April 15, 1941. D. H. MORGAN 2,238,181

BIFOLD DOOR

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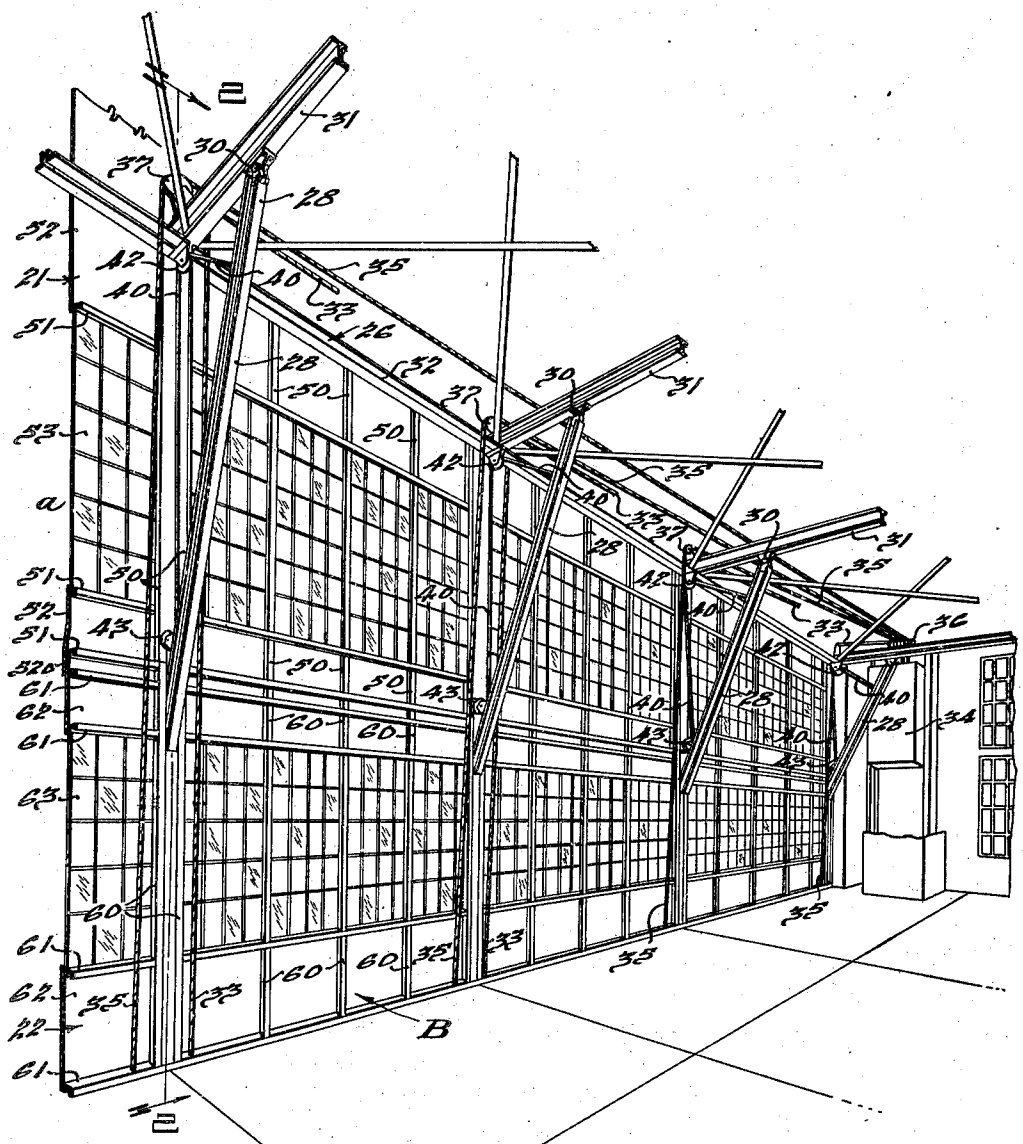



Fig. 1.

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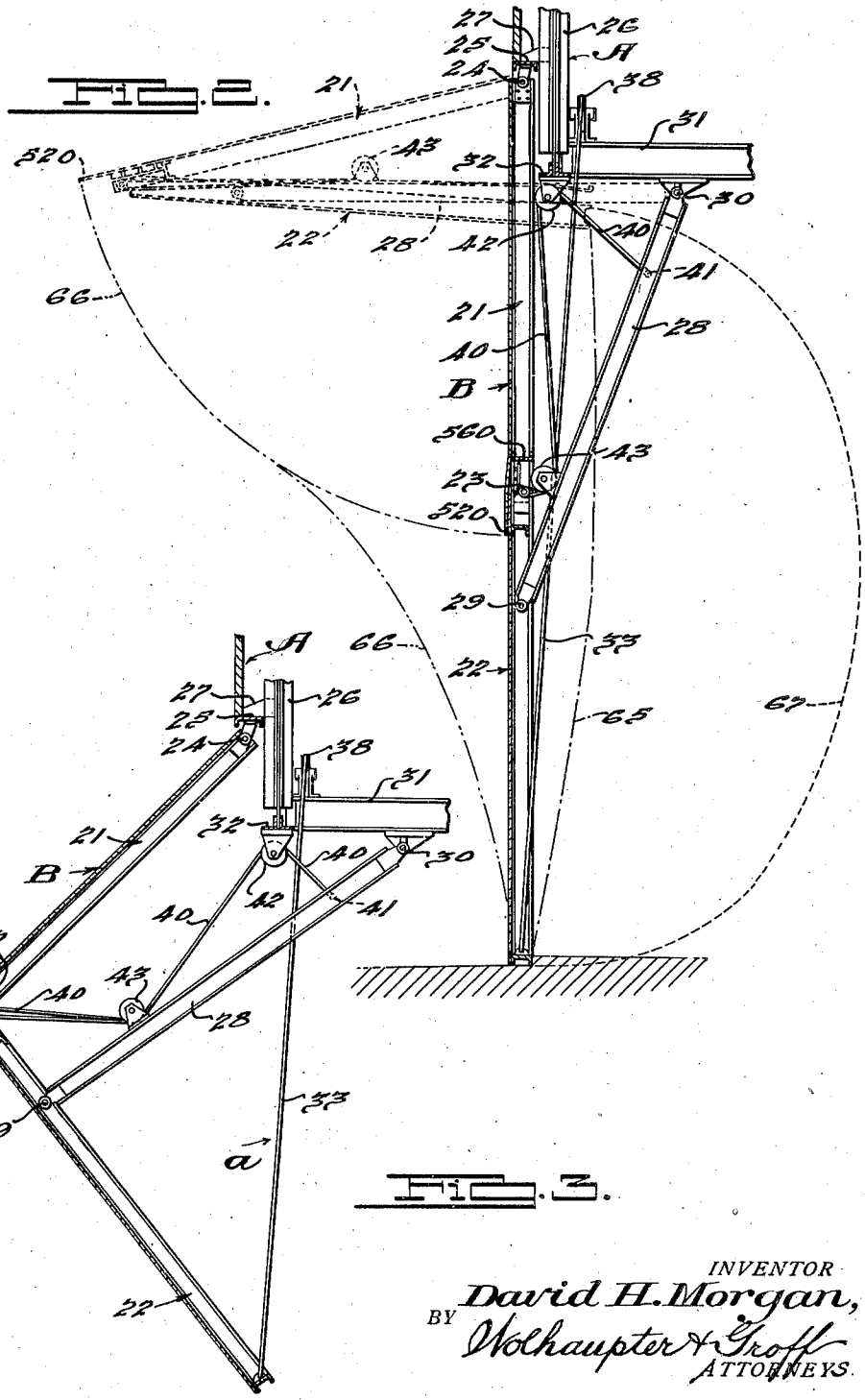



FIG. 2.

