Sept. 17, 1946. D. H. MORGAN 2,407,674

DOOR AND OPERATING MEANS THEREFOR

Filed Jan. 22, 1945 4 Sheets-Sheet 1

FIG. 1.

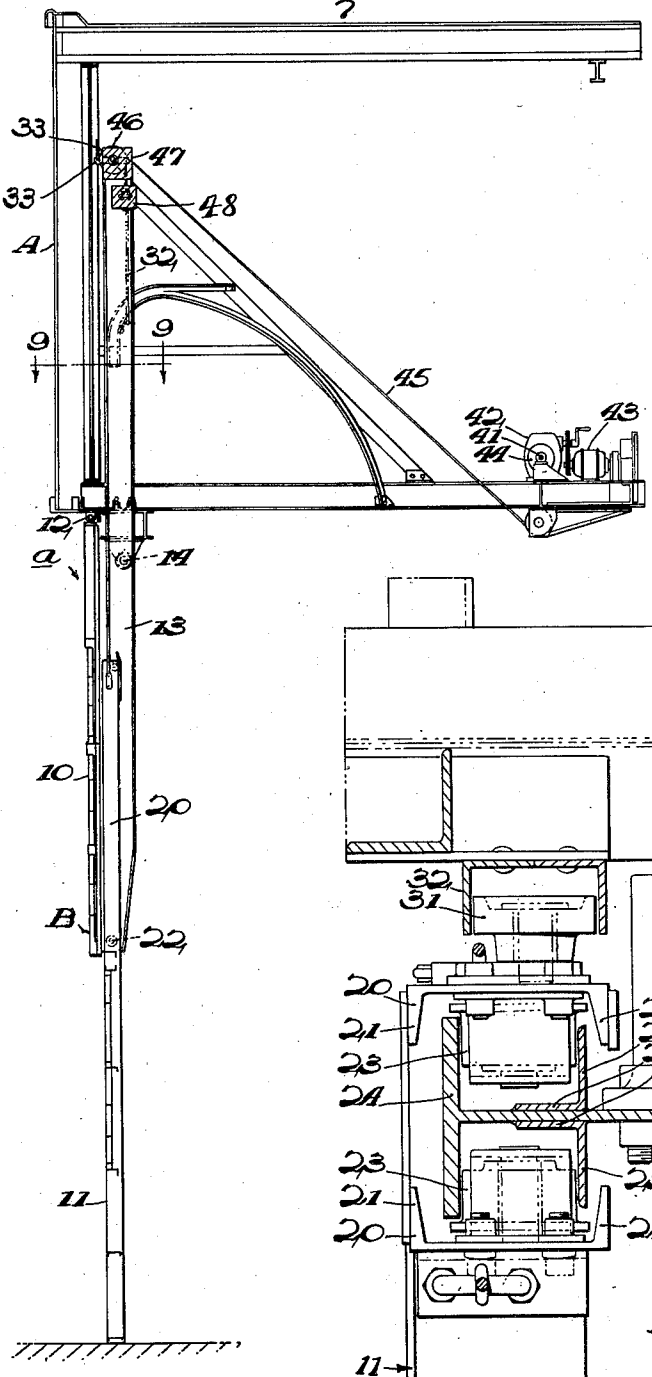
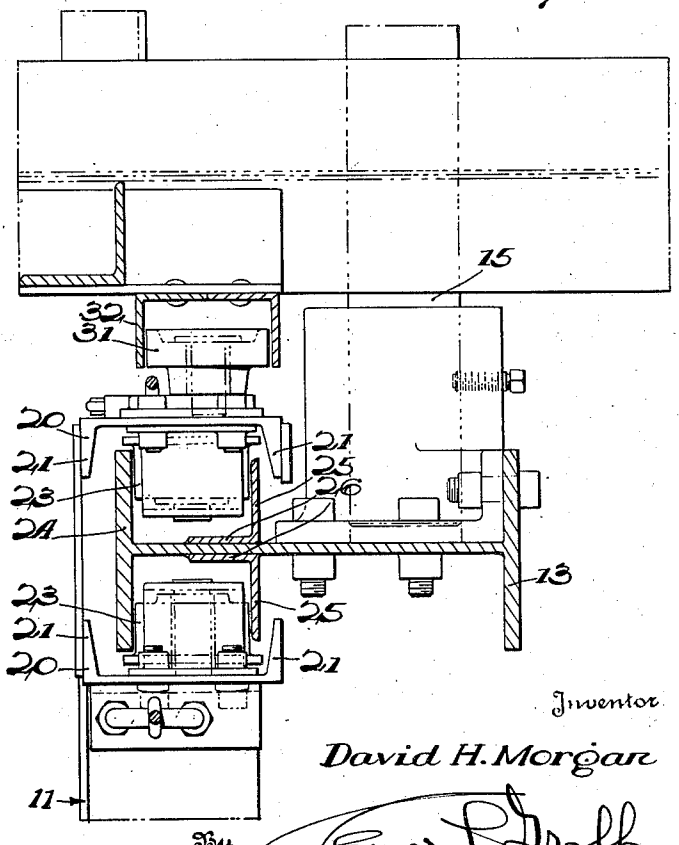


FIG. 9.



