

Nov. 18, 1941.

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2,262,976

BOTTOM LEAF RETAINING MEANS FOR CANOPY DOORS

Filed Jan. 12, 1940

2 Sheets-Sheet 1

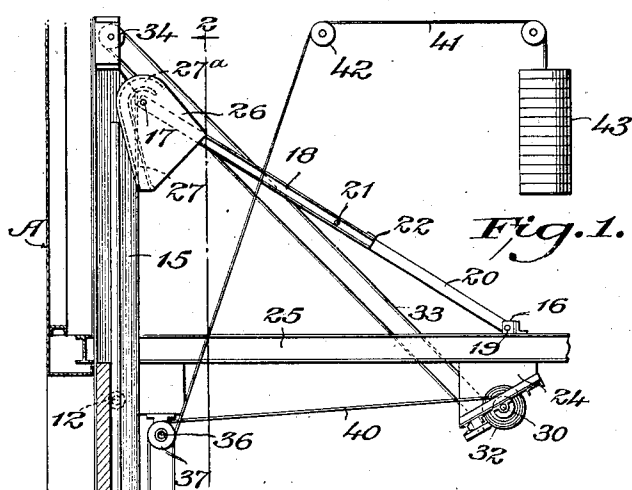


Fig. 1.

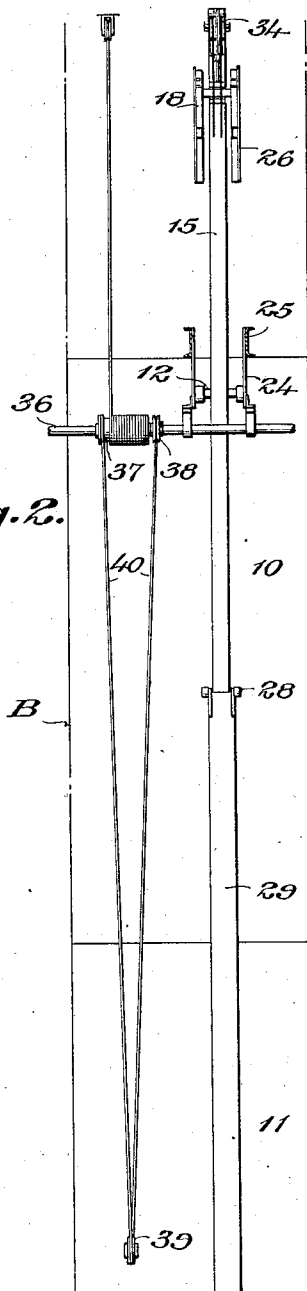


Fig. 2.

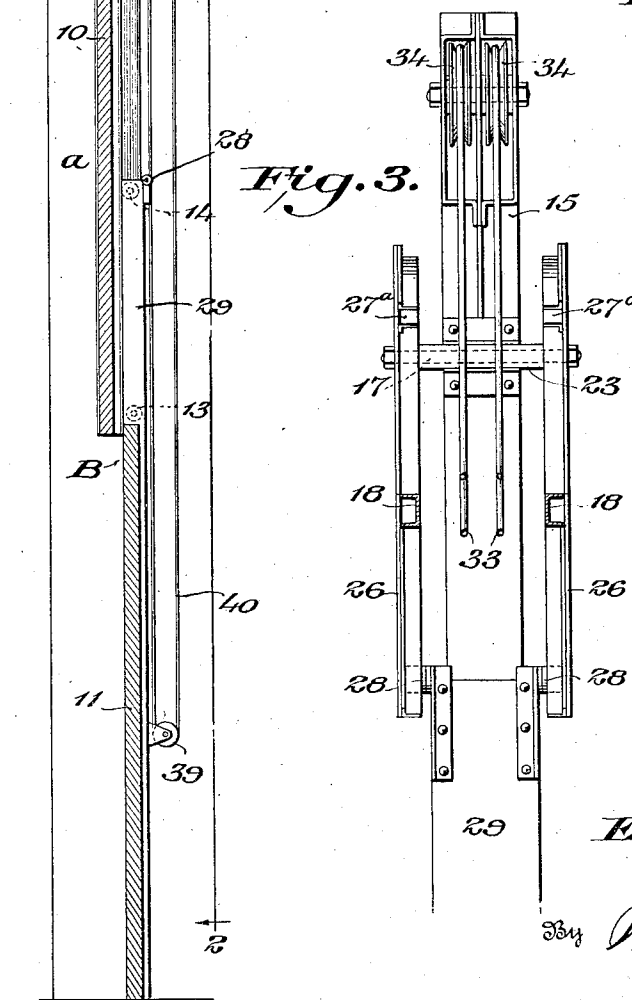


Fig. 3.