FIG. 3.

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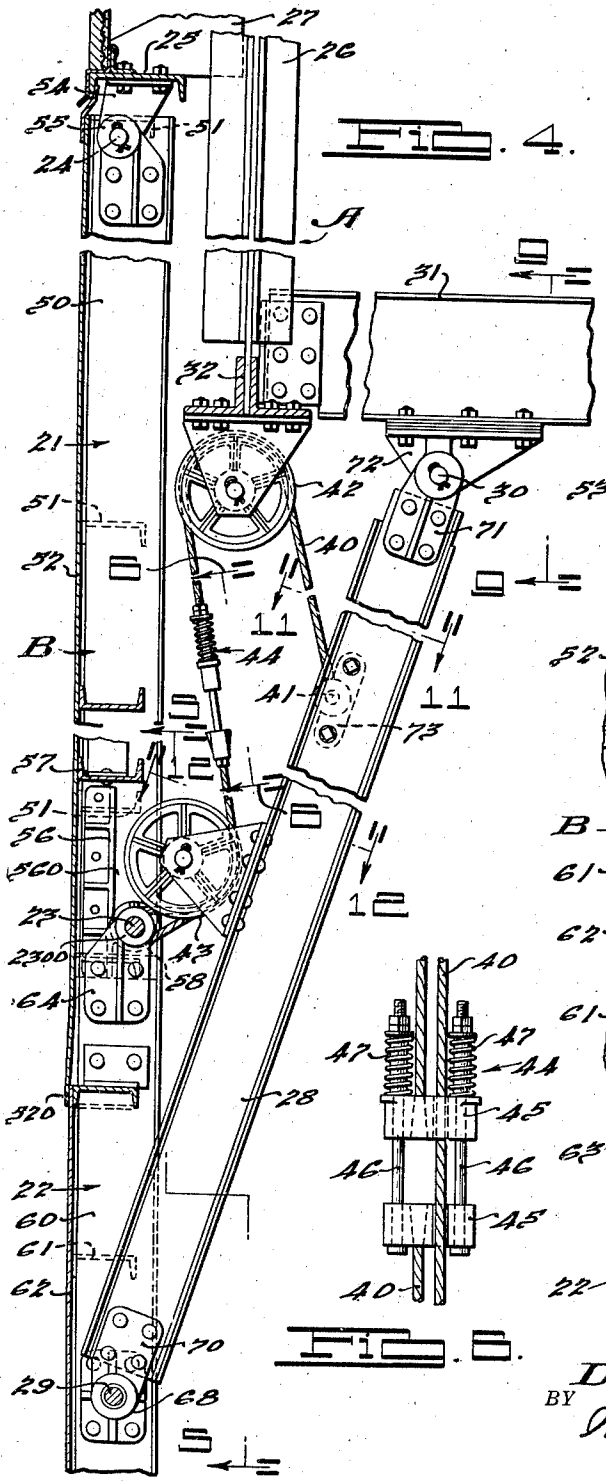


FIG. 4.



FIG. 6.

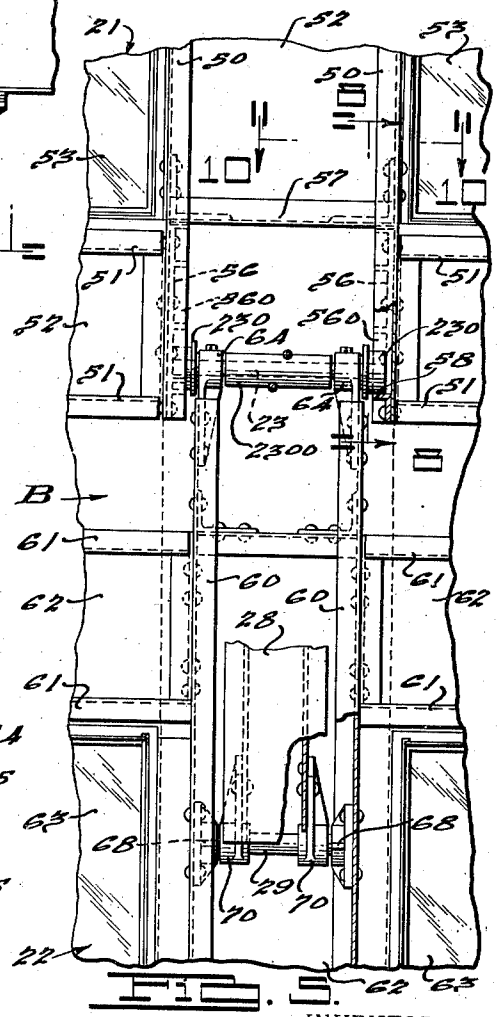


FIG. 5.

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BIFOLD DOOR

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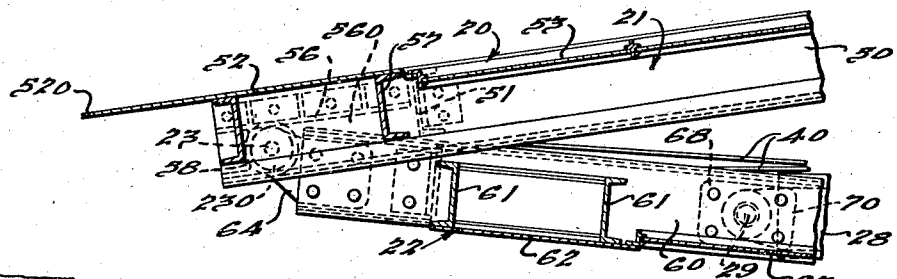



FIG. 7.

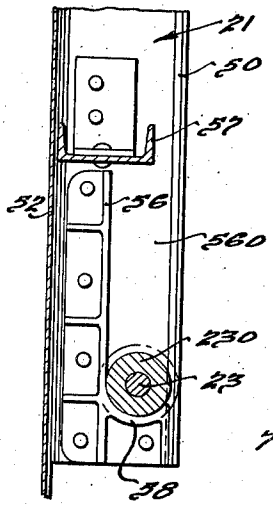



FIG. 8.

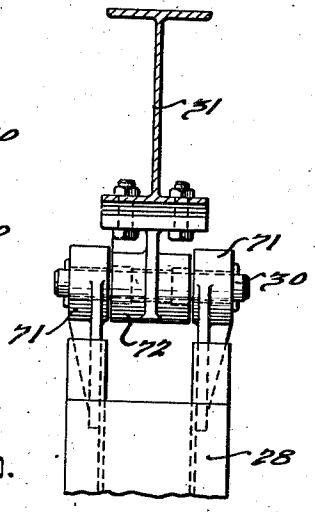



FIG. 9.

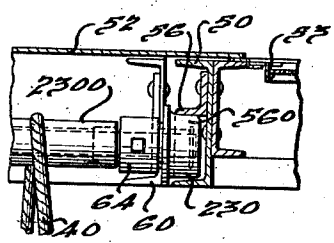



FIG. 10.

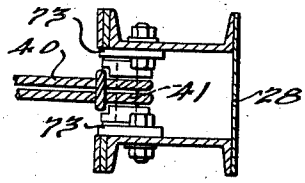



FIG. 11.

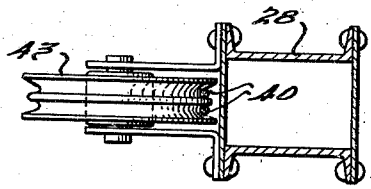



FIG. 12.

