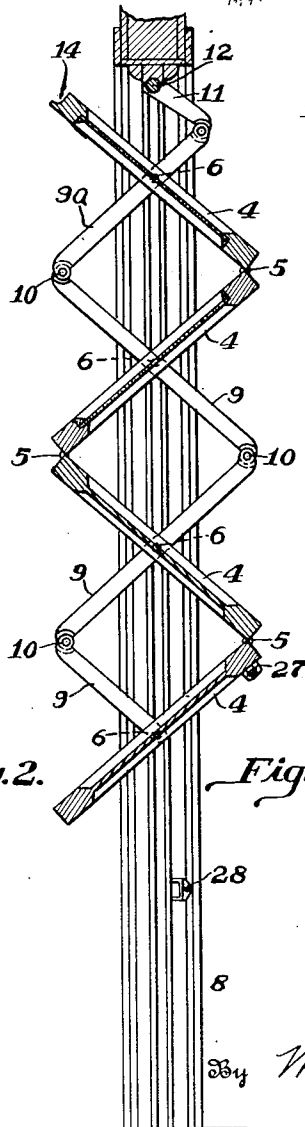
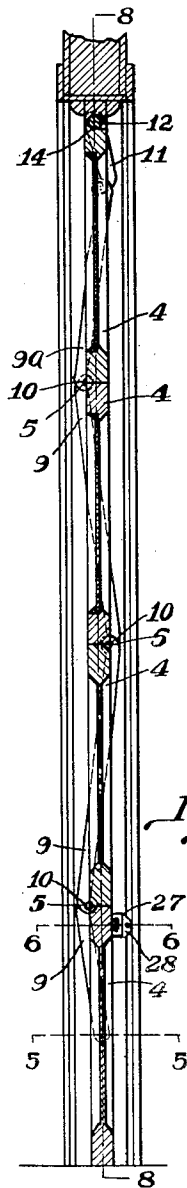
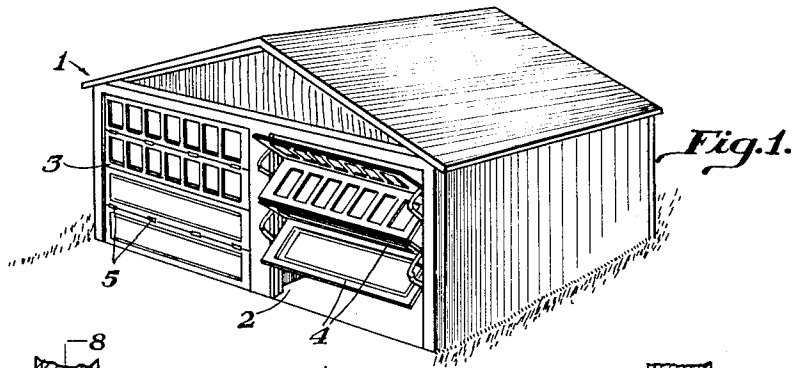
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1,892,340

FOLDABLE DOOR STRUCTURE

Filed Oct. 17, 1930

4 Sheets-Sheet 1



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FOLDABLE DOOR STRUCTURE

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4 Sheets-Sheet 2

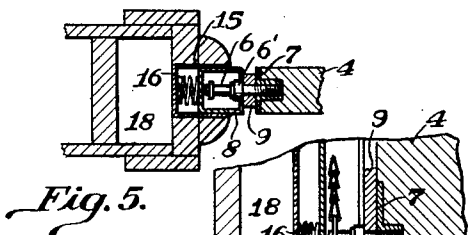


Fig. 5.

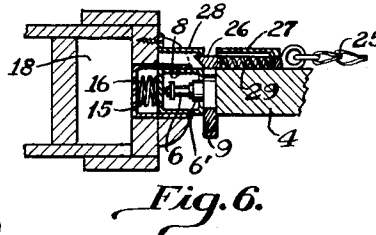


Fig. 6.

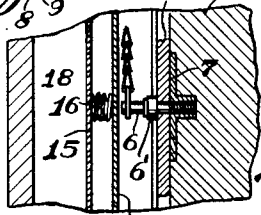


Fig. 7.