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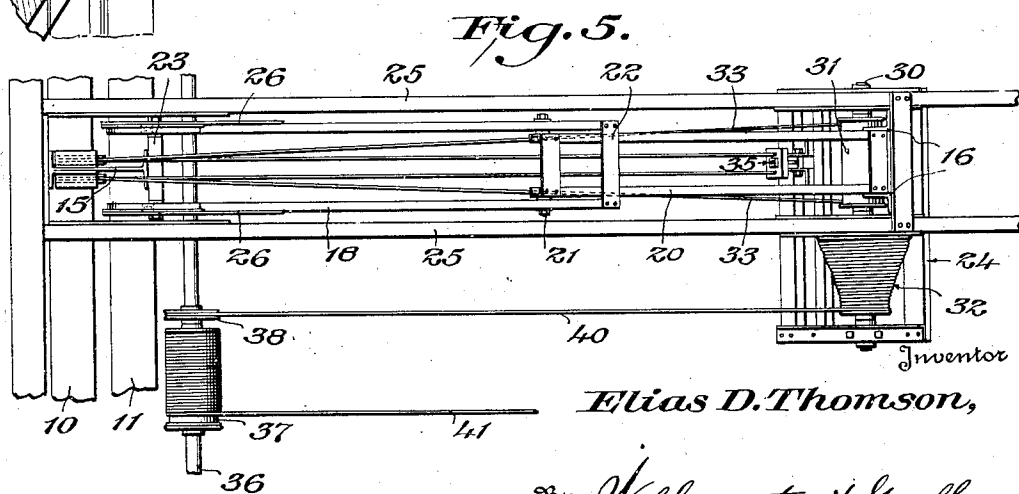
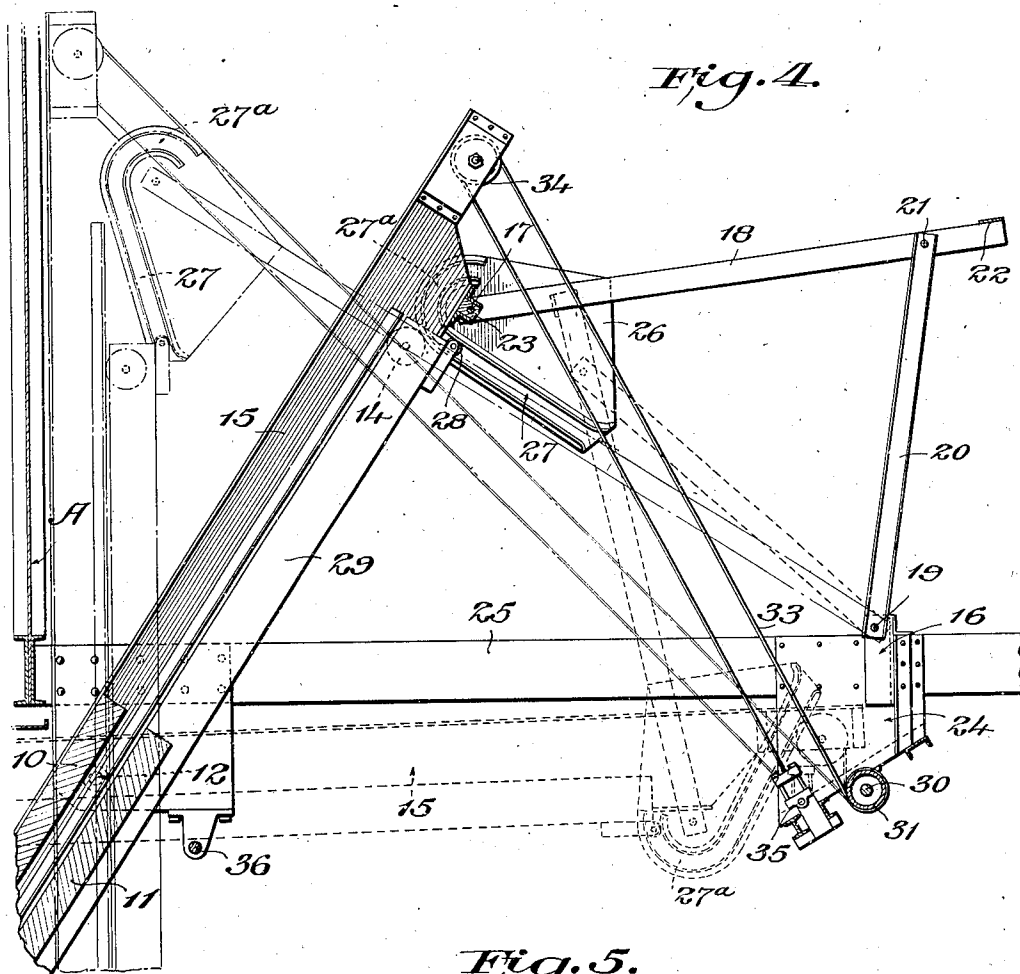
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,262,976