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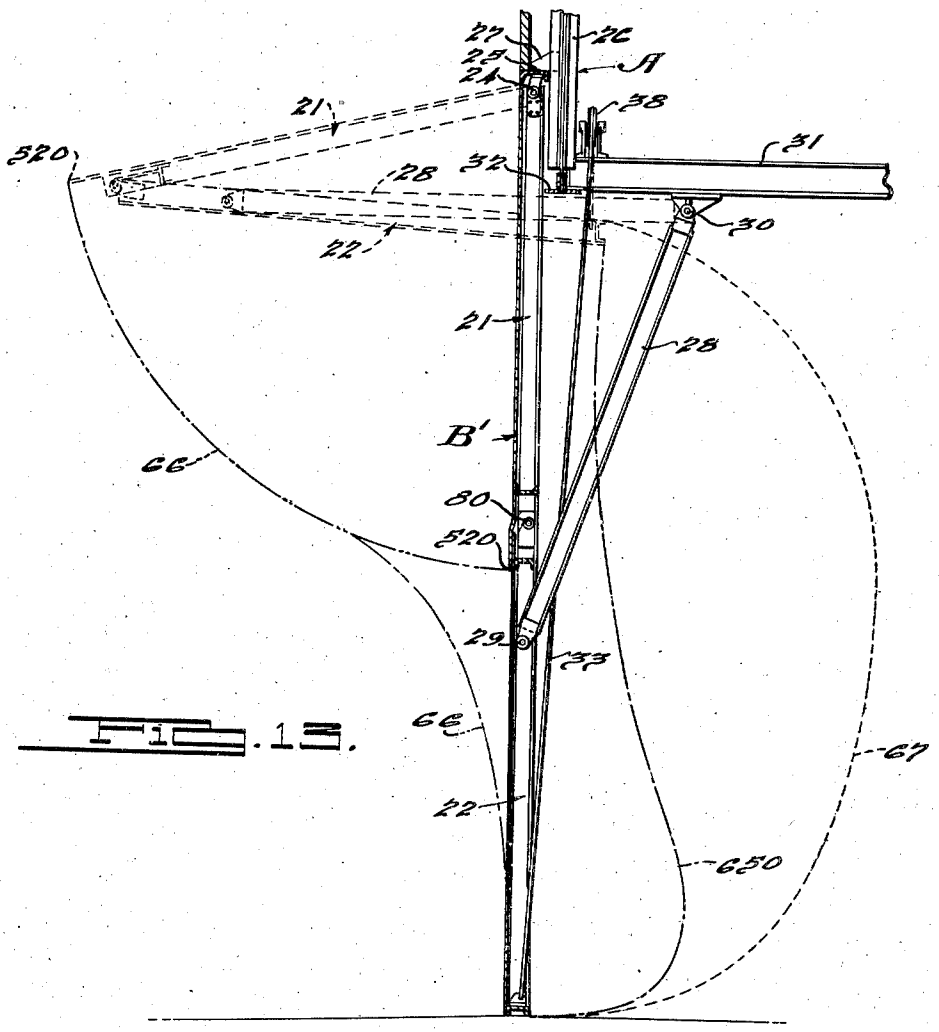



Fig. 13.

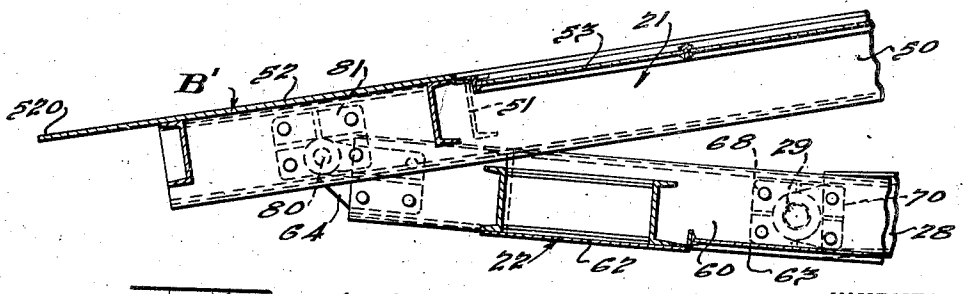



Fig. 14.

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Fig. 15.

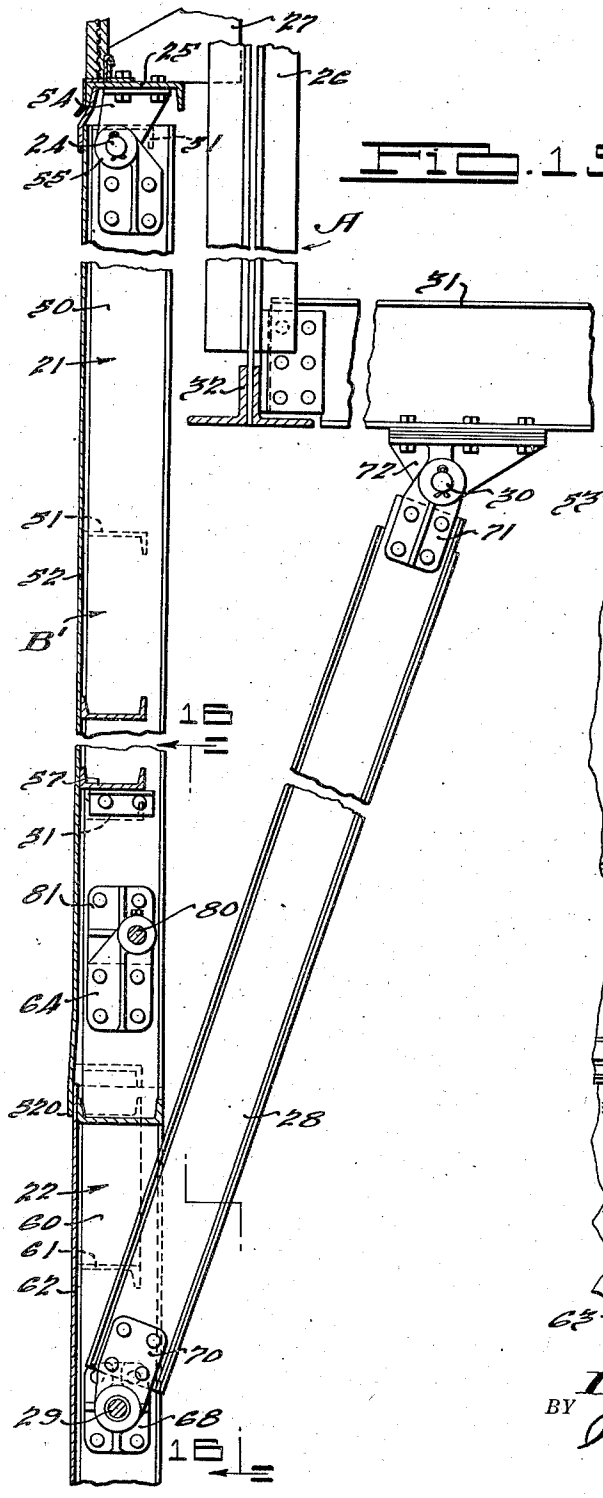
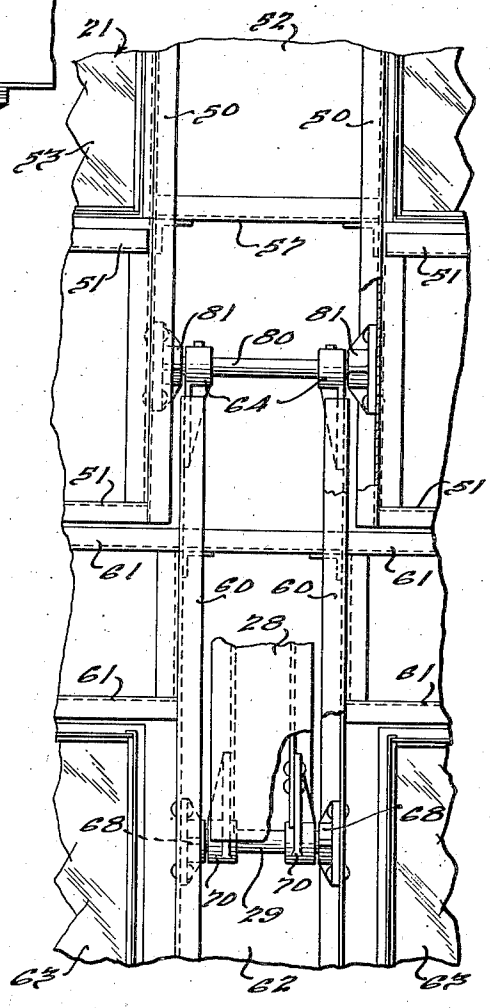



Fig. 16.