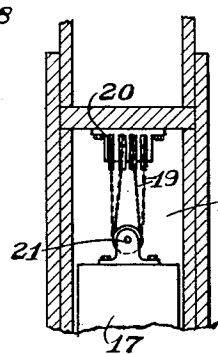
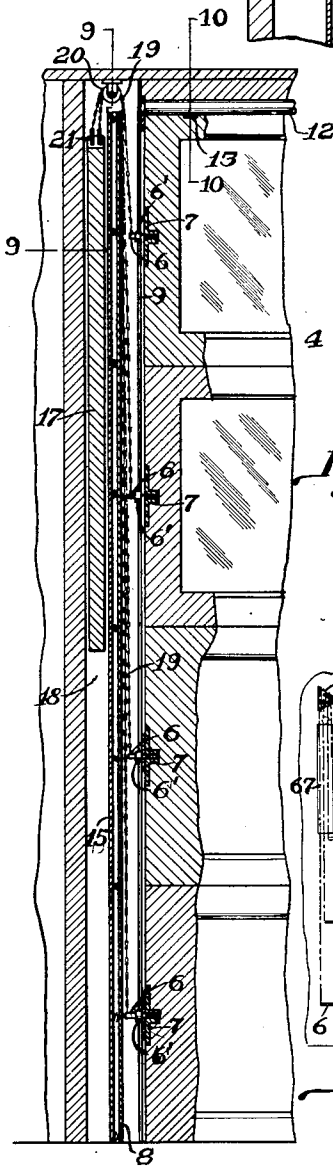


Fig. 9.

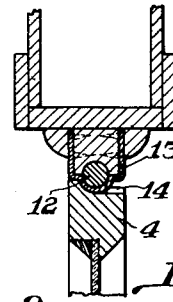


Fig. 10.

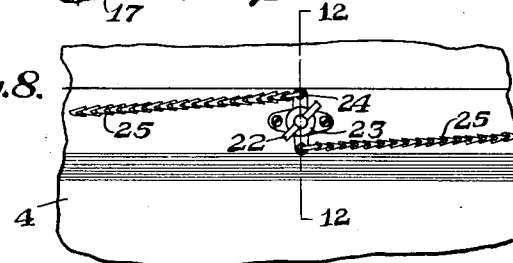


Fig. 11.

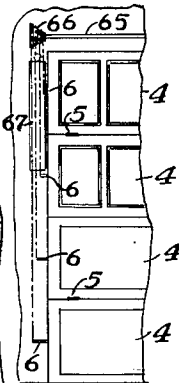


Fig. 24.

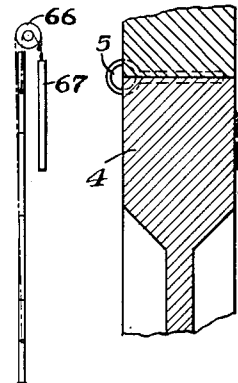


Fig. 25.



Fig. 12.

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FOLDABLE DOOR STRUCTURE

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Fig.13.