BOTTOM LEAF RETAINING MEANS FOR
CANOPY DOORS

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Application January 12, 1940, Serial No. 313,643

6 Claims. (Cl. 20-19)

This invention relates to doors, and has particular reference to improvements in so-called "canopy" doors; that is to say, doors of the type which, when open, extend horizontally, or substantially horizontally, forwardly, canopy-like, from a doorway at or near the top thereof.

Such doors commonly are used for controlling large doorways, such as the doorways of aircraft hangers, warehouses and the like, and usually they are quite high, wide and heavy, often being composed of two or more independent sections disposed in side to side relationship.

It is known to form such doors, or door sections, of upper and lower leaves, the lower leaf of which is mounted on the upper leaf to slide vertically relative thereto between raised and lowered positions to open and close the lower part of the doorway when the upper leaf is disposed vertically closing the upper part of the doorway, and the upper leaf of which is pivoted for swinging movement between a vertically disposed closed position and a substantially horizontally disposed open position in which it extends forwardly from the doorway at or near the top thereof and carries with it the lower leaf which is disposed therebeneath in raised or open position with respect thereto. Thereby, the space in front of the door, for a considerable height and immediately adjacent to the door, may advantageously be utilized for any desired purpose without interfering with operation of the door to open and close either the lower part of the doorway or the entire doorway.

Being, usually, of considerable area, it is important to brace such doors against inward or outward swinging movement due to wind pressure thereagainst or to other causes, especially when the door leaves are disposed vertically, and means for this purpose also are known, one such means comprising a lever arm extending upwardly from the upper leaf above the pivot thereof and a pair of cooperating, upper and lower, pivotally connected together brace arms, the upper of which is pivotally connected at its upper end to said lever arm, the lower of which is pivotally connected at its lower end to a fixed support located above or at least not appreciably below the level of the top of the door, and which extend in alignment with each other diagonally downwardly and inwardly from said brace arm to said fixed support when the door leaves are disposed vertically. Thereby the door leaves, when vertically disposed, are held effectively against swinging movement and, at the same time, the bracing means does not interfere with

utilization of the space behind and adjacent to the door for storage or any other desired purpose.

In connection with such bracing means it also is known to provide the upper brace arm with cam means and the lower door leaf with roller or other suitable means for cooperation with said cam means during the final portion of raising movement of the lower leaf relative to the upper leaf to swing the brace arms upwardly about their pivotal connections with the lever arm and the fixed support, respectively, thereby to disalign said brace arms to permit the two door leaves to be swung as a unit toward open position, and to initiate such swinging movement.

In addition, it is known to provide, in connection with doors of the type mentioned, means to positively hold the lower door leaf against sliding downwardly relative to the upper door leaf during opening and closing swinging movements of the leaves, and this is a very important provision against serious accidents. However, such means, as heretofore provided, have been separate and distinct from the bracing means and the brace arm disaligning means, and its provision in many instances has involved complications and considerable expense. Accordingly, the object of the present invention is to provide, in association with a door of the type mentioned, braced in the manner mentioned, cam means on the upper brace arm and roller or equivalent means on the lower door leaf which serve not only to disalign the brace arms and to initiate opening swinging movement of the door leaves in response to the final portion of raising movement of the lower door leaf, but which thereafter cooperate with each other to positively prevent accidental downward sliding movement of the lower door leaf relative to the upper door leaf during opening and closing swinging movements of the leaves. Thereby, the disadvantages of prior means for the same purpose are practically eliminated.