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BIFOLD DOOR

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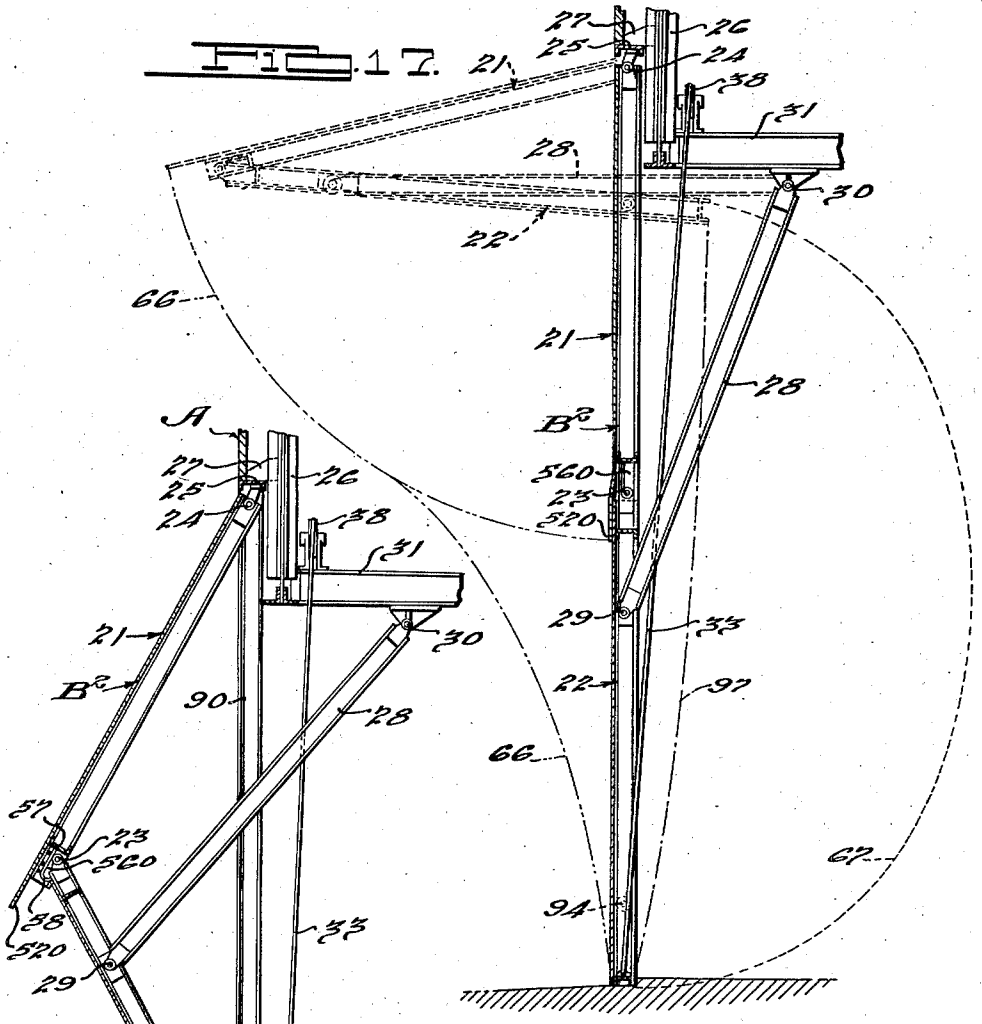



FIG. 17.

FIG. 18.

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BIFOLD DOOR

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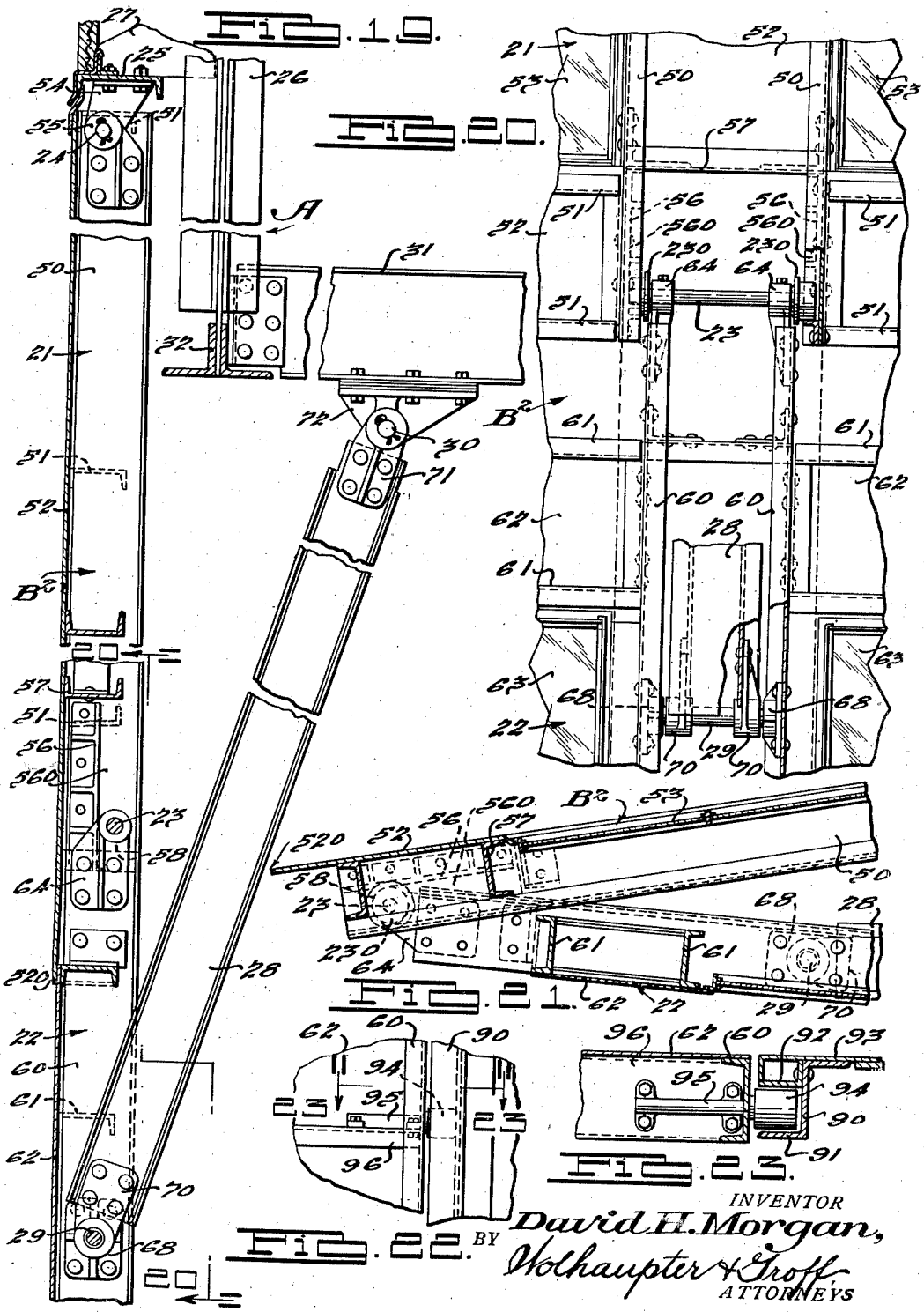


Fig. 10.