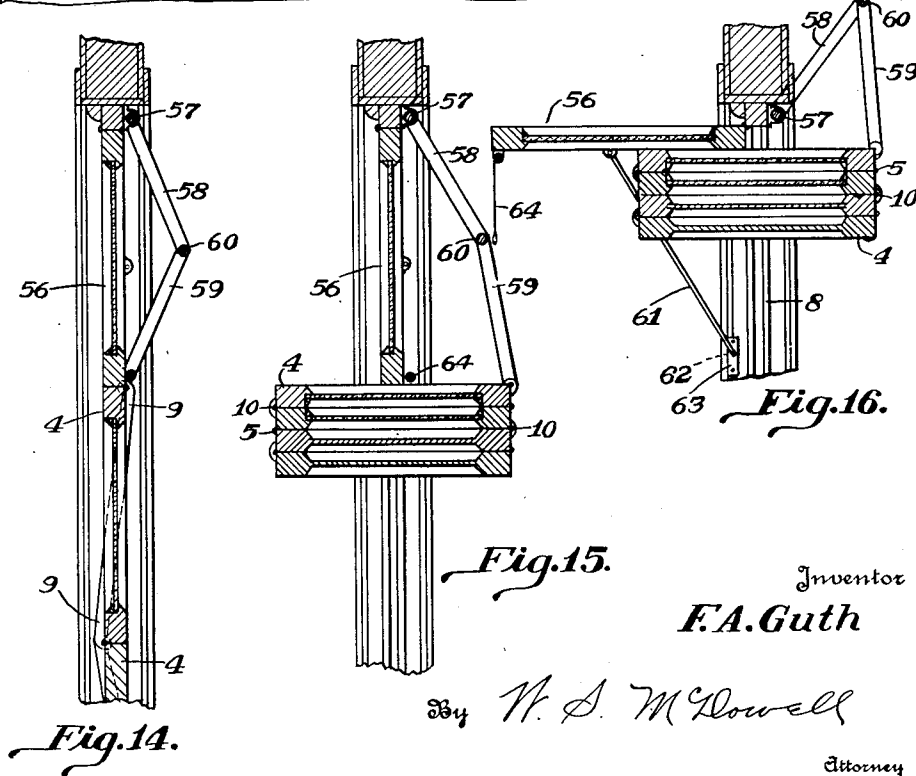
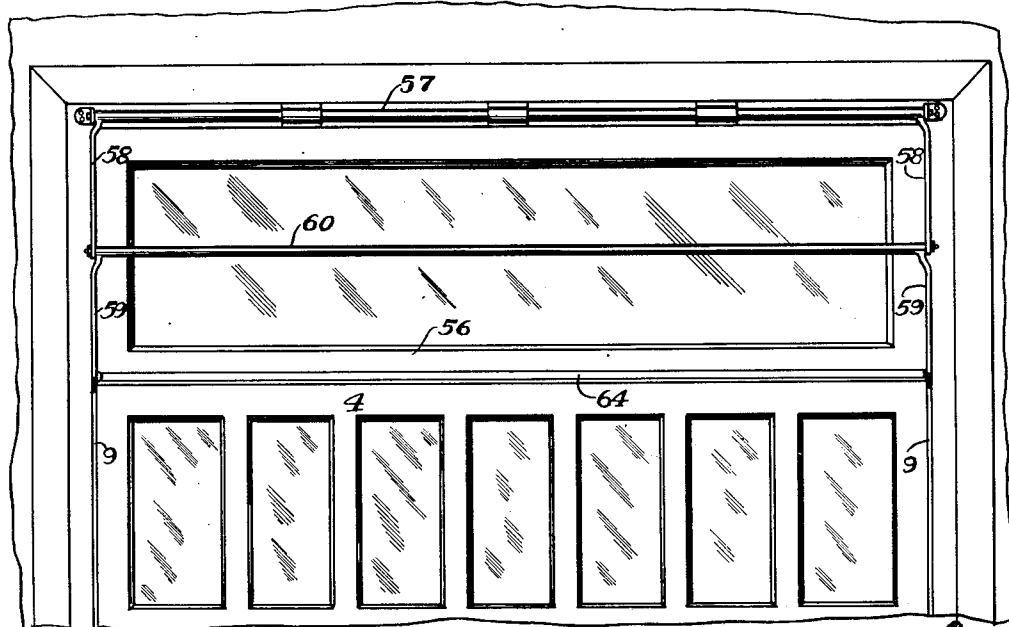


Fig.15.

Fig.16.