With the foregoing and other objects in view, which will become more fully apparent as the nature of the invention is better understood, the same consists in the novel features of construction, combination and arrangement of parts as will be hereinafter more fully described, illustrated in the accompanying drawings and defined in the appended claims.

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

Fig. 1 is a vertical, transverse section through

a canopy door equipped with means in accordance with one practical embodiment of the invention to hold the lower door leaf against sliding downwardly relative to the upper door leaf during swinging movement of the door leaves between closed and open positions.

Fig. 2 is a section on the line 2—2 of Fig. 1.

Fig. 3 is an enlarged section similar to Fig. 2 of the upper part of the door structure.

Fig. 4 is an enlarged view similar to Fig. 1 of the upper part of the door structure showing, by dash and dot lines, a vertical disposition of the door leaves, by full lines the door partly swung to open position and, by dotted lines, the door swung to fully open, canopy-like position; and

Fig. 5 is a top plan view of the door and its control and operating means.

Referring to the drawings in detail, A designates a part of a building structure having a doorway *a*, and B designates, generally, a canopy door controlling said doorway.

The door B comprises upper and lower leaves designated as 10 and 11, respectively, which, within the purview of the invention, may be of any suitable or desired specific construction. They accordingly have not been illustrated in detail, but have been indicated conventionally as of panel form.

The upper leaf 10 is pivotally mounted in any suitable manner, as indicated at 12, at or near its top, to the building structure A, 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 at or near the top of the doorway *a*. On the other hand, the lower leaf 11 is mounted in any suitable manner on the upper leaf 10 for vertical sliding movement between raised and lowered, open and closed positions, respectively, relative thereto. For example, the upper leaf may be suitably provided with rollers 13 to ride in suitable vertically extending trackways of the lower leaf, and the lower leaf may be suitably provided with rollers 14 to ride in suitable vertically extending trackways of the upper leaf. In any event, the upper leaf 10 is of a height to control approximately the upper half of the doorway *a*, the lower leaf 11 is disposed inwardly relative to the upper leaf 10 and is of a height to control the lower portion of the doorway *a*, and the means slidably mounting the lower leaf upon the upper leaf is of a suitable form such that it holds the lower leaf at all times in a plane parallel to the plane of the upper leaf. Thus, the lower leaf can move only vertically relative to the upper leaf and whenever the upper leaf is swung the lower leaf is swung therewith.

Extending upwardly from the upper leaf 10 a suitable distance above the pivot 12 of said leaf is a lever arm 15 which may be comprised, for example, by the upper portion of an I-beam constituting part of the upper leaf structure, while located at a point which is suitably spaced downwardly and inwardly from the top of said lever arm when the upper leaf and said lever arm are disposed vertically, is a suitable fixed support 16.

Pivotally connected at or near its upper end, as indicated at 17, to the lever arm 15 at or near the upper end of the latter, is an upper brace arm 18, while pivotally connected at or near its lower end, as indicated at 19, to the fixed support 16, is a lower brace arm 20. At or near their lower and upper ends, respectively, these brace arms 18 and 20 are pivotally connected together as indicated at 21, and when the door leaves are dis-

posed vertically said brace arms 18 and 20 extend in alinement, or substantially in alinement, with each other, diagonally downwardly and inwardly from the lever arm 15 to the fixed support 16 and together constitute a brace which acts both in compression and tension to positively hold the door against any swinging movement.

Any suitable means may be provided to insure an alined, or substantially alined, disposition of the brace arms 18 and 20 relative to each other when the door leaves are disposed vertically. For example, and as illustrated in the present instance, the lower end portion of the upper brace arm 18 may extend a short distance below the pivot 21 so as to overlap the upper end portion of the lower brace arm 20 when said arms are alined, or are substantially alined, and the said lower end portion of the arm 18 may be provided with a suitable stop 22 to engage a top portion of the lower brace arm at a point spaced downwardly from the pivot 21 when, of course, said arms are alined or are substantially alined. The said arms are upwardly swingable about their pivots 17 and 19, respectively, to permit the door leaves to swing and are downwardly swingable about their pivots 17 and 19, respectively, to alined or substantially alined positions when the door is swung from open to vertical position. The stop 22 thus serves to prevent the arms 18, 20 from swinging beyond, or appreciably beyond, alined positions when the door is swung to vertical position.

