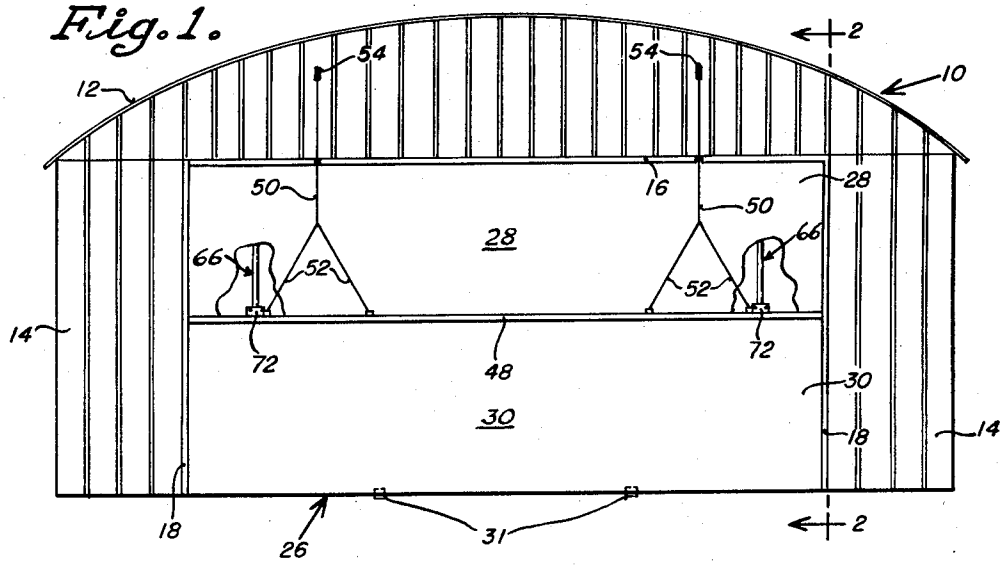
May 17, 1960 K. L. MOSHER 2,936,830

OPENING AND LOCKING BRACE FOR CANOPY TYPE DOORS

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Fig. 1.



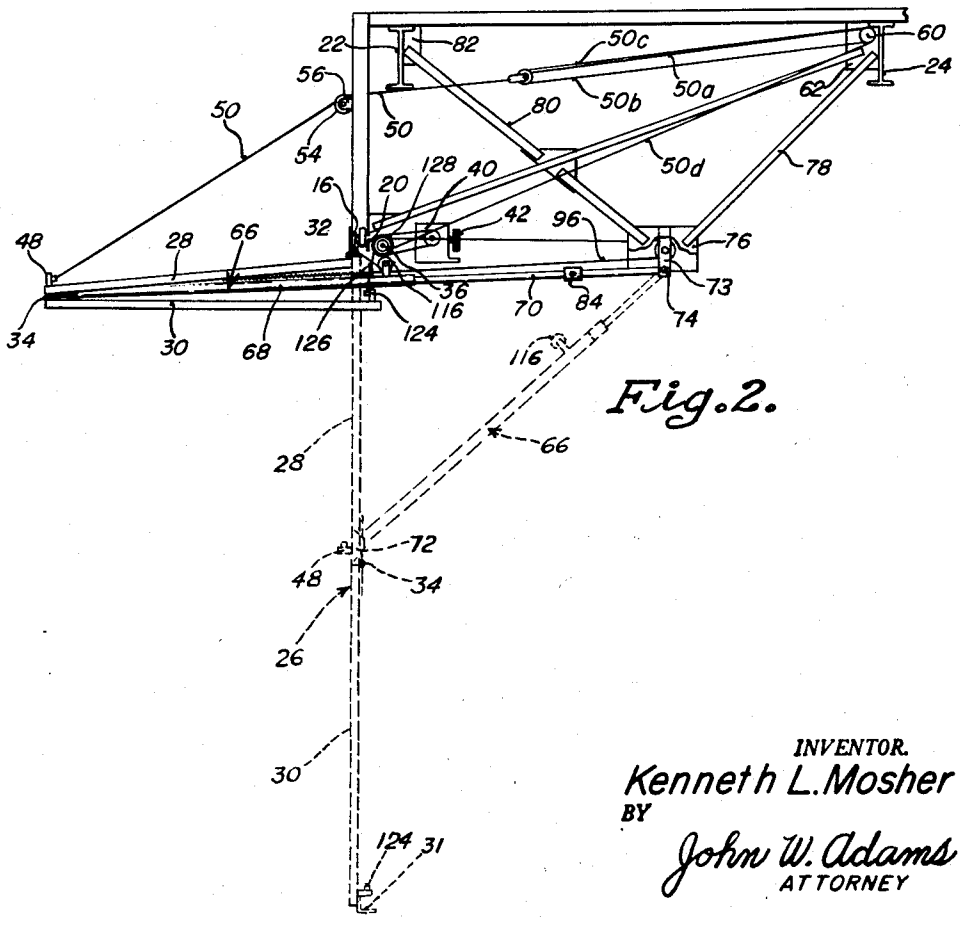


Fig. 2.