Fig. 20.

Fig. 21.

Fig. 23.

Fig. 22.

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Patented Apr. 15, 1941 2,238,181

# UNITED STATES PATENT OFFICE

2,238,181

## BIFOLD DOOR

David H. Morgan, Youngstown, Ohio, assignor to Truscon Steel Company, Youngstown, Ohio, a corporation of Michigan

Application April 11, 1940, Serial No. 329,151

7 Claims. (Cl. 20—16)

This invention relates to doors, and has particular reference to improvements in so-called "bifold" doors of the type comprising upper and lower leaves of which the upper leaf is pivoted at or near its upper end to a building structure at or near the top of a doorway therein for upward and outward swinging movement from a vertically disposed closed position to an open position in which it extends substantially horizontally forwardly, canopy-like, from the building structure at the top of the doorway, and the lower leaf is pivoted at or near its upper end to the upper leaf at or near the lower end thereof for inward and upward swinging movement relative to said upper leaf from a vertically disposed closed position to an open position in which it underlies the upper leaf when the upper leaf is open.

Generally speaking, the object of the invention is to provide a better door at lower cost than any comparable door heretofore produced.

One special object of the invention is to provide simple means which may practicably be located at any desired number of points spaced apart transversely of a door of the type mentioned for effectively bracing the lower leaf thereof, and through the lower leaf bracing the upper leaf, so that both leaves are braced against sway due to wind pressures exerted thereagainst, both when the door is closed and during opening and closing movements thereof, whereby the door may be of great width and height and, at the same time, of economical, light weight construction without danger of its collapse under any ordinary wind pressure.

Another special object of the invention is to provide bracing means for the leaves of a door of the type mentioned which not only accomplish the purpose stated, but which also serve as parts of a lever system for controlling opening and closing movements of the door leaves, whereby any necessity of guides for the leaves at the sides of the doorway is avoided and whereby the door may be divided into as many independent side-to-side sections as desired without any necessity of providing fixed supports obstructing the doorway at the ends of the individual sections.

Another special object of the invention is to provide bracing means for the leaves of a door of the type mentioned which not only accomplish the purposes stated, but which additionally assist in limiting the lower part of the lower leaf to a minor amount of lateral movement during initial opening movement and final closing movement of said lower leaf, whereby opening and closing of the door does not interfere with use of the space both inside and outside of the door and close thereto for any desired purposes.

Another special object of the invention is to provide, in association with bracing means serving the purposes mentioned in a door of the type mentioned, a novel mechanical advantage arrangement whereby only a minor amount of power is required for moving the leaves to open position.

With the foregoing and other objects in view, which will more readily appear as the nature of the invention is better understood, the same consists in the novel construction, combination and arrangements of parts hereinafter more fully described, illustrated and claimed.

In the accompanying drawings, wherein like characters of reference denote corresponding parts in related views:

Fig. 1 is a fragmentary view in perspective of the inside of an airplane hangar having along one side thereof a strutted, guideless bifold canopy door embodying the invention.

Fig. 2 is a more or less diagrammatic vertical sectional view taken on the line 2—2 of Fig. 1 showing the bifold canopy door both closed and opened and indicating the clearance lines of the door leaves during the opening and closing of the door.

Fig. 3 is a more or less diagrammatic vertical sectional view similar to Fig. 2 showing the bifold canopy door partially opened and clearly illustrating the means employed for minimizing the opening and closing clearances.

Fig. 4 is an enlarged detailed fragmentary sectional view showing the construction of the bifold canopy door disclosed in Figs. 1 to 12 inclusive.

Fig. 5 is a fragmentary vertical elevational view taken on the line 5—5 of Fig. 4.

Fig. 6 is an enlarged fragmentary elevational view taken on the line 6—6 of Fig. 4 showing the spring-type cable take-up means preferably employed for the clearance regulating cables.

Fig. 7 is a fragmentary detailed sectional view showing the bifold canopy door disclosed in Figs. 1 to 12 inclusive in its fully opened position.

Fig. 8 is an enlarged vertical sectional view taken on the line 8—8 of Fig. 4 showing in detail the moving pivot employed between the upper and lower leaves of the bifold canopy door disclosed in Figs. 1 to 12 inclusive.

Fig. 9 is an enlarged vertical sectional view taken on the line 9—9 of Fig. 4.

Fig. 10 is an enlarged fragmentary horizontal sectional view taken on the line 10—10 of Fig. 5.

Fig. 11 is an enlarged sectional view taken on the line 11—11 of Fig. 4.

Fig. 12 is an enlarged sectional view taken on the line 12—12 of Fig. 5.

Fig. 13 is a more or less diagrammatic sectional view similar to Fig. 2 showing a second embodiment of the invention which is similar in every respect to the embodiment of the invention disclosed in Figs. 1 to 12 inclusive except that strut means only is employed for preventing sway during opening and closing of a guideless bifold canopy door and for regulating the opening and closing clearances thereof.

Fig. 14 is a fragmentary detailed sectional view showing the bifold canopy door disclosed in Figs. 13 to 16 inclusive in its fully opened position.

Fig. 15 is an enlarged detailed fragmentary sectional view showing the construction of the bifold canopy door disclosed in Figs. 13 to 16 inclusive.

Fig. 16 is a fragmentary vertical elevational view taken on the line 16—16 of Fig. 15.

Fig. 17 is a more or less diagrammatic sectional view similar to Figs. 2 and 13 showing a third embodiment of the invention which is similar in every respect to the embodiment of the invention disclosed in Figs. 1 to 12 inclusive except that both strut and guide means are employed for preventing sway during opening and closing and for regulating the opening and closing clearances thereof.

Fig. 18 is a more or less diagrammatic vertical sectional view similar to Fig. 17 showing the bifold canopy door disclosed in Fig. 17 in a partially opened position.

Fig. 19 is an enlarged detailed fragmentary sectional view showing the construction of the bifold canopy door disclosed in Figs. 17 to 23 inclusive.

Fig. 20 is a fragmentary vertical elevational view taken on the line 20—20 of Fig. 19.

Fig. 21 is a fragmentary detailed sectional view showing the bifold canopy door disclosed in Figs. 17 to 23 inclusive in its fully opened position.

Fig. 22 is a fragmentary elevational view of the door guide and jamb of the bifold canopy door disclosed in Figs. 17 to 23 inclusive.

Fig. 23 is a horizontal sectional view taken on the line 23—23 of Fig. 22.

Referring to the drawings in detail, first with particular reference to the embodiment of the invention illustrated in Figs. 1 to 12, A designates, generally, a part of a building structure, such as an aircraft hangar, having a doorway *a*, and B designates, generally, a door constructed, mounted and operable in accordance with the invention for controlling said doorway *a*.

The door B is composed of an upper leaf 21 and a lower leaf 22, and in accordance with the invention pivot means 23, vertically shiftable with respect to the upper leaf 21, connects the top portion of the lower leaf 22 with the lower portion of said upper leaf 21. Also in accordance with the invention, the upper leaf 21 is pivotally mounted at or near its top to the building structure A at or near the top of the doorway *a*, as indicated at 24, for swinging movement between a vertically disposed, closed position and a substantially horizontally disposed, open position in which it extends, canopy-like, forwardly from the building structure A at or near the top of the doorway *a*.