The arms 18 and 20 may comprise single members, but preferably each of said arms is comprised by a pair of members of channel section or other suitable form secured together in parallel, spaced apart relationship as illustrated in the present instance, the members comprising the upper arm being disposed to opposite sides of the lever arm 15 and being more widely spaced apart than the members comprising the lower arm 20 and accommodating the members comprising the latter arm therebetween. At their upper ends the arms 18 may be pivotally connected to the lever arm 15 through the instrumentality of a pivot pin extending through a block 23 suitably fastened to said lever arm. On the other hand, the fixed support 16 may comprise a pair of upright angle-iron members or one or more members of any other suitable form constituting, for example, part of a drum supporting frame 24 carried by a pair of channel members 25 disposed horizontally, inwardly with respect to the door at about the level of the top of the doorway *a* and constituting part of the building structure, and the members comprising the arm 20 may be pivotally connected to said angle-iron or equivalent member, or members, by a common pivot pin, as shown.

Carried by the members comprising the upper brace arm 18 are vertically disposed plates 26, which, at their adjacent or inner sides, are suitably provided with cam channels 27 for cooperation with rollers 28 carried, by the lower door leaf, said rollers, or suitable equivalents thereof, being carried, for example, at or near the top of suitable arm means 29 constituting part of the lower door leaf structure.

When the door leaves are disposed vertically and the brace arms 18 and 20 are alined in diagonal downward and inward disposition relative to the door, the lower portions of the channels 27 extend diagonally downwardly and inwardly and their lower, open ends are disposed in vertical alinement with the rollers 28 at ele-

ventions such that their lower ends will be entered by said rollers 28 when the lower door leaf 11 is raised nearly to its fully open position relative to the upper door leaf, but before said lower door leaf has reached its fully raised or open position. It follows, therefore, that when the upper door leaf is disposed vertically closing the upper part of the doorway *a*, and is braced in that position by the arms 18 and 20, the lower door leaf may be nearly fully raised and lowered to open and close the lower part of the doorway *a* without disturbing the closed, braced status of the upper door leaf, and that, since the lower door leaf cannot swing relative to the upper door leaf, both leaves are effectively braced during substantially full opening and closing movements of the lower leaf. When, however, the lower leaf is farther raised after its rollers 28 have entered the lower end portions of the cam channels 27, said rollers, due to the downward and inclination of said portions of said channels, cooperate with said channels to swing the brace arm 18 upwardly about its pivot 17. This results in the pivot 21 being swung upwardly with consequent upward swinging of the lower brace arm 20 about its pivot 19, with the result that, as illustrated in Fig. 4 of the drawings, the pivot 21 becomes disposed above a straight line drawn through the pivots 17 and 19, and the arms 18 and 20 become disaligned and extend in upwardly converging relationship to each other so that they no longer are effective to hold the door leaves against swinging movement. In fact, since upward swinging movement of the arms 18 and 20 about their pivots 17 and 19 results in shortening of the distance between said pivots 17 and 19, it follows that cooperation of the rollers 28 with the lower portions of the cam channels 27 results not only in releasing the bracing means to permit the door leaves to swing, but actually initiates swinging movement of said leaves.

Any suitable operating means may be provided for effecting upward movement and controlling downward movement of the lower leaf 11 relative to the upward leaf 10 and for effecting swinging movement of said leaves as a unit to canopy-like open position and for controlling their return to vertical position. In this connection and as illustrated in the present instance, a shaft 30, disposed horizontally and extending parallel to the door, is suitably supported, as for example, by the frame 24, preferably at a point a short distance below the pivot 19 of the brace arm 20 at a distance inwardly from the pivot 12 of the upper door leaf about equal to the length of the lever arm 15, and has fixed thereon a pair of cable drums 31 and 32, the former of which is cylindrical and the latter of which is conical or of other suitable form larger at one end than at the other.

A pair of cables 33 are fixed at corresponding ends to the drum 31, at opposite ends of said drum, respectively, and extend from said drum upwardly and outwardly over sheaves 34 carried by the lever arm 15 at or near the top thereof and then extend downwardly and inwardly from said sheaves to points adjacent to the drum 31 where they are suitably anchored as indicated at 35.