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FOLDABLE DOOR STRUCTURE

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4 Sheets-Sheet 4

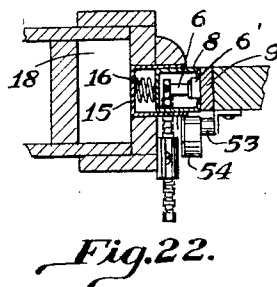
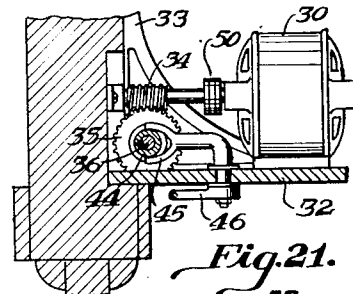
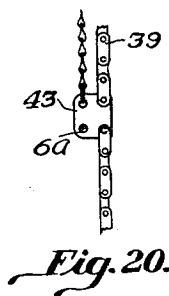
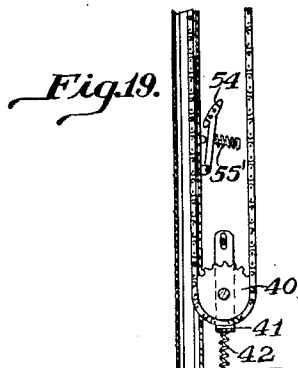
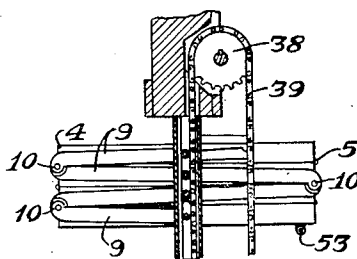
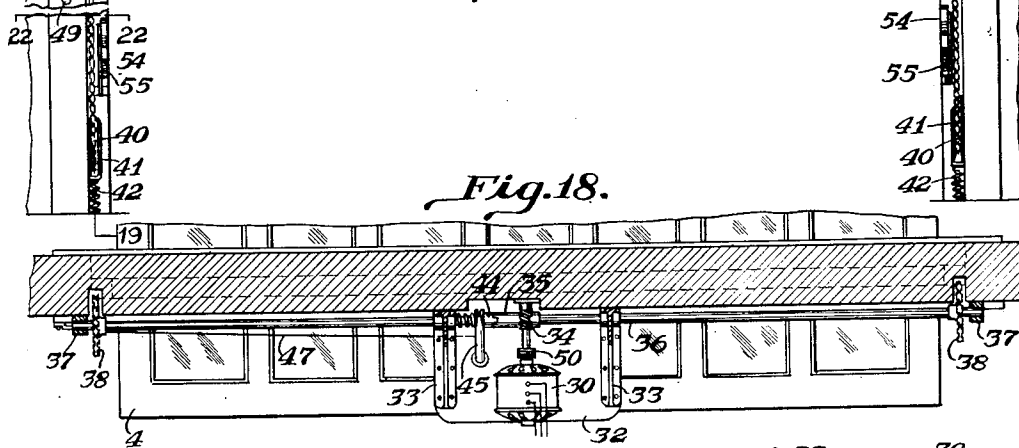
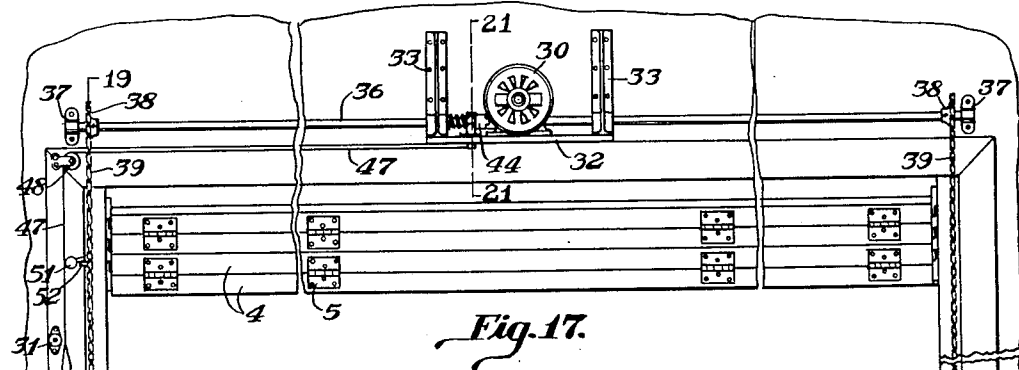


Fig. 23.
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UNITED STATES PATENT OFFICE

FREDERICK A. GUTH, OF COLUMBUS, OHIO

FOLDABLE DOOR STRUCTURE

Application filed October 17, 1930. Serial No. 489,417.

This invention relates to improvements in collapsible doors and is particularly directed to the vertically moving and folding type used in connection with garages, repair shops and other buildings of like character.

The primary object of the present invention resides in the provision of a door of this type which may be raised vertically and folded or nested at the upper end of the door opening and be completely out of the way to avoid interfering with the vehicles passing in and out of the door opening.

Another object is to provide a door structure which is formed in a plurality of pivoted panel sections hingedly united along their longitudinal edges and which sections are capable of being folded in an accordion fashion, one upon the other in vertical order when raised and capable of being maintained in this position by a novel mechanism which, together with counterbalancing means, permits the operation of opening and closing the door structure to be carried out by the operator in an easy and convenient manner.

Another object of the invention lies in providing novel means for effecting the folding of the panel sections comprising the door so that the sections will always maintain a certain angular relation with respect to one another during the raising and lowering thereof and to be held in positions free of strains and stresses at the ends thereof.

A still further object of the invention is to provide power operated means, such as an electric motor, for effecting the opening and closing of the door and to include means controlled by the movement of the door for automatically controlling the operation of said electric motor.

With these and other objects in view, which will appear as the description proceeds, the invention consists in the novel features of construction, combinations of elements and arrangements of parts hereinafter to be more fully described and pointed out in the appended claims.

In the accompanying drawings:

Figure 1 is a perspective view of a building equipped with the doors formed in accord-

ance with the present invention, one of which is shown partially opened or folded,

Figure 2 is a vertical sectional view taken through the door structure showing the same in a closed position,

Figure 3 is a similar view showing the door in a partly opened or folded position,

Figure 4 is also a similar view showing the door in its fully opened position,

Figure 5 is a horizontal sectional view taken on the line 5—5 of Figure 2,

Figure 6 is a similar view taken on the line 6—6 of Figure 2,

Figure 7 is a detail vertical sectional view through the pivotal connection for one of the handle members of the door,

Figure 8 is a vertical sectional view taken on the line 8—8 of Figure 2,

Figure 9 is a transverse vertical sectional view taken on the line 9—9 of Figure 8,