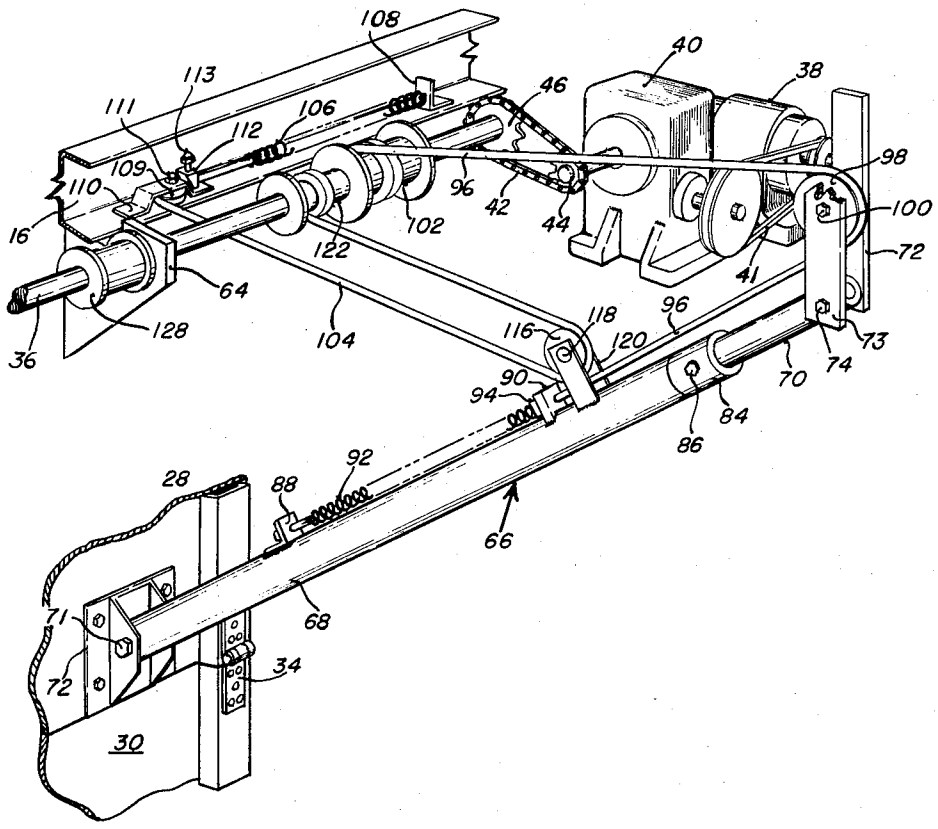
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OPENING AND LOCKING BRACE FOR CANOPY TYPE DOORS

Filed July 23, 1958 2 Sheets-Sheet 2

Fig. 3.



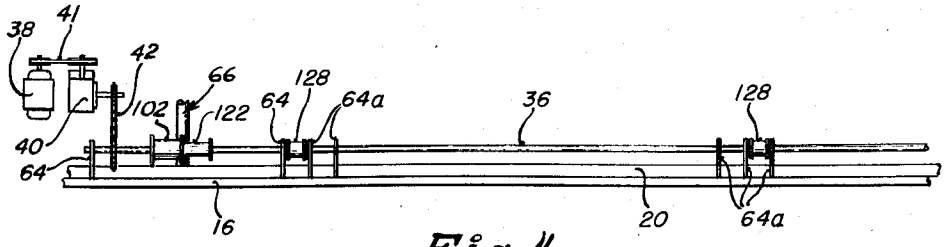


Fig. 4.

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OPENING AND LOCKING BRACE FOR CANOPY TYPE DOORS

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Application July 23, 1958, Serial No. 750,397

16 Claims. (Cl. 160—188)

This invention relates generally to overhead doors, such as are used on hangars, warehouses, garages and the like. More particularly, the invention is concerned with an automatic operating mechanism for a canopy type door.