Inwardly of and adjacent to the door, near the top of the doorway *a*, is a horizontally disposed power shaft 36 which extends parallel to the door and which has fixed thereon a cable drum 37 and loose thereon a sheave 38, while car-

ried by the lower door leaf 11 is another sheave 39.

A cable 40 is fixed at one end to the drum 32 at the larger end thereof and extends from said drum substantially horizontally forwardly over the sheave 38, then downwardly beneath the sheave 39 and then upwardly to the drum 37 to which it is fixed at its other end.

When the door leaves are disposed vertically, the cables 33 are unwound from the drum 31 and the cable 40 is wound onto the drum 32, extending from the smaller end thereof.

More force is required to be exerted through the cable 40 upon the drum 32 to effect rotation thereof and of the drum 31 to wind the cables 33 onto the latter drum and thereby effect swinging movement of the door leaves by exerting a downward and inward pull on the lever arm 15, than is required to be exerted by said cable 40 through the sheave 39 on the lower door leaf to lift said lower door leaf. Consequently, when the door leaves are disposed vertically and the lower door leaf is lowered, rotation of the power shaft 36 in a direction to effect winding of the cable 40 onto the drum 37 results in raising of the lower door leaf until the rollers 28 enter the lower ends of the cam channels 27, without disturbing the vertical position of the upper door leaf, especially since the upper door leaf is braced against swinging movement by the arms 18 and 20. Accordingly, the lower door leaf may be raised and lowered between its lowermost position and a nearly fully raised position to open and close the lower part of the doorway without disturbing the vertical, braced position of the upper door leaf. When, however, the rollers 28 enter the lower ends of the channels 27, further upward movement of the lower leaf is resisted due to the fact any continued upward movement of said leaf must of necessity result in swinging movement of the brace arms 18 and 20 in the manner heretofore described and also in initial opening swinging movement of the door leaves. Consequently, continued rotation of the power shaft 36 in a direction to effect winding of the cable 40 onto the drum 37 thereof, results in unwinding of said cable from the drum 32. This, in turn, results in rotation of the drum 31 and in winding of the cables 33 onto the same, with the further result that said cables react from their anchorages 35 and pull the lever arm 15 downwardly. This occurs soon after the rollers 28, by cooperation with the lower portions of the cam channels 27, effect initial opening swinging movement of the door leaves. Thereafter, the upward swinging movement of the brace arm 18 about its pivot 17 resulting from continued opening swinging movement of the door leaves, exerts through the cam channels 27 and the rollers 28 an upward leverage on the lower door leaf which results in said lower leaf being lifted to fully raised position simultaneously, with initial opening swinging movement of the door leaves.

As the cable 40 is unwound from the drum 32 it approaches the larger end of said drum with the result that progressively increasing leverage is exerted on the shaft 30 to rotate the same to effect opening swinging movement of the door leaves as said leaves approach substantially horizontal position and require more power to effect their opening swinging movement.

As the door leaves continue to swing toward open position the brace arm 18 swings upwardly about its pivot 17 and the brace arm 20 swings

upwardly and rearwardly about its pivot 19 until the pivots 12, 17 and 21 become disposed in a straight line with the brace arm 18 extending upwardly from the lever arm 15. Thereafter, the brace arm 18 swings forwardly and downwardly relative to the lever arm 15 and the brace arm 20 swings forwardly and downwardly until said brace arms reach the relationship shown by dotted lines in Fig. 4 of the drawings when the door reaches its fully open, canopy-like position. During these swinging movements the rollers 28 travel in the cam channels 27, and in this connection it will be noted that the upper portions 27^a of said channels are curved concentrically about the pivot 17 and are of radii and lengths such that the rollers 28 begin to cooperate therewith as the lower door leaf reaches fully raised position relative to the upper door leaf and thereafter remain therein during further opening swinging movement of the door leaves to fully open, canopy-like position. Consequently, the lower door leaf not only is positively held against sliding downwardly relative to the upper door leaf during opening and closing swinging movements of said leaves, but also is held against any oscillation vertically relative to the upper leaf during opening and closing swinging movements of the door, it being understood, of course, that in swinging from canopy-like open position to vertical position, gravity is the propelling force and swinging movement of the door is under the control of the power shaft 36.