Further in accordance with the invention, struts 28 are provided at any desired spaced intervals transversely of the door B and extend from the upper portion of the lower leaf 22 to points at about tthe level of the top of the doorway *a* and spaced inwardly from the pivots 24, where they are pivotally connected at their upper ends, as indicated at 30, to suitable fixed supports such, for example, as frame elements 31 of the building structure A extending inwardly from a truss structure 26 above the doorway *a*. At their lower ends the struts 28 are pivotally connected with upper portions of the lower leaf 22, as indicated at 29, at points spaced downwardly from the pivotal connections 23 of said lower leaf with the upper leaf 21.

For opening the door A and for controlling closing thereof, cables 33 are provided at suitable spaced intervals transversely of said door. These cables are connected at their lower ends to bottom portions of the lower leaf 22 and extend upwardly from said lower leaf over sheaves 36 and then to a suitably located power driven drum or other operating means, not shown. Other cables 35 are connected at their lower ends to bottom portions of the lower leaf 22 and extend over suitably located sheaves 36 and 37 to a counterweight 34 for substantially balancing the door A.

The sheaves 38 are located above the level of the top of the doorway *a* at points spaced inwardly from the upper leaf pivots 23 and outwardly from the strut top pivots 30. Consequently, when the door A is closed with the leaves 21, 22 thereof disposed vertically as shown in Fig. 2 and the cables 33 are pulled to open the door, the lifting force exerted by said cables upon the lower leaf is in an upward and inward direction relative to said lower leaf and in an upward and outward direction relative to the struts 28. Therefore, as the lower leaf is lifted it is caused to swing outwardly, primarily at its top, by the struts 28, and at the same time is rotated about its pivotal connections 29 with the lower ends of said struts 28, its top portion swinging outwardly and downwardly and its bottom portion swinging upwardly and inwardly. Moreover, due to the pivotal connections 23 between the leaves 21, 22, said opening movements of the lower leaf 22 cause upward and outward opening swinging movement of the upper leaf 21 about its suspension pivots 24.

Associated with any one or more of the struts 28 is a rope or cable means which acts in response to opening swinging movement of the lower leaf 22 about its pivots 23 to serve the dual purpose of assisting in swinging said strut or struts upwardly and outwardly and of limiting initial opening and final closing swinging movements of said lower leaf 22 about its pivots 23 to a minor amount. Thus, only a minor amount of power is required for opening the door and, at the same time, clearance spaces of only minor width are required to be maintained inwardly and outwardly of the lower part of the doorway *a*, thereby rendering said spaces available near the doorway for storage or other purposes.

If a plurality of the rope or cable means referred to are employed they may be duplicates of one another. Therefore, a description of one will suffice for all. It comprises a rope or cable 40 which is anchored at one end, as indicated at 41, to the related strut 28 at a point near the upper end of said strut and which extends from its anchorage 41 first over a sheave 42 suitably mounted on the building structure A at or near the top of the doorway *a*, then beneath a sheave

43 mounted on the strut 28 near the lower end of said strut and then to the lower leaf 22 at a point above the pivotal connection 29 of said lower leaf with the lower end of the strut 28, where it is attached to said lower leaf in any desired manner, either directly or by being looped around the pivot 23 for example and then extended back to the strut 28 and fastened to said strut, as indicated in the present instance.

When the door is closed the pivots 23 are disposed at their lower limits of vertical shifting movement relative to the upper leaf 21, and their tendency is to remain at their lower limits of shifting movement relative to said upper leaf due to the tendency of the lower leaf 22 to rotate about its pivotal connections 29 with the lower ends of the struts 28. However, the locations of the points of connection 41, 23 of the rope or cable 40 relative to the pivots 30, 29, respectively, are such that as the lower leaf 22 is lifted the rope or cable 40 is placed in tension and causes the pivot 23 to shift upwardly relative to the upper leaf 21. The lower leaf thus is caused to move more directly vertically than would be the case if the pivot 23 remained at its lower limit of vertical shifting movement relative to the upper leaf 21. Accordingly, the lower leaf, during its initial opening movement and its final closing movement, moves substantially vertically with only a minor amount of pivotal movement about its pivots 29, with the result that clearances of only minor width are required to be maintained at the front and rear thereof, thus leaving the spaces at the front and rear of the doorway and close thereto available for storage or other purposes.

During opening of the door the lower leaf 22 acts as a lever fulcruming about its pivots 29 and tending to straighten the rope or cable 40. The result is that said rope or cable 40 is caused to react from the sheave 42 through the sheave 43 to exert a strong lifting effort upon the strut 28, thus permitting the door to be opened by only a minor amount of lifting effort applied through the cables 33.

If desired, the rope or cable 40 may have interposed therein suitable resilient means such as indicated at 44 in Figs. 4 and 6 of the drawings to take up any slack in said rope or cable and thus maintain same at all times taut.

Figs. 4 to 12 inclusive show in more or less detail and for the purpose of illustration, the construction of the embodiment of the invention disclosed generally in Figs. 1 to 3 inclusive. The upper leaf 21 of the door B is constructed of a framework of vertical channels 50 and horizontal channels 51 welded or riveted together and covered with a steel plate 52 except where the steel sash 53 occurs. Some of the vertical channels 50 are preferably located in pairs under the framing members 31 and are suitably spaced to accommodate like channels 60 of the lower leaf 22 therebetween when the said door B is in its fully opened position as best shown in Figs. 2 and 7. The lower leaf 22 is constructed in like manner of a framework of vertical channels 60 and horizontal channels 61 welded or riveted together and covered with a steel plate 62 except where the steel sash 63 occurs.

The upper leaf 21 is pivotally suspended from a supporting member 25 on pivot pins 24 which are journaled in brackets 54 secured to the said supporting member 25 and in hangars 55 secured to the upper end of the vertical channels 50 shown in Fig. 4. The lower end of the upper leaf 21 is provided with pivot track castings 56 secured on the insides of the webs of the channels 50 and forming, together with one flange of each channel to which a casting 56 is attached, tracks 560 into which flanged wheels 230 journaled on the ends of the pivot pins 23 are disposed. Upper stop channels 57 secured between pairs of vertical framework channels 50 and lower arcuate stops 58 integral with the pivot track castings 56 limit shifting movement of the pivots 23 vertically with respect to the upper leaf 21.

The lower leaf 22 has its pairs of vertical framework channels 60 spaced slightly closer together than the pairs of vertical framework channels 50 of the upper leaf 21 as best shown in Fig. 5 in order to nest therebetween when the door 20 is in its fully opened position. Each channel of each pair of channels 60 has a hanger casting 64 secured on the upper end thereof and a pivot pin 23 is extended through each pair of hangar castings as best shown in Fig. 5. When the door is in its fully closed position, the lower leaf 22 thereof is hung in depending relationship from the upper leaf 21 thereof on the pivots 23 which, when the said door 20 is closed, are each supported by its flanged wheels 230 in the lower arcuate stops 58 of the pivot track castings 56, the said arcuate stops 58 serving as cradles.