Inventor

David H. Morgan

By

Attorney

Sept. 17, 1946. D. H. MORGAN 2,407,674

DOOR AND OPERATING MEANS THEREFOR

Filed Jan. 22, 1945 4 Sheets-Sheet 2

FIG. 2.

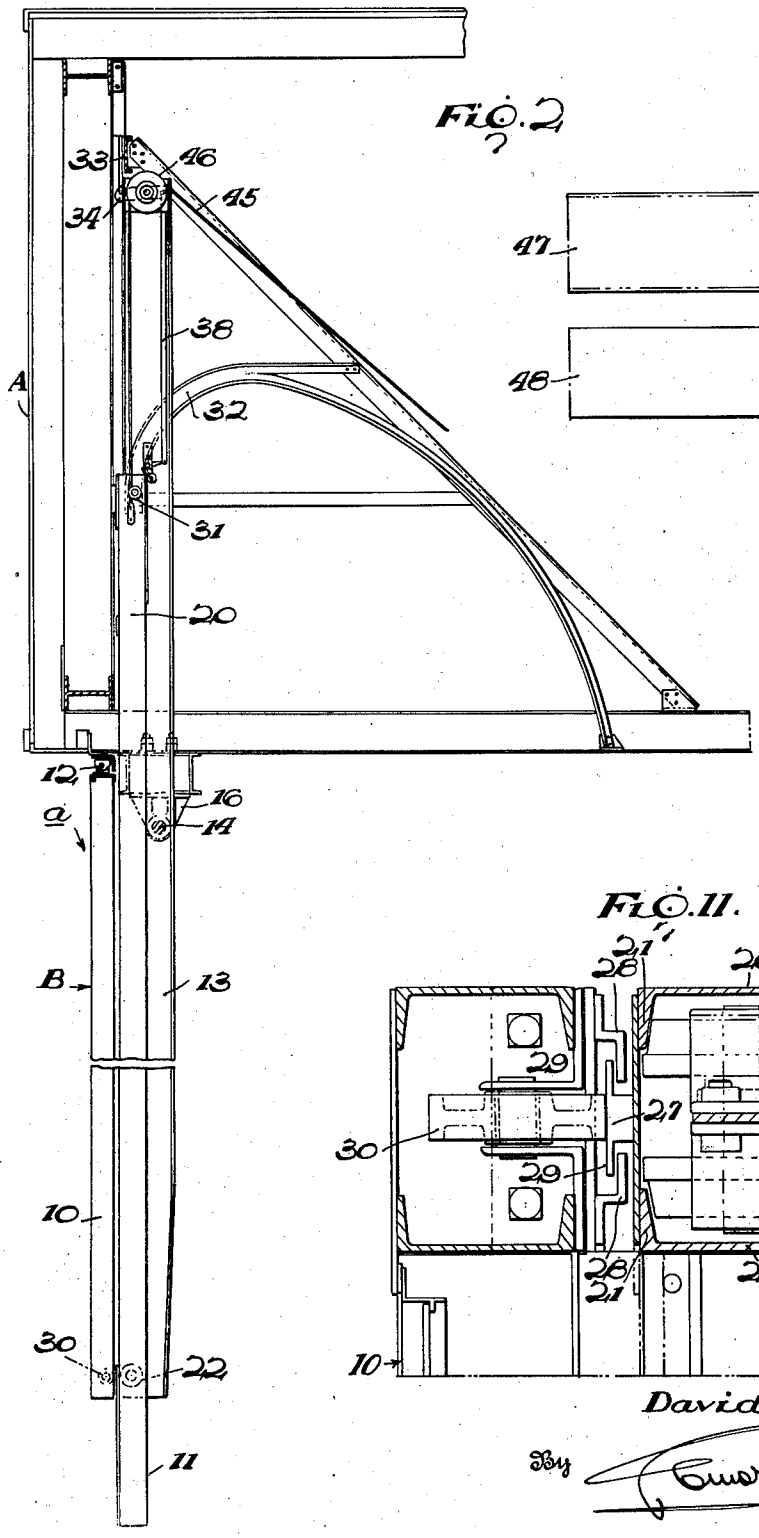


FIG. 6.

FIG. 11.