Preferably, but not necessarily, a second cable 41 is attached at one end to the drum 37 and extends from said drum over a suitable sheave or sheaves 42 to any suitable point where it is equipped at its other end with a weight 43. Thus, the lower leaf 11 may be effectively counter-weighted. The two cables 40 and 41 may be attached to opposite ends of the drum 36 so that as one of them winds onto said drum the other unwinds therefrom.

Of course, only one or as many as desired of the described braces and associated operating means, whether of the form illustrated and described or of any other suitable form, may be employed in connection with any given door or door section. Moreover, it is further apparent that the present bracing and operating means are disposed quite high so that they do not interfere with utilization of the space behind and adjacent to the door for substantially the full height thereof for storage or other purposes, and that the cam channels 27, 27^a formed as illustrated and described, afford a simple yet practical and inexpensive means of insuring against accidental downward sliding movement of the lower door leaf relative to the upper door leaf during opening and closing swinging movements of the door.

Without further description it is thought that the features and advantages of the invention will be readily apparent to those skilled in the art, and it will of course be understood that changes in the form, proportion and minor details of construction may be resorted to, without departing from the spirit of the invention and scope of the appended claims.

I claim:

1. A door comprising an upper leaf pivoted for swinging movement between vertical and substantially horizontal closed and open positions, respectively, a lower leaf mounted on said upper leaf for vertical sliding movement between raised and lowered, open and closed positions, respectively, relative thereto, a brace for the upper leaf

comprising a lever arm extending from said upper leaf above the pivot thereof, an upper brace arm pivoted at its upper end to said lever arm at a point above the pivot of said upper leaf, a lower brace arm having a fixed pivot at a point spaced inwardly from the pivot of said upper leaf and at a point spaced downwardly from the pivotal connection of said upper brace arm with said lever arm when the said upper leaf is disposed vertically, a pivotal connection between said brace arms, means to insure a substantially aligned relationship of said brace arms in which they extend diagonally downwardly and inwardly from said lever arm when the upper door leaf is disposed vertically and thereby hold said upper leaf against swinging movement, a pair of elements, one on the upper brace arm and the other on the lower leaf acting one upon the other in response to the final portion of raising movement of the lower leaf relative to the upper leaf to urge said upper brace arm upwardly about its pivotal connection with said lever arm, thereby to disalign said brace arms and to initiate opening swinging movement of the door leaves and to permit continued opening swinging movement of said leaves, and means for raising said lower leaf relative to said upper leaf and for thereafter swinging said leaves to open position, the said elements on said upper brace arm and on said lower leaf including means whereby they become interlocked one with the other by the final portion of raising movement of the lower leaf relative to the upper leaf and thereby act to hold the lower leaf against sliding vertically relative to the upper leaf during swinging movements of said leaves when the lower leaf is fully raised relative to the upper leaf.

2. A door comprising an upper leaf pivoted for swinging movement between vertical and substantially horizontal closed and open positions, respectively, a lower leaf mounted on said upper leaf for vertical sliding movement between raised and lowered, open and closed positions, respectively, relative thereto, a brace for the upper leaf comprising a lever arm extending from said upper leaf above the pivot thereof, an upper brace arm pivoted at its upper end to said lever arm at a point above the pivot of said upper leaf, a lower brace arm having a fixed pivot at a point spaced inwardly from the pivot of said upper leaf and at a point spaced downwardly from the pivotal connection of said upper brace arm with said lever arm when the said upper leaf is disposed vertically, a pivotal connection between said brace arms, means to insure a substantially aligned relationship of said brace arms in which they extend diagonally downwardly and inwardly from said lever arm when the upper door leaf is disposed vertically and thereby hold said upper leaf against swinging movement, cam means on the upper brace arm and cam follower means on the lower leaf cooperating in response to the final portion of raising movement of the lower leaf relative to the upper leaf to swing said upper brace arm upwardly about its pivotal connection with said lever arm, thereby to disalign said brace arms and to initiate opening swinging movement of the door leaves and to permit continued opening swinging movement of said leaves, and means for raising said lower leaf relative to said upper leaf and for thereafter swinging said leaves to open position, the said cam means on said upper brace arm being constructed and arranged to cooperate with the said cam follower means on said lower leaf to hold the lower leaf against

sliding vertically relative to the upper leaf during swinging movements of said leaves when the lower leaf is fully raised relative to the upper leaf.