Figure 10 is a similar view taken on the line 10—10 of Figure 8,

Figure 11 is a detail view showing the hand control of the door locking mechanism,

Figure 12 is a vertical sectional view taken on the line 12—12 of Figure 11,

Figure 13 is a view showing a slightly modified form of the invention wherein a transom is used in connection with the door structure,

Figure 14 is a vertical sectional view showing the transom and the door in a closed position,

Figure 15 is a view showing the transom closed but the door structure in an open position,

Figure 16 is a view showing both the transom and the door open,

Figure 17 is a side elevation of a further modified form of the invention wherein power operated means is used for controlling the opening and closing of the door structure,

Figure 18 is a horizontal sectional view taken above the motor structure for operating the door mechanism and showing the same in elevation,

Figure 19 is a transverse vertical sectional view taken on the line 19—19 of Figure 17,

Figure 20 is a detail view showing a chain connection used in connection with the door mechanism,

Figure 21 is a transverse vertical sectional view taken on the line 21—21 of Figure 17,

Figure 22 is a horizontal sectional view taken on the line 22—22 of Figure 17 showing the door in its closed position disclosing the location of the door aligning mechanism,

Figure 23 is a detailed fragmentary view of the structure disclosed in Figure 22 and showing more in detail the working of this mechanism,

Figure 24 is a diagrammatic view showing a still further modified form of the invention, and

Figure 25 is an edge elevation thereof.

Referring more particularly to the drawings, the numeral 1 designates a building, which in this instance has been shown as that of a garage and, for the purpose of illustration, has been provided with two doors one of which is shown partly folded or opened. Preferably, the doors are operated independently of one another and by separate mechanisms, although it will be understood that it is within the scope of the invention to couple up two or more doors for simultaneous operation.

The door opening indicated by the numeral 2 which is of a size permitting of the passage of motor vehicles therethrough, is covered and uncovered by a door structure 3 comprising a plurality of panel members or sections 4 which are hingedly united to one another as at 5 along their longitudinal edges and as illustrated in Figure 2 of the drawings are arranged on edge one above the other in a single plane to completely close the door opening. Each of the panel members 4 is provided with horizontally extending pivot studs at their ends which are located in the longitudinal axis of the panels and on which the latter are mounted to swing in a vertical plane of movement. The studs 6, which may be anchored at the ends of the panels or door sections 4 in any suitable manner such as by a threaded connection with plates 7, projects into channel members 8 through the open sides thereof and are provided with collars 6' which are positioned within the open sides of the channels 8. The collars serve to permit easy turning movement of the door sections and to prevent undue friction between the channels and the pivot studs 6.

Mounted on studs 6 and positioned between the ends of the panels 4 and the channels 8 are links 9 which are of a length substantially equal to the height of the panels and which are pivotally connected as at 10 to each other at their ends. The links serve to keep the panel sections at uniform angles with respect to each other during the folding thereof and regulate the turning movement of the panels so that they will fold and unfold in an orderly manner and prevent binding or straining action on the pivots and hinges thereof. The ends of the links may be bent

slightly to impart to them a shape of an S so that when the door is in a collapsed position the links will lie one upon the other in a parallel order without crossing each other. It will be noted by inspection of Figure 2 that the pivots at the ends of the links 9 are located in alignment with the hinges 5 of the panel sections and that said hinges are positioned in a plane on each side of the pivots 6. Thus, the panels or door sections will readily open or swing on their pivots upon upward lifting on the door 3.

To keep the pivotal axes of the panel member in a true horizontal plane during the folding of the door and to prevent sagging of the door at one end or side thereof, the top links 9a which are located at each side of the door are formed somewhat shorter in length and have their upper ends pivotally connected to arms 11 fixed at the end of a cross shaft 12 journaled for rotation within bearing members 13 secured to the under side of the upper edge of the door frame. It will be seen that by the provision of the shaft 12, equal rocking movement will be imparted to the links at each side or edge of the door and that the ends of the panel members will be raised simultaneously, assuring free and easy movement thereof devoid of strain due to lagging or sagging of one of the sides of the door. As the shaft 12 is located in vertical alignment with the door pivots, the upper edge of the top panel section 4 is cut away as at 14 in order to permit the closing of the door and to form a weather-tight joint at the upper end of the door structure. Also, to form weather-tight joints along the side edges of the door the channel members 8 may be mounted for limited lateral movement within metallic casings 15 carried by the side edges of the door frame and forced in an outward direction therefrom by short coil springs 16 positioned between the casings and the channels. This floating mounting of the channels 8 allows the same to engage the links 9 and tends to hold the same against the edges of the door and to permit the channels to move in and out relative to the casings 15 so as to take up any differences in length of the panel members caused by expansion or contraction.