Inventor

David H. Morgan

By Emery L. Groff

Attorney

Sept. 17, 1946. D. H. MORGAN 2,407,674

DOOR AND OPERATING MEANS THEREFOR

Filed Jan. 22, 1945 4 Sheets-Sheet 3

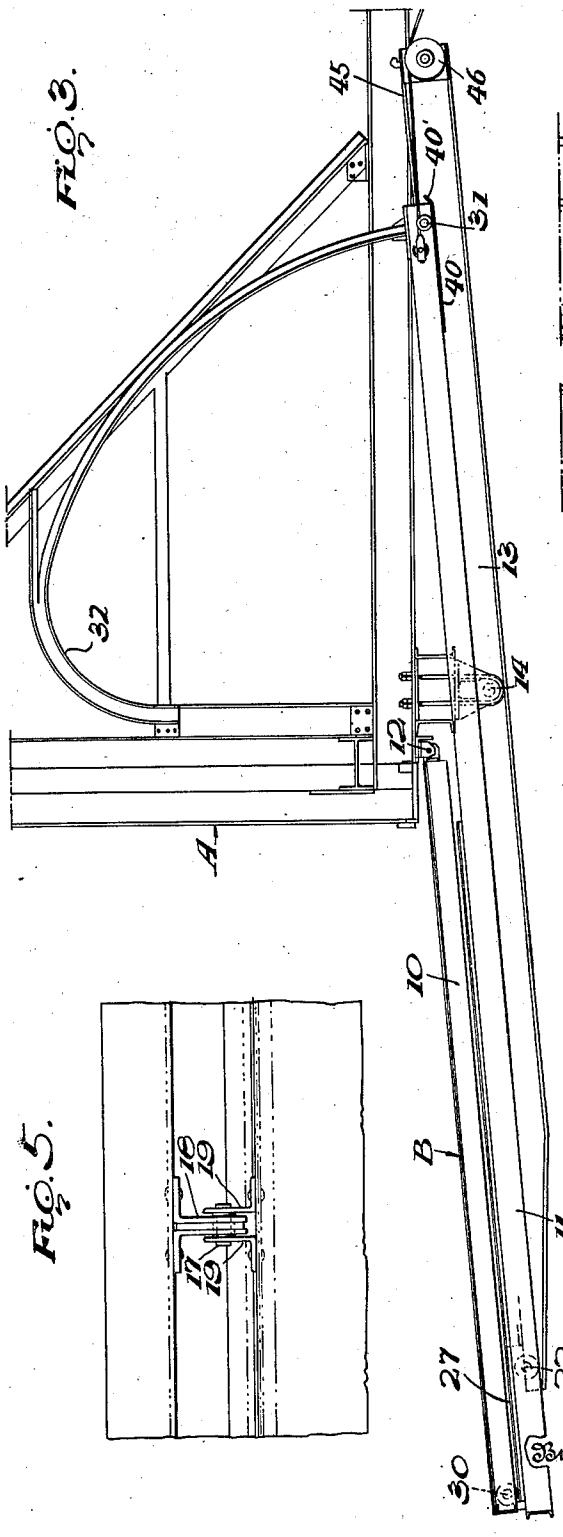


FIG. 3.

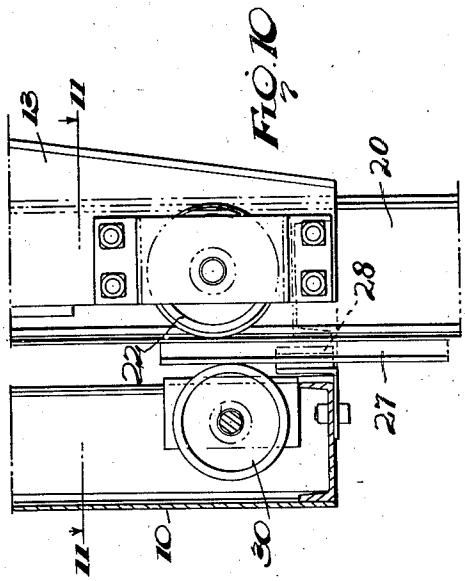


FIG. 10.

FIG. 5.

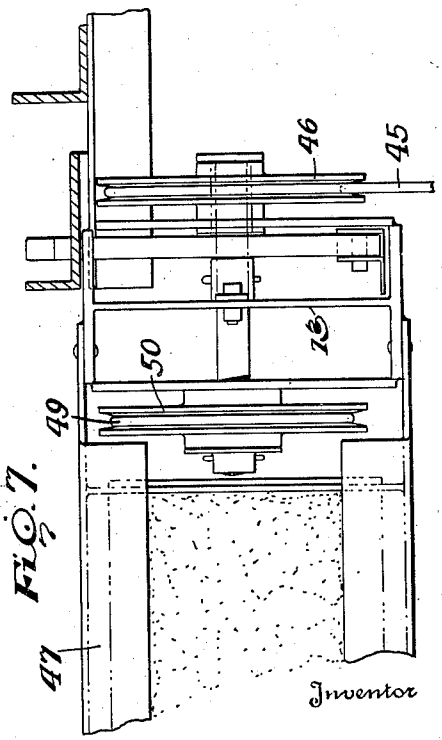


FIG. 7.