As the door B is opened, the lower leaf 21 first is lifted by the lifting cables 33 vertically substantially to the limit of the vertical movement of the pivots 23 which brings the said pivots 23 substantially against the upper stops 57. Upon further opening of the door under control of the struts 28 and the cable means 40 and as the lower end of the lower leaf 22 travels in a path substantially as indicated by the dash and dot line 65 in Fig. 3 and as the front of the lower leaf 22 and the bottom flash plate 520 of the upper leaf 21 maintain the clearance line indicated by the dash and two dot line 66 in Fig. 2, the pivots 23 move downward and toward the lower arcuate stops 58 of the pivot track castings 56 to approximately the position indicated in Figs. 2 and 7. During the opening of the door, the cable means 40 constantly urges the moving pivot 23 as far as possible toward the upper stop 57 of the track 560 which maintains the lower end of the lower leaf 21 to the clearance line 65 which is nearly in line with the plane of the door 20 when closed, thus reducing the opening and closing clearance of the bottom of the lower leaf 21 from normal closing clearance indicated by the dotted line 67 in Fig. 2 obtained in free hanging fixed pivot guideless bifold canopy door construction.

The particular embodiment of the strut and cable means 40 employed in the illustrative construction shown in the drawings will now be described. Each of the said pairs of vertical framework channels 60 on the back of the lower leaf 22 of the door has a pair of castings 68 secured thereto which support a pivot 29 onto which the strut 28 is pivotally mounted by means of a pair of castings 70 secured in extending relationship to the lower end of the said strut 28 as best shown in Figs. 4 and 5. The upper end of the said strut 28 is provided with a pair of castings 71 which are journaled on the pivot 30 which extends through a pivot securing casting 72 bolted to the roof framing member 31, which, in the instant illustration, is an I-beam, see Figs. 4 and 9.

The cable 40 is preferably double looped around

the anchor pin 41 journaled to the strut 28 near the upper end thereof by means of suitable castings 73 bolted between the channels 74 forming the said strut 28 as best shown in Fig. 11. The said cable 40 runs over a double sheave 42 fixed in depending relationship to the bottom chord 32 of the truss 26 and then runs under a double sheave 43 fixed to the top of the pivoted strut 28 as best shown in Figs. 4 and 12. From the said sheave 43, the said stay cable 40 runs to the moving pivot 23 fixed to the top of the lower leaf 21 of the door 20 and is preferably single looped therearound. A circumferentially grooved sleeve 2300 journaled on the said moving pivot 23 permits the cable 40 to creep therearound responsive to the spring-loaded take-up means 44. The said sleeve 2300 also prevents wear of the said cable 40 as the door 20 is opened and closed by eliminating friction between the cable 40 and the moving pivot 23.

The spring-loaded cable take-up means 44 preferably comprises a pair of cable anchor blocks 45 telescopically mounted on a pair of bolts 46 carrying compression springs 47 which constantly urge the said cable anchor blocks 45 toward each other. Inasmuch as one end of the cable 40 is anchored in each of the cable anchor blocks 45, it is obvious that, with the arrangement of cable indicated in Figs. 4 and 6, the spring-loaded take-up blocks 45 hold the cable taut at all times during the opening and closing of the door 20. The said take-up means 44 also compensates for stretching of the stay cable 40 and provides means for regulating the tension of the cable 40.

By changing the location of the strut pivots 29 and 30, the length of the track 560 of the moving pivot 23, and by changing the location of the auxiliary stay cable 40 anchorage pin 41 and sheaves 42 and 43, other opening and closing clearance lines 65 and 66 may be obtained. In each instance, the struts 28 transfer wind stresses to the building structure through the roof framing member 31 thereby avoiding the necessity of designing the door leaves 21 and 22 to span between side guides. As a result, the invention permits the use of a single door the full length of a building or permits the use of a plurality of doors along one side of a building without columns or door jambs therebetween, all with economical construction costs and a minimum loss of usable apron space outside the building and usable floor space within the building. Because of the use of the shifting pivots 23 and the struts 28, the initial lifting stress on the lifting cables 33 is much less than in the ordinary type of bifold canopy doors.

The invention is not only applicable to hangar and storage building construction but obviously is of great value in industrial constructions where the industrial process within the building requires and permits 100% ventilation in hot weather and less during cold weather, particularly because of the fact that the door is thoroughly braced against wind pressure and sway in a partially opened position.

The door B' illustrated in Figs. 13 to 16 inclusive is similar to the door 20 illustrated in Figs. 1 to 21 inclusive, except that fixed pivots 80 are substituted for the moving pivots 23 and the cable means 40 including the sheaves, cable anchorages and cable take-ups relating thereto are omitted. Each fixed pivot 80 is journaled in pairs of pivot supporting castings 31 secured to the inside of the web of the channels 50 of the pairs of upper leaf vertical framework channels 50 which are disposed under the roof framing members 31 as best shown in Figs. 15 and 16.

The said embodiment of the invention illustrated in Figs. 13 to 16 inclusive produces all the advantageous results obtained in the embodiment of the invention disclosed in Figs. 1 to 12 inclusive, except that the opening and closing clearance line 650 of the lower end of the lower leaf 21 of the door B' is less favorable than the corresponding clearance line 65 of the door B disclosed in Figs. 1 to 12 inclusive and except that the initial lifting stress on the lifting cables 33 is more than when the moving pivots 23 are employed.

By comparing the clearance line 650 of the bifold door shown in Fig. 13 with the clearance line 65 in the bifold door B in Fig. 2, and both with the clearance line 67 of a guideless and strutless bifold door, it will be readily observed that the bifold door B' disclosed in Figs. 13 to 16 inclusive is equally as valuable as the door B disclosed in Figs. 1 to 12 inclusive in hangars where the engines and propellers of airplanes are disposed above the floor at least to the height of the bottom of the upper leaf 21 of the door B' and in buildings where little more than an absolute minimum of space may be allotted for opening and closing the doors thereof.

The embodiment of the invention disclosed in Figs. 17 to 23 inclusive is similar to the embodiment of the invention disclosed in Figs. 1 to 12 inclusive except that, in the door $B^2$ disclosed in Figs. 17 to 23 inclusive, the auxiliary cable means 40 is omitted and side guides 90 are employed. Each side guide 90 may comprise a Z-bar 91 and an angle 92 extending vertically alongside the door jamb member 93. The lower leaf 22 of the door $B^2$ is provided at each side thereof with a guide roller 94 journaled on the end of a guide pin 95 secured to a horizontal member 96 provided near the bottom of the lower leaf 22 of the door as best shown in Figs. 22 and 23. The said guide rollers 94 are so located as to permit the door $B^2$ to open and close without binding, see Figs. 17 and 18.

The opening and closing clearance line 97 of the door $B^2$ disclosed in Figs. 17 to 23 inclusive is obviously governed by the rolling of the guide rollers 94 in the side guides 90 and is not materially different from the clearance line 65 of the bifold door 20 disclosed in Figs. 1 to 12 inclusive. The major amount of any wind pressure against the door $B^2$ is taken by the struts 28 when the door is closed and when the door is partially opened. The stresses transferred to the side guides 90 are less than one-quarter of the wind stresses against the door and include a very slight reaction from the weight of the door $B^2$ due to the guide 90 controlling the opening and closing clearance of the said door.

By referring to Fig. 17, the opening and closing clearance line 97 of the door $B^2$ may be compared with the opening and closing clearance line 67 of the lower end of the lower leaf 21 of the door 20 when constructed without side guides, without a strut 28 and without cable means 40. The door $B^2$ disclosed in Figs. 17 to 23 inclusive is applicable to wide bifold doors and the side guides 90 merely regulate the opening and closing clearances thereof. The employment of the struts 28 in the bifold door $B^2$ disclosed in Figs. 17 to 23 inclusive relieves the side guides 90 of a major amount of wind pressure normally transferred thereto in the case of an ordinary side

guided bifold door which does not employ a strut 28 and a sliding pivot 23. For a wide opening, the bifold door $B^2$ as in the other two embodiments of the invention disclosed herein, need not be constructed as strong or as heavy as a bifold door which does not employ one or more struts 28 to relieve the door of its wind pressure load at intervals along the width thereof.