To counterbalance the weight of the door, weights 17 are provided at each side of the door which are positioned for sliding movement within weight compartments 18 and connected with the doors by means of cables or chains 19 passing over pulleys 20 located at the upper end of the door frame and over sets of pulleys 21 carried by the upper end of the weights 17. The arrangement of the chains is such that one thereof is passed over certain of the pulleys 20 and 21 and the ends of the chain connected to the pivot studs 6 of the upper and lower of the panel members 4, whereas the other chain, which also passes over other of the pulleys 20 and 21, is con-

5 nected with the pivots of the intermediate panel members. By connecting the chains in this manner, the same may be of equal length and only one weight at each side of the door will thus be necessary to counterbalance the panel members.

10 To facilitate the raising of the door structure of the preferred form of the invention shown in Figures 1 to 12, inclusive, the lower of the panel sections 4 is provided near its upper edge with a handle member 22 which is mounted for rotation within a bracket 23. Fixed for rotation with the handle 22 is a lever 24 which has its ends connected to one end of the chains 25 which in turn are connected at their opposite ends with latch bolts 26 mounted for sliding movement within casings 27 secured near the outer edges of the panel section 4. Cooperating with the latch members 26 are keeper members 28 carried by the door frame. By rotating the handle member 22 the latch members 26 may be withdrawn from the keepers 28 thus unlocking the door which may then be raised by the handle. The locking of the door may be automatically effected by the closing thereof due to the bevelled faces provided upon the latch members 26 and the coil springs 29 which allow the latch members to move to a position seating themselves within the keepers 28, as will be readily understood.

15 In the modified form of the invention disclosed in Figures 17 to 22, inclusive, use is made of an electric motor 30 for raising and lowering the door structure and which motor may be of the reversible type and connected with any suitable circuit controlled by a switch or switches located at convenient points, such as has been located on the frame of the door and is indicated by the numeral 31. For convenience of installation the motor is positioned above the door structure and interior of the building and mounted on a platform 32 supported by bracket members 33 secured to the inner wall of the building structure. Provided upon the motor shaft is a worm gear 34 which meshes with a gear 35 mounted for free rotation upon a shaft 36 extending the full width of the door and has its ends journaled within bearings 37. Keyed or otherwise secured to the outer ends of the shaft are sprockets 38 over which are trained sprocket chains 39 extending vertically and along the outer edge of the door. The chains are also trained over sprockets 40 positioned near the lower edge of the door which are mounted for rotation within brackets 41. The chains 39 are held taut by means of tension springs 42 attached to the lower ends of the brackets 41 and the door frame. The springs serve to take up any variation of the chains in length and slack which may develop. The sprocket chains 39 are provided with links 43 formed with bearing openings for the reception of the pivot

studs 6a of the lower of the panel members 4. Thus, by this connection between the chains and the panel member movement imparted to the chains 39 will raise and lower the door sections to open and close the same as desired. 70

To establish a drive between the motor 30 and the shaft 36, a spring actuated jaw clutch 44 is provided upon the shaft 36 which is keyed thereon for sliding movement and which is normally in engagement with the gear 35. It will therefore be seen that as the motor is started motion will be imparted to the door sections through the chains 39, the shaft 36 and through the gearing 34 and 35. If the motor should fail to operate for any reason or the electric current should be shut off, the clutch 44 may be provided with a hand control in the form of a rocking lever 45 journaled for rotation within a bearing carried in connection with the platform 32. One end of this lever is arranged for engagement with the clutch 44 and the other end provided with an arm 46 to which is attached one end of an operating cable 47. The cable 47 is trained over a pulley 48 attached to the door frame and the lower end thereof provided with a handle 49. By means of the control the clutch may be held out of engagement with the gear 35 and the door operated by pulling or lifting on the chains 39. The door in this, as well as in the preferred form, may be counterbalanced so that it may be readily operated for opening and closing. To prevent injury to the mechanism for opening and closing the door in case the motor should continue running after the door is completely opened or closed or in case the same should stick or become out of order, a slip clutch 50 may be provided on the motor shaft which may be of any well known construction to provide flexibility between the gearing and the motor. 75 80 85 90 95 100 105