Inventor

David H. Morgan

By

Emery P. Groff

Attorney

Sept. 17, 1946. D. H. MORGAN 2,407,674

DOOR AND OPERATING MEANS THEREFOR

Filed Jan. 22, 1945 4 Sheets-Sheet 4

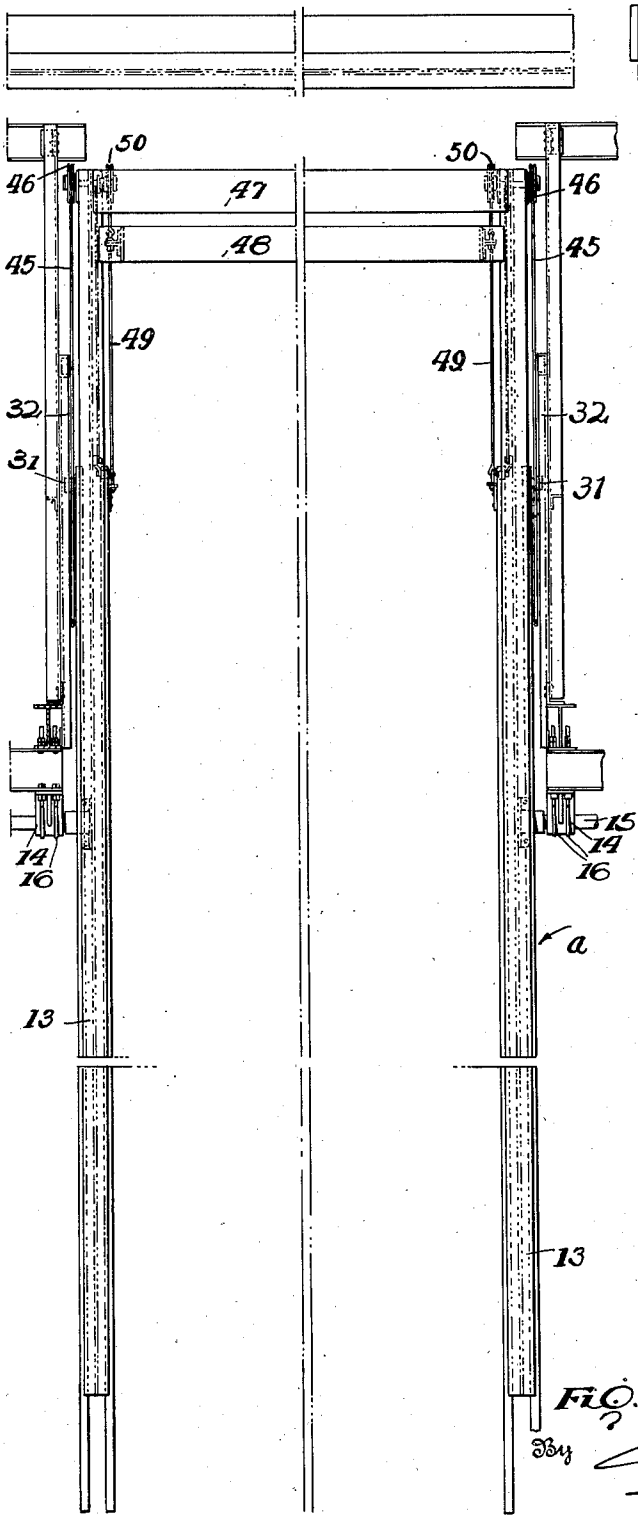


FIG. 4.

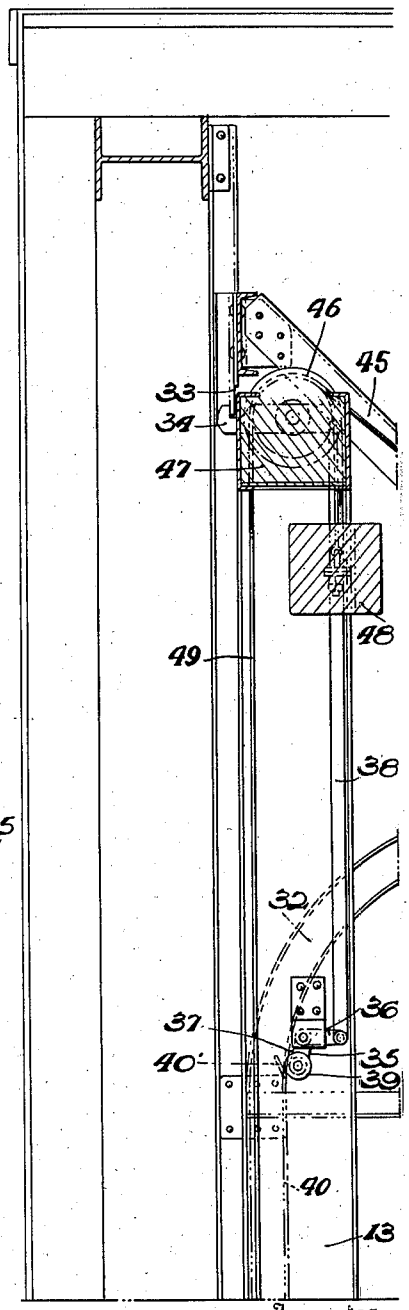


FIG. 8.

Inventor
David H. Morgan
By Emery L. Groff
Attorney

Patented Sept. 17, 1946

2,407,674

UNITED STATES PATENT OFFICE

2,407,674

DOOR AND OPERATING MEANS THEREFOR

David H. Morgan, Youngstown, Ohio

Application January 22, 1945, Serial No. 573,912

14 Claims. (Cl. 160—184)

1

This invention relates to so-called "canopy" doors; i. e., doors of the type which, when open, extend horizontally, or substantially horizontally, forwardly, canopy-like, from a doorway at or near the top thereof.