The several embodiments of the door herein disclosed all resist wind pressures in their fully closed, partially opened and fully open positions without unduly heavy construction by transferring either substantially all or a major portion of wind pressure thereagainst directly to the building structure at intervals along the width of the door to prevent swaying and undue deflection of the door when under wind loads. All forms of the door therefore are economical to manufacture and all require only a minimum of apron space and space within the building during the opening and closing thereof.

Many changes and modifications may be made in the described constructions and many widely different embodiments of the invention may be had without departing from the spirit of the invention. It is therefore intended that all matter contained in the foregoing description and shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. A door comprising an upper leaf pivotally mounted at its top for upward and outward swinging movement from a vertically disposed closed position to an open position, a lower leaf pivotally connected at its top to said upper leaf near the bottom of said upper leaf for upward and inward swinging movement relative to said upper leaf from a vertically disposed closed position to an open position, a strut pivotally connected at its lower end to the lower leaf at a point near the top of the lower leaf but spaced downwardly from the pivotal connection of said lower leaf with said upper leaf, said strut being disposed at the inner side of said door between planes including the side edges of the leaves and extending in upwardly diverging relationship to said leaves when the leaves are in their vertically disposed closed positions, and fixed means to which said strut is pivoted at its upper end, whereby said strut braces the door and in conjunction with the upper leaf controls opening and closing movements of the lower leaf.

2. A door comprising an upper leaf pivotally mounted at its top for upward and outward swinging movement from a vertically disposed closed position to an open position, a lower leaf pivotally connected at its top to said upper leaf near the bottom of said upper leaf for upward and inward swinging movement relative to said upper leaf from a vertically disposed closed position to an open position, the pivotal connection between said leaves being vertically shiftable relative to the upper leaf, fixed means for guiding the lower part of the lower leaf during opening and closing movements of the door, a strut pivotally connected at its lower end to the lower leaf at a point near the top of the lower leaf but spaced downwardly from the pivotal connection of said lower leaf with said upper leaf, said strut being disposed at the inner side of said door between planes including the side edges of the leaves and extending in upwardly diverging relationship to said leaves when the leaves are in their vertically disposed closed positions, and fixed means to which said strut is pivoted at its upper end, whereby said strut braces the door and in conjunction with the upper leaf and said fixed guide means controls opening and closing movements of the lower leaf.

3. A door comprising an upper leaf pivotally mounted at its top for upward and outward swinging movement from a vertically disposed closed position to an open position, a lower leaf having a fixed pivotal connection at its top with said upper leaf near the bottom of said upper leaf for upward and inward swinging movement relative to said upper leaf from a vertically disposed closed position to an open position, a strut pivotally connected at its lower end to the lower leaf at a point near the top of the lower leaf but spaced downwardly from the pivotal connection of said lower leaf with said upper leaf, said strut being disposed at the inner side of said door between planes including the side edges of the leaves and extending in upwardly diverging relationship to said leaves when the leaves are in their vertically disposed closed positions, and fixed means to which said strut is pivoted at its upper end, whereby said strut braces the door and in conjunction with the upper leaf controls opening and closing movements of the lower leaf.

4. A door comprising an upper leaf pivotally mounted at its top for upward and outward swinging movement from a vertically disposed closed position to an open position, a lower leaf pivotally connected at its top to said upper leaf near the bottom of said upper leaf for upward and inward swinging movement relative to said upper leaf from a vertically disposed closed position to an open position, the pivotal connection between said leaves being vertically shiftable relative to the upper leaf, a strut pivotally connected at its lower end to the lower leaf at a point near the top of the lower leaf but spaced downwardly from the pivotal connection of said lower leaf with said upper leaf, said strut being disposed at the inner side of said door between planes including the side edges of the leaves and extending in upwardly diverging relationship to said leaves when the leaves are in their vertically disposed closed positions, fixed means to which said strut is pivoted at its upper end, whereby said strut braces the door and in conjunction with the upper leaf controls opening and closing movements of the lower leaf, means connected with the lower leaf near its lower end for raising the same, and means whereby opening swinging movement of said lower leaf about its pivotal connection with said strut exerts a lifting effort upon said strut.

5. A door comprising an upper leaf pivotally mounted at its top for upward and outward swinging movement from a vertically disposed closed position to an open position, a lower leaf pivotally connected at its top to said upper leaf near the bottom of said upper leaf for upward and inward swinging movement relative to said upper leaf from a vertically disposed closed position to an open position, the pivotal connection between said leaves being vertically shiftable relative to the upper leaf, a strut extending diagonally upwardly and inwardly from said lower leaf when said lower leaf is in a vertically disposed closed position, a pivotal connection between the lower end of said strut and the lower leaf at a point near the top of the lower leaf but spaced downwardly from the pivotal connection of said lower leaf with said upper leaf, fixed means to which said strut is pivoted at its upper

end, whereby said strut braces the door and in conjunction with the upper leaf controls opening and closing movements of the lower leaf, means connected with the lower leaf near its lower end for raising the same, a sheave carried by said strut, a cable connected to said lower leaf at a point above the pivotal connection of said strut with said lower leaf and extending beneath said sheave, and means from which said cable reacts in response to opening swinging movement of said lower leaf about its pivotal connection with said strut to exert a lifting effort upon said strut.

6. A door comprising an upper leaf pivotally mounted at its top for upward and outward swinging movement from a vertically disposed closed position to an open position, a lower leaf pivotally connected at its top to said upper leaf near the bottom of said upper leaf for upward and inward swinging movement relative to said upper leaf from a vertically disposed closed position to an open position, the pivotal connection between said leaves being vertically shiftable relative to the upper leaf, a strut extending diagonally upwardly and inwardly from said lower leaf when said lower leaf is in a vertically disposed closed position, a pivotal connection between the lower end of said strut and the lower leaf at a point near the top of the lower leaf but spaced downwardly from the pivotal connection of said lower leaf with said upper leaf, fixed means to which said strut is pivoted at its upper end, whereby said strut braces the door and in conjunction with the upper leaf controls opening and closing movements of the lower leaf, means connected with the lower leaf near its lower end for raising the same, a sheave carried by said strut near its lower end, a second sheave having a fixed mounting outwardly with respect to the pivotal connection of the upper end of said strut with said fixed means, and a flexible element connected with said lower leaf at a point above the pivotal connection of said strut with said lower leaf and extending beneath said strut-carried sheave and over said second mentioned sheave and then to and connected with said strut, whereby opening swinging movement of said lower leaf about its pivotal connection with said strut causes said flexible element to exert a lifting effort upon said strut.

7. A door comprising an upper leaf pivotally mounted at its top for upward and outward swinging movement from a vertically disposed closed position to an open position, a lower leaf pivotally connected at its top to said upper leaf near the bottom of said upper leaf for upward and inward swinging movement relative to said upper leaf from a vertically disposed closed position to an open position, the pivotal connection between said leaves being vertically shiftable relative to the upper leaf, a strut extending diagonally upwardly and inwardly from said lower leaf when said lower leaf is in a vertically disposed closed position, a pivotal connection between the lower end of said strut and the lower leaf at a point near the top of the lower leaf but spaced downwardly from the pivotal connection of said lower leaf with said upper leaf, fixed means to which said strut is pivoted at its upper end, whereby said strut braces the door and in conjunction with the upper leaf controls opening and closing movements of the lower leaf, means connected with the lower leaf near its lower end for raising the same, and means tending constantly during opening movement of the lower leaf to resist upward and inward swinging movement of said lower leaf about its pivotal connection with the lower end of said strut, thereby to limit the lower part of the lower leaf to a minor amount of lateral movement during the initial part of its opening movement and the final part of its closing movement.

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