If desired automatic control of the motor may be provided by positioning a rocking switch 51 on the door frame and adjacent one of the chains 39 and which chains may be provided with suitably spaced pins 52 which will engage the movable arm of the switch breaking the circuit when the door has been fully opened or closed. To insure complete closing of the door the lowermost panel member 4 is provided with a roller 53 which extends beyond the edge of the panel and engages the cam member 54 mounted for pivotal movement within the bracket 55 carried by the door frame. The cam 54, which is formed with a pair of arcuate cam surfaces is held normally against the door frame by means of a coil spring 55'. Upon the closing of the door the roller 53 will engage with the inner cam surface and tend to rock the cam outwardly against the action of the spring 55'. This tension of the spring 55' tends to force the roller 53 and the door inwardly into contact with the door frame. The roller 53 will, 110 115 120 125 130

upon the final closing of the door, move downwardly of the cam surface and clear the lower end of the cam 54 at which time the compressed spring 55' will again return the cam into engagement with the door frame. Upon the raising of the door the roller 53 will again engage with the cam 54 but will follow the exterior cam surface thereof and thus aid in moving the door panel outwardly, the relation between the roller 53 and the cam surface of the cam member 54 being particularly illustrated in Figure 23 of the drawings.

From the structure so far described it will be seen that a door has been provided which is entirely automatic with the exception of starting the motor, after which the movement of the door will control the operation of the motor. The door when in an open position will be completely out of the way and will not obstruct adjacent doors or windows nor consume wall space. Neither can a door of this construction blow shut when open, or vice versa, which is a common fault with doors of the ordinary construction. The door is not only balanced in weight, but each section thereof is centrally and laterally pivoted and balanced individually so that wind pressure has no effect thereon as the amount of surface above the pivot for each section equals that which extends below the pivot.

In buildings where ventilation is desired, a swinging section 56 may be provided at the upper end of the door opening which may serve as a transom. In such a case the door opening must be of an additional height to accommodate the swinging member. Under ordinary conditions the door may be raised to a point even with the bottom of the panel 56, but when said member is swung to a position raising the same as illustrated in Figure 16, the door may be raised to an additional height thereby accommodating high vehicles, such as trucks and the like. In this instance, the cross shaft 57 which ordinarily would be located at the upper edge of the door, as the shaft 12 in the preferred form, is raised to a point slightly above the hinge connection for the swinging panel 56 and connected to the links 9 by means of a pair of arms 58 and 59. The arms 58 are rigidly attached to the shaft 57 and the links 59 are similarly attached to a second shaft 60 connecting the arms 59 for simultaneous movement. The arms 58 and 59 are of such length and so arranged that they do not interfere with the raising and lowering of the door structure or the transom and serve together with the shafts 57 and 60, to connect the links 9 positioned at each side edge of the door in order to hold the door sections in true horizontal positions during the raising and lowering thereof. Any suitable means may be provided for holding the section 56 in its open position, such as by a rod 61 pivoted at its upper end to the side frame of the sec-

tion and its lower end is provided with a laterally offset finger 62 which is positioned within an opening formed in a plate 63 attached to the side of the door frame. If desired, the section 56 may be provided with a transparent panel so as to admit light to the interior of the building. To shade the door opening and to hide the outer edges of the folding sections a curtain 64 may be attached to the lower edge of the transom and may be of the spring operated type in order that it may be readily rolled up when not in use.

In Figure 24 of the drawings there has been disclosed a modified form of mechanism for taking the place of the links 9. This mechanism consists of providing a cross shaft 65 located above the door with pulleys or sprockets 66 of varying diameters which are keyed to rotate with the shaft and over which sprockets the chains connecting the pivots for the panel members may pass. Thus, in this structure the chain connecting the pivot for the upper of the panel members may pass over the smaller of the pulleys and around one of the pulleys carried by the weight 67 and then back over the larger of the pulleys and to the lower of the panel sections and the other chain connecting the two intermediate sections may pass in a similar manner over the two intermediate pulleys and over the other pulley carried by the weight. It will thus be seen that the movement of each of the panel sections will be timed so as to fold and unfold properly. By the employment of this mechanism for controlling the movement of the doors, the door panels may be set flush with the edges of the door frame as the links 9 are omitted.

It will be seen that various changes may be made in the construction and operation of the door structure, and I therefore do not desire to limit myself to the exact details shown and described in the drawings other than what will fairly fall within the scope and spirit of the appended claims.

What is claimed is:

1. A door structure comprising open sided casings carried by the vertical inner edges of a door opening, channels mounted for lateral movement within said casings, a plurality of panel members hingedly united to one another and mounted to swing about horizontally extending pivot studs positioned within said channels, said pivot studs being arranged for vertical sliding movement within said channels and permitting of the raising and lowering of said panel members, and weights connecting said studs and adapted to counterbalance said door structure.