More particularly, the present invention relates to so-called "canopy" doors of the type comprising an upper leaf and a lower leaf, the latter of which is vertically slidable between raised and lowered positions relative to the former to control opening and closing of the lower part of the doorway while the upper part of the doorway remains closed, and both of which are swingable as a unit between vertical and substantially horizontal positions to control opening and closing of the upper part of the doorway when the lower leaf is raised. The outstanding advantage of such an arrangement is that the space to either side of the doorway, closely adjacent thereto and to the height of the bottom of the upper leaf, may be utilized for any desired purpose without interfering with operation of the door.

Generally speaking, the object of the present invention is to simplify the construction, mounting and mode of operation of doors of the type mentioned by providing for separately pivotally mounting the upper and the lower leaves thereof and by providing a simple, practical connection between said leaves whereby they are constrained to swing as a unit between closed and open positions.

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 a door embodying 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 the different views:

Fig. 1 is a vertical, transverse section through a door constructed in accordance with one practical embodiment of the invention and showing the leaves thereof in positions completely closing the doorway of a building structure with which the door is associated.

Fig. 2 is a view similar to Fig. 1 showing the lower leaf in nearly its fully raised position.

Fig. 3 is a view similar to Figs. 1 and 2 showing the door fully open.

Fig. 4 is a rear elevation of the door.

Fig. 5 is an enlarged, fragmentary, elevation

2

showing one of the pivotal mountings of the upper leaf.

Fig. 6 is an enlarged, fragmentary rear elevation of the top portion of one of the lower leaf supporting arms and its associated parts.

Fig. 7 is a top plan view of the structure shown in Fig. 6.

Fig. 8 is a vertical section showing in detail one of the latch means for holding the leaves against opening swinging movements.

Fig. 9 is a cross section on an enlarged scale on the line 9—9 of Fig. 1.

Fig. 10 is a vertical section on an enlarged scale showing the connection between the lower portion of the upper leaf and the lower leaf; and

Fig. 11 is a cross section on the line 11—11 of Fig. 10.

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

The door B comprises an upper leaf 10 and a lower leaf 11, and within the purview of the invention these leaves may be of any suitable specific construction. They accordingly have not been illustrated in detail, but have been indicated conventionally as being of panel form.

The upper leaf 10 is pivoted at its top to the building structure A at the top of the doorway *a*, as indicated generally at 12, for upward and outward swinging movement to a substantially horizontally disposed, open position in which it extends, canopy-like, forwardly from the building structure A above the doorway *a*, and for downward and inward swinging movement to a vertical position in which it closes the upper part of the doorway *a*. On the other hand, the lower leaf 11 is mounted upon two or more arms 13 for sliding movements therealong between lower or closed and upper or open positions, and said arms 13 are pivoted, intermediate their ends, to the building structure A adjacent to the top of the doorway *a* and behind the hinges 12 of the upper leaf 10, as indicated generally at 14, whereby said lower leaf also is swingable between vertical and substantially horizontal positions. Moreover, the upper leaf is suitably coupled, near its lower end, either to the arms 13 or to the lower leaf 11. Accordingly, when said arms 13 and the lower leaf are swung, the upper leaf is constrained to swing therewith.

Preferably each leaf 10 and 11 is approximately one-half the height of the doorway *a*. In any event, when the door is fully closed both leaves are disposed vertically with the upper leaf clos-

ing the upper part of doorway and the lower leaf extending between the lower portion of the upper leaf and the bottom of the doorway and closing the lower part of the doorway. With the leaves disposed vertically, the lower leaf 11 may be raised and lowered to open and close the lower part of the doorway *a* while the upper leaf 10 remains in its vertical position closing the upper part of said doorway; on the other hand, means is provided whereby the upper leaf may be swung to open and close the upper part of the doorway only when the lower leaf is in substantially its fully raised position. It is apparent, therefore, that the space in front of and behind and closely adjacent to the doorway *a* may be utilized substantially to the height of the lower edge of the upper leaf for storage or other purposes without interference with operation of the lower leaf to open and close the lower part of the doorway and without interference with swinging of the two leaves as a unit to open and close the upper part of the doorway.

The arms 13 may be pivotally mounted upon the building structure A in any suitable manner as, for example, upon shafts 15 journaled in bearings 16 bolted or otherwise suitably fixed to the building structure at the sides of the doorway *a*. Likewise, the upper leaf 10 may be pivotally mounted upon the building structure A in any suitable manner as, for example, by means of pins 17 extending through overlapping hinge ears 18 and 19 suitably fixed to the building structure and the top of the upper leaf, respectively.