3. A door comprising an upper leaf pivoted for swinging movement between vertical and substantially horizontal closed and open positions, respectively, a lower leaf mounted on said upper leaf for vertical sliding movement between raised and lowered, open and closed positions, respectively, relative thereto, a brace for the upper leaf comprising a lever arm extending from said upper leaf above the pivot thereof, an upper brace arm pivoted at its upper end to said lever arm at a point above the pivot of said upper leaf, a lower brace arm having a fixed pivot at a point spaced inwardly from the pivot of said upper leaf and at a point spaced downwardly from the pivotal connection of said upper brace arm with said lever arm when the said upper leaf is disposed vertically, a pivotal connection between said brace arms, means to insure a substantially aligned relationship of said brace arms in which they extend diagonally downwardly and inwardly from said lever arm when the upper door leaf is disposed vertically and thereby hold said upper leaf against swinging movement, means carried by said upper brace arm defining a cam channel the lower portion of which is inclined upwardly and outwardly when the upper leaf is disposed vertically and the upper portion of which is concentric to the pivotal connection of the upper brace arm with said lever arm, a roller on the lower leaf to enter the lower portion of said cam channel and to cooperate therewith in response to the final portion of raising movement of the lower leaf relative to the upper leaf to initiate opening swinging movement of said leaves and thereafter to cooperate with the upper portion of said channel to hold the lower leaf against sliding relative to the upper leaf, and means for raising said lower leaf relative to said upper leaf and for thereafter swinging said leaves as a unit to open, canopy-like position.

4. A door comprising an upper leaf pivoted for swinging movement between vertical and substantially horizontal closed and open positions, respectively, a lower leaf mounted on said upper leaf for vertical sliding movement between raised and lowered, open and closed positions, respectively, relative thereto, brace means cooperating with the upper leaf to hold the same against swinging movement when said leaf is disposed vertically, a pair of elements one on said brace means and the other on said lower leaf acting one upon the other in response to the final portion of raising movement of the lower leaf relative to the upper leaf to exert force on said bracing means to release same and thus permit the two leaves to be swung as a unit to open position, said elements including means whereby they become interlocked one with the other by the final portion of raising movement of the lower leaf

relative to the upper leaf and thereby prevent sliding movement of the lower leaf relative to the upper leaf when the lower leaf is fully raised relative to said upper leaf, and means for raising said lower leaf relative to said upper leaf and for thereafter swinging said leaves as a unit to open position.

5. A door comprising an upper leaf pivoted for swinging movement between vertical and substantially horizontal closed and open positions, respectively, a lower leaf mounted on said upper leaf for vertical sliding movement between raised and lowered, open and closed positions, respectively, relative thereto, brace means cooperating with the upper leaf to hold the same against swinging movement when said leaf is disposed vertically, cam and cam follower elements on said bracing means and the lower door leaf, respectively, acting one upon the other in response to the final portion of raising movement of the lower leaf relative to the upper leaf to exert force on said bracing means and thereby release same and to initiate swinging movement of the leaves as a unit toward open position, one of said elements including means whereby it becomes interlocked with the other of said elements by the final portion of raising movement of the lower leaf relative to the upper leaf and thereby acts to hold the lower leaf against sliding movement relative to the upper leaf during all further opening swinging movement of the leaves, and means for raising said lower leaf relative to said upper leaf and for thereafter swinging said leaves as a unit to canopy-like open position.

6. A door comprising an upper leaf pivoted for swinging movement between vertical and substantially horizontal closed and open positions, respectively, a lower leaf mounted on said upper leaf for vertical sliding movement between raised and lowered, open and closed positions, respectively, relative thereto, brace means cooperating with the upper leaf to hold the same against swinging movement when said leaf is disposed vertically, cam and cam follower elements, one on said bracing means and the other on said lower leaf, acting one upon the other in response to the final portion of raising movement of the lower leaf relative to the upper leaf to exert force upon said bracing means and thereby release the same and to initiate swinging movement of the leaves as a unit toward open position, one of said elements including means whereby it becomes interlocked with the other by the final portion of raising movement of the lower leaf relative to the upper leaf and thereby acts to hold the lower leaf against sliding movement relative to the upper leaf during all further opening swinging movement of the leaves, and means for raising said lower leaf relative to said upper leaf and for thereafter swinging said leaves as a unit to canopy-like open position.

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