2. A foldable door structure comprising a plurality of panel members hingedly united to one another along their meeting edges, means for mounting said panels for horizontal swinging movement and for vertical sliding movement relative to the side edges of the

door opening, means for effecting the raising and lowering of the panels, and a spring pressed cam member carried by the door frame and adapted to be engaged by one of said panels to force said cam outwardly and thereby arrange the panels in vertical alignment.

3. A door structure comprising casings carried by the vertical inner edges of a door, and having its open sides located within the confines of said opening, channel members mounted for lateral movement within said casings, spring means interposed between said casings and channel members for exerting pressure against said channel members outwardly away from said casings, a plurality of panel members hingedly united with one another along their horizontally extending edges positioned between said channel members and provided with pivot studs at their ends which are received within said channels, said pivot studs being arranged for vertical sliding movement within said channels and permitting of the raising and lowering of said panel members and the simultaneous horizontal swinging movement thereof, said channel members serving to close the open space between the ends of the panels and the side edges on the door opening to effect a substantially weather-tight joint therebetween.

4. In a collapsible door structure, a frame provided with a door opening having vertically disposed casing members located at the sides thereof with their open sides directed into the opening, channel members telescopically positioned within said casings with their open sides also directed into the door opening, a foldable door structure positioned between said channel members comprising a plurality of foldable sections, pivot studs for each of said sections positioned within said channel members for effecting the sliding and rotary movement of said sections, and resilient means positioned between said casings and said channel members for exerting an outward pressure on the latter against the ends of said door sections.

5. In a door structure, a frame provided with a door opening having its vertical side edges thereof provided with inwardly opening casing members of a substantially similar formation telescopically mounted within said casing members and provided with inturned edges at their outer ends forming slots opening into the door opening, a plurality of panel members comprising a door structure positioned between said channel members and having their ends provided with pivot members positioned within said channel members and extending through said slots, said panel members being hingedly united along their horizontal meeting edges to effect the collapse thereof to a nested form at the upper end of a door opening, means connect-

ing said pivot members counterbalancing said door structure and means for effecting an outward movement of said channel members away from the casings to close up the space between the ends of said panel members and the sides of the door opening when the panel members are in a lowered or extended position.

6. A door structure comprising open sided casings carried by the vertical inner edges of a door opening, channels mounted for lateral movement within said casings, a plurality of door panels hingedly united to one another and mounted to swing about horizontally extending pivot studs positioned within said channels, said pivot studs being arranged for vertical sliding movement within said channels and permitting of the raising and lowering of said panels, a horizontally extending shaft arranged above said door opening, an arm provided at each end of said shaft, and an operating connection between said arms and the upper of said panels whereby the panels will be raised and lowered uniformly and without binding in said channels.

7. A structure comprising a plurality of door panels hingedly united to one another and mounted to rock about horizontally extending pivot studs fixed centrally at the ends of the panels and arranged for vertical sliding movement within grooves provided therefor in the side edges of the door opening, a shaft journaled for rotation above said door structure and extending the full width thereof, an arm provided at each end of said shaft, and connecting means between said arms and panels whereby the panels are held in a true horizontal plane and capable of being raised and lowered without bind.

8. A door structure comprising a plurality of door panels hingedly united to one another and mounted to rock about horizontally extending pivot studs arranged for vertical sliding movement in connection with the inner edges of the door opening, a shaft journaled for rotation above said door structure and extending the full width thereof, an arm at each end of said shaft, and means connecting said arms with the panels whereby upon the raising of said panels to uncover the door opening, said shaft, arms and connecting means will serve to guide the panels into nesting relationship at the top of the door opening without binding.

9. A door structure comprising vertically positioned channel members movably carried by the vertical inner edges of the door opening, a plurality of panel members hingedly united to one another and mounted to swing about horizontally extending pivot studs arranged for vertical sliding movement within said channels, a shaft journaled for movement at the upper end of the door opening and extending over the full width there-

or, an arm provided at each end of said shaft, and links connecting one another and fulcrumed on said pivot studs, said links together with the panels forming a lazy-tong arrangement, the top link on each side being attached to said arms.

10. A door structure comprising a plurality of panel members all of the same size and each being hingedly united to the other at the longitudinally extending edges thereof, each of the panels being provided with pivot studs arranged at the ends of the panels and centrally thereof, which studs are mounted for vertical sliding movement within grooves formed therefor in the side edges of the door frame, links united to one another at the ends and having their intermediate portions fulcrumed about said studs, said links together with the panel members forming a lazy-tong arrangement, a shaft extending above the door structure, and an arm at each end of said shaft connected to the uppermost of said links.

In testimony whereof I affix my signature.
FREDERICK A. GUTH.

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