Below their common pivotal axis 14, the arms 13 preferably are of lengths to extend to the bottom of the upper leaf 10 when the door is closed, while above their common pivotal axis said arms may be of any suitable lengths. The lower leaf 11 may be mounted on said arms 13 in any suitable manner. In this connection, and as illustrated in the present instance, the lower leaf includes an opposed pair of vertically extending channel members 20, 20, related to and disposed at opposite sides, respectively, of the front portion of each arm 13, with their flanges 21 extending toward said arm. Moreover, the web of each arm 13 carries, near its lower end and at opposite sides thereof, respectively, a pair of rollers 22, 22, one disposed between the flanges of one of the related pair of channel members 20, and the other disposed between the flanges of the other of said channel members (see Figs. 10 and 11). In addition, the webs of the channel members 20 of each pair carry, at their inner sides and near their tops, rollers, 23, 23, respectively (see Fig. 9), which are disposed in trackways between the front flanges 24 of the arms 13 and opposed flanges 25 of angle members 26, which are suitably fastened to the webs of said arms 13. Thus, the lower leaf is mounted upon the front portions of said arms 13 for free and easy sliding movements therealong between raised and lowered, open and closed positions, respectively, and, at the same time, is coupled to said arms so as to be constrained to swing therewith.

In the example of the invention illustrated in the drawings, a coupling is provided between the lower portion of the upper leaf and the lower leaf 11 to constrain said upper leaf to swing with the arms 13 and said lower leaf. In this connection, the specific coupling illustrated comprises a T-shaped track element 27 mounted upon the channel members 20, 20 of each pair at the fronts thereof and extending longitudinally therealong, and, related to each track element 27, a pair of fingers 28, 28 carried by the upper leaf near its lower end and at the rear thereof and extending, respectively, behind the side flanges 29, 29 of the track member 27. Thus, while said couplings do not interfere with sliding movements of the lower leaf 11 relative to the upper leaf 10, they require the upper leaf to swing with the arms 13 and said lower leaf. Preferably the upper leaf 10 also carries, near its lower end, rollers 30, one for engagement with the front face of each track element 27, to support the lower end portion of the upper leaf upon the lower leaf for free and easy sliding movements therealong during swinging movements of the leaves, sliding of the lower end portion of the upper leaf relative to the lower leaf occurring during swinging movements of the leaves due to the offset relationship of the pivots 12 and 14 of said leaves, as is manifest.

The pairs of channel members 20, 20 extend above the top of the lower leaf 11 and, above the top of said lower leaf, constitute arms which, near their upper ends, are provided with cam followers in the form of rollers 31 for cooperation with cams 32 fixed to the building structure interiorly thereof above the doorway *a* to effect swinging movement of the leaves toward open position in response to the final portion of upward opening movement of the lower leaf.

The cams 32 preferably are in the form of channel members and have downwardly directed, open, front end portions which are disposed in alinement with the rollers 31 when the lower leaf 11 is in its vertically disposed position so as to receive said rollers when said lower leaf is raised.

From their open, front end portions the cams 32 are curved upwardly, rearwardly and downwardly so that as their curves are followed by the rollers 31 the leaves 10 and 11 are caused to swing from vertical toward horizontal positions. In this connection, it will be understood, of course, that curving of the cams 32 begins at points such that initiation of swinging movement of the leaves 10 and 11 occurs only after the lower leaf is nearly fully raised and as it begins the final portion of its upward opening movement.

Any suitable means may be provided to prevent outward swinging movement of the upper portions of the arms 13 or, alternatively, inward swinging movement of the lower portions of said arms, or of the leaf 11, when said leaf 11 is disposed vertically. For example, stop plates 33 carried by the building structure A to be engaged by the upper, front portions of the arms 13 may be provided for this purpose. On the other hand, suitable latch means is provided to prevent rearward swinging movement of the upper end portions of the arms 13 and, consequently, outward swinging movement of the lower portions of said arms and the leaves 10 and 11 until the lower leaf has been raised to nearly its fully open position. In this connection, and according to the construction specifically illustrated in the present instance, the arms 13 carry, near their upper ends, latches 34 which are suitably formed to engage the related stop plates 33 and to assume latched positions relative thereto under the influence of gravity or suitable spring means in response to forward swinging movement of the arms 13 to vertical positions.

The latches 34 are in the form of substantially horizontally disposed arms pivoted intermediate

their ends for upward and downward swinging movements of their front end portions to latched and unlatched positions, respectively. Below each latch and pivoted to the related arm 13 is a bell-crank lever 35 having a substantially horizontally disposed, rearwardly extending arm 36 and a substantially vertically disposed, downwardly extending arm 37, the former of which is connected to the rear end portion of the related latch 34 by a push-rod 38 and the latter of which arms is free and preferably, but not necessarily, provided with a roller 39. In this connection, it will be noted that the channel members 20, 20 of the lower leaf carry, at the tops thereof, plates 40, one related to each bell-crank lever 35 and having an upwardly and forwardly inclined upper end portion 40' and that the rollers 39 are disposed in the paths of upward movement of said inclined upper end portions to be engaged thereby as the lower leaf 11 approaches its fully raised position. It will be apparent, therefore, that as the lower leaf approaches its fully raised position, the inclined upper end portions 40' of the plates 40, by engagement with the rollers 39, swing the bell-crank levers 35 to raise the rear ends and to depress the front ends of the latch arms 34 and thus release said latch arms to permit the upper end portions of the arms 13 to swing rearwardly. The arrangement in this respect is such, as shown, that the latch arms 34 are released just prior to cooperation of the rollers 31 with the upwardly and rearwardly curved portions of the cams 32. Accordingly, the arms 13 and, consequently, the leaves 10 and 11, are held against swinging movement until the lower leaf approaches its fully raised position, but in response to the final portion of upward or opening movement of said lower leaf the latches 34 first are unlatched and immediately thereafter the cams 32, by cooperation with the rollers 31, act to swing the leaves toward open position.

Any suitable means may be provided for raising the lower leaf 11 and for swinging said leaf and the upper leaf to open positions. In this connection and, as illustrated, in Figure 1 of the drawings, a horizontally disposed power shaft 41 is mounted behind the doorway *a* at a suitable elevation and is connected, through a reduction gear 42, with a reversible electric motor 43 to be driven by the latter in either direction. On the shaft 41 is one or more cable drums 44, preferably two, and on said drums are wound cables 45 which extend from said drums over sheaves 46 carried by related arms 13 near their upper end and downwardly from said sheaves to the lower leaf 11 to which they are suitably connected. Accordingly, when the motor 30 is operated in a direction to rotate the shaft 41 to wind the cables 45 onto the drums 44, the lower leaf first is raised and then the two leaves are swung to their canopy-like, open positions extending forwardly from the doorway *a* at the top thereof. On the other hand, the leaves gravitate to their closed positions when the motor 43 is rotated in a direction to effect cable-unwinding rotation of the drums 44.

Upon the upper end portions of the arms 13 is mounted a suitable counterweight 47 to counterbalance the weight of said arms and the leaves 10 and 11 during swinging movements thereof. On the other hand, another weight 48 is provided to counterbalance the weight of the lower leaf 11 to render the latter freely and easily slidable along the arms 13 between its raised and lowered positions. The weight 48 is shown as being slidably mounted on the arms 13 and as being connected to the lower leaf by means of cables 49 extending over sheaves 50 carried by said arms 13 near their upper ends. Alternatively, both the counterbalance means for the lower leaf, and for the combined leaves, may be of any other suitable form.

If desired, a suitable switch may be provided to be automatically actuated, as the leaves 10 and 11 approach their substantially horizontal open positions, to cut off flow of current to the motor 43. On the other hand, another switch may be provided to be automatically actuated to cut off flow of current to the motor 43 as the lower leaf nears its lower or closed position. In addition, a third switch may be located at any suitable point for manual operation to cause the motor 43 to operate in either direction to open or to permit closing of the door.

Assuming the door to be completely closed, it is apparent that, upon actuation of the motor 43 to open the door, the lower leaf first will be raised to nearly its fully open position while the upper leaf remains in its vertical position closing the upper part of the doorway; that, responsive to the final portion of upward or opening movement of the lower leaf, the latches 34 will be released and opening swinging movement of the leaves initiated; and that thereafter the leaves will be swung to their fully open positions. On the other hand, assuming the door to be fully open, it is apparent that upon actuation of the motor 43 to unwind the cables 45 from the drums 44, thereby to permit the leaves to gravitate to their closed positions, the two leaves first will swing from their substantially horizontal positions to vertical positions and thereafter the lower leaf will gravitate to its lowered or closed position, with actuation of the switch 52 to cut off flow of current to the motor 43 as said lower leaf reaches its lowered or closed position.

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 adjacent to its top for swinging movements between substantially vertical and substantially horizontal closed and open positions, respectively, a lower leaf mounted for vertical sliding movement relative to said upper leaf between raised and lowered open and closed positions, respectively, means pivoting said lower leaf at a point spaced inwardly and downwardly from the pivot of said upper leaf for swinging movement between substantially vertical and substantially horizontal positions, and means coupling said leaves together for unitary swinging movements thereof.

2. A door comprising an upper leaf pivoted for swinging movements between substantially vertical and substantially horizontal positions, a lower leaf coupled to said upper leaf for vertical sliding movements with respect thereto and for swinging movements therewith, and pivot means for said lower leaf disposed in offset relationship to the pivot of said upper leaf.

3. A door comprising a plurality of arms pivoted for swinging movements between substantially vertical and substantially horizontal posi-

tions, a lower leaf slidably mounted on said arms, an upper leaf pivoted independently of said arms for swinging movements between substantially vertical and substantially horizontal positions, and means coupling said leaves together so as to require both to swing when either is swung.

4. A door comprising an upper leaf pivoted adjacent to its top for swinging movements between substantially vertical and substantially horizontal positions, arms pivoted at points below and behind the pivot of said upper leaf for swinging movements between substantially vertical and substantially horizontally disposed positions, a lower leaf mounted on said arms for sliding movements therealong, and means coupling said leaves together so that swinging movements of said arms and said lower leaf imparts swinging movements to said upper leaf.

5. A door comprising an upper leaf pivoted adjacent to its top for swinging movements between a substantially vertical position and a substantially horizontal position, a lower leaf, coupled with said upper leaf for vertical sliding movements with respect thereto between raised and lowered open and closed positions respectively, and for swinging movements therewith, pivot means for said lower leaf spaced behind and below the pivotal axis of said upper leaf, and cam means operable in response to the final portion of upward opening movement of said lower leaf to initiate swinging movement of both leaves toward substantially horizontal open positions.

6. A door comprising an upper leaf pivoted adjacent to its top for swinging movements between a substantially vertical position and a substantially horizontal position, a lower leaf coupled with said upper leaf for vertical sliding movements, with respect thereto between raised and lowered open and closed positions, respectively, and for swinging movements therewith, pivot means for said lower leaf spaced behind and below the pivotal axis of said upper leaf, power means for raising and for controlling lowering of said lower leaf, and cam means operable in response to the final portion of upward opening movement of said lower leaf to initiate swinging movement of both leaves toward substantially horizontal open positions.

7. A door comprising an upper leaf pivoted adjacent to its top for swinging movements between substantially vertical and substantially horizontal positions, arms pivoted at points below and behind the pivot of said upper leaf for swinging movements between substantially vertical and susbtantially horizontally disposed positions, a lower leaf mounted on said arms for sliding movements therealong, means coupling said leaves together so that swinging movements of said arms and said lower leaf imparts swinging movements to said upper leaf, power means for raising and for controlling lowering of said lower leaf, and cam means operable in response to the final portion of upward opening movement of said lower leaf to initiate swinging movements of said arms and leaves toward their substantially horizontal positions.

8. A door comprising an upper leaf pivoted adjacent to its top for swinging movements between a substantially vertical position and a substantially horizontal position, a lower leaf, coupled with said upper leaf for vertical sliding movements with respect thereto between raised and lowered open and closed positions, respectively and for swinging movements therewith, pivot means for said lower leaf spaced behind and below the pivotal axis of said upper leaf, latch means to hold said leaves in substantially vertical positions during the major portion of upward opening movement of the lower leaf, means operable in response to the final and minor portion of upward opening movement of said lower leaf to release said latch means, and cam means also operable in response to the final minor portion of upward opening movement of said lower leaf and following release of said latch means to initiate swinging movement of said leaves toward their substantially horizontal open position.

9. A door comprising an upper leaf pivoted adjacent to its top for swinging movements between substantially vertical and substantially horizontal positions, arms pivoted intermediate their ends at points below and behind the pivot of said upper leaf for swinging movements between substantially vertical and substantially horizontally disposed positions, a lower leaf mounted on said arms for sliding movements therealong, means coupling said leaves together so that swinging movements of said arms and said lower leaf imparts swinging movements to said upper leaf, cable drums spaced behind the pivots of said arms, sheaves carried by said arms adjacent to their upper ends, and cables connected to and extending from said lower leaf over said sheaves to said drums to be wound onto the latter to raise said lower leaf and to swing said arms and said leaves toward their substantially horizontal positions.

10. A door comprising an upper leaf pivoted adjacent to its top for swinging movements between substantially vertical and substantially horizontal positions, arms pivoted intermediate their ends at points below and behind the pivot of said upper leaf for swinging movements between substantially vertical and substantially horizontally disposed positions, a lower leaf mounted on said arms for sliding movements therealong, means coupling said leaves together so that swinging movements of said arms and said lower leaf imparts swinging movements to said upper leaf, cable drums spaced behind the pivots of said arms, sheaves carried by said arms adjacent to their upper ends, cables connected to and extending from said lower leaf over said sheaves to said drums to be wound onto the latter to raise said lower leaf and to swing said arms and said leaves toward their substantially horizontal positions, latch means to hold said arms and said leaves in their vertical positions during the major portion of upward opening movement of the lower leaf, and means operable in response to the final and inner portion of upward opening movement of said lower leaf to release said latch means.

11. A door comprising an upper leaf pivoted adjacent to its top for swinging movements between substantially vertical and substantially horizontal positions, arms pivoted intermediate their ends at points below and behind the pivot of said upper leaf for swinging movements between substantially vertical and substantially horizontally disposed positions, a lower leaf mounted on said arms for sliding movements therealong, means coupling said leaves together so that swinging movements of said arms and said lower leaf imparts swinging movements to said upper leaf, cable drums spaced behind the pivots of said arms, sheaves carried by said arms adjacent to their upper ends, cables connected to and extending from said lower leaf over said sheaves to said drums to be wound onto the latter to raise

said lower leaf and to swing said arms and said leaves toward their substantially horizontal positions, latch means to hold said arms and said leaves in their vertical positions during the major portion of upward opening movement of the lower leaf, means operable in response to the final and inner portion of upward opening movement of said lower leaf to release said latch means, and means also operable in response to the final minor portion of upward opening movement of said lower leaf to initiate swinging movement of said arms and said leaves toward their substantially horizontal positions following release of said latch means.

12. A door as set forth in claim 4 including a counterweight for the lower door slidably mounted on the arms.

13. A door as set forth in claim 4 including a counterweight for the arms and the leaves carried by the arms.

14. A door as set forth in claim 9 including other sheaves carried by the arms adjacent to their upper ends, a counterweight for the lower leaf slidably mounted on said arms, and cables extending over said last-mentioned sheaves and connected at their ends to said lower leaf and said counterweight, respectively.

DAVID H. MORGAN.