In my Patent No. 2,548,042 granted April 10, 1951, I depicted a semiautomatic door operator which, while generally satisfactory, possessed certain disadvantages. Among these disadvantages was the need for manually actuating a locking member to bring the door to a fully closed position and which would thereafter retain the door closed so that it would not inadvertently open due to wind. Although the need for manually actuating the locking member in and of itself proved inconvenient, the inconvenience was aggravated where the door was of rather large dimensions. Also, since the locking member was mounted on the inner side of the door, further inconvenience was experienced when leaving the building, for one could not exit through the main door opening and then press an exteriorly located operating switch to initiate closing of the door. By the same token, one could not open the door from the outside without first having entered the building through an auxiliary door in order to unlock the locking member. Additionally, unless the axis of the lifting pulley or drums was sufficiently offset from the plane of the door when closed, difficulty would result in achieving the initial opening or "breaking" of the door. Thus, it can be seen that my patented structure, although satisfactory in many respects, left much to be desired. In other words, it was indeed semiautomatic in character as stated in the title of the invention.

Accordingly, the present invention has for a general object the provision of a fully automatic canopy type door structure.

One specific object of the instant invention is to impart an inward pull to the lower end of the leaf having its upper end pivotally mounted for swinging movement about a fixed horizontal axis. Where two leaves are hinged together to constitute the door, this pull is applied adjacent the bottom edge of the upper leaf. The inward pull, it may be stated, is synchronized with the lowering action of the door so that it is applied at the most opportune time.

The invention also has for an object the maintenance of the positive inward pull mentioned above after the door has been completely closed, thereby providing an automatic continued locking of the door in its closed position. Such a feature will prevent the door from being opened due to wind action and can be additionally relied upon to prevent unauthorized entry into the building.

Another object is to provide a positive "breaking" of the door during the initial opening thereof.

Still another object of the invention is to provide a door of the foregoing character that can be operated quickly into either an open or closed position.

A further object of the invention is to provide a canopy type door construction requiring a minimum of

operating power for a door of a given size, the mechanism automatically supplying an enhanced mechanical advantage during certain portions of the operating cycle that would otherwise increase the power demand. Thus, for a particular installation a relatively small motor can be employed without sacrificing the opening and closing speed of the door.

Yet another object is to provide a door operator that is inexpensive, simple, rugged, compact, and not apt to get out of order readily.

Other objects and advantages of the invention will hereinafter appear, and for purposes of illustration, but not of limitation, an embodiment of the invention is shown on the accompanying drawings, in which:

Fig. 1 is a front elevational view of a building equipped with a canopy type door having two leaves and my operating mechanism therefor;

Fig. 2 is a vertical section taken in the direction of line 2—2 of Fig. 1;

Fig. 3 is a perspective view showing primarily the gust bracing arrangement in relation with the door header and the line drive shaft supporting the various takeup drums, only two of which drums are pictured in this particular view; and,

Fig. 4 is a plan view of the header, together with the line shaft and all of the drums that are employed in illustrating the invention.

Referring now in detail to the drawings, Fig. 1 illustrates the front of a typical building **10**, such as a hangar, where my invention will find especial utility. The hangar **10** is provided with a curved roof **12**, and as is conventional in many hangar designs, the building is faced with corrugated sheet metal panels **14**. The door frame comprises a header **16** and side jambs **18**. Although the framework for the hangar will vary considerably from design to design, several transverse beams or trusses **20**, **22** and **24** have been indicated inasmuch as general reference will be made hereinafter to these beams.

A canopy type door has been designated in its entirety by the numeral **26**, being comprised of, in this instance, two individual leaves or sections **28** and **30**. Through the agency of a series of laterally spaced strap hinges **32**, the upper leaf **28** is pivotally mounted for swinging movement on a fixed horizontal axis adjacent the lower edge of the header **16**, whereas a second series of strap hinges **34** serve to pivotally connect the lower leaf **30** to the bottom edge of the upper leaf **28**. A pair of door stops **31** are positioned inwardly from the side jambs **18** so as to limit inward movement of the bottom of the lower leaf **30**.

The operating mechanism for opening and closing the canopy door **26** will now be described. Included as a basic part of the operating mechanism is a drive or line shaft **36** which is substantially coextensive in length with the width of the door **26**. If the door **26** is wide enough, and this is frequently the case, the shaft may constitute two separate sections. As best viewed in Figs. 3 and 4, it can be seen that the shaft **36** is rotated by a reversible electric motor **38**. The motor **38** is mechanically coupled to the input side of a self locking worm-gear type speed reducing unit **40** via a belt **41**, and the output or low speed side of the speed reducer **40** is coupled to the shaft **36** through the media of a chain **42** and a pair of sprockets **44** and **46**, the latter being fixed upon the shaft **36**. It will be understood that the motor **38** is energized by way of appropriately disposed push button switches which need not be illustrated, since the use of such switches is conventional. Hereinafter, it will become manifest that parallel-connected switches may be employed, if desired, one being located outside the hangar **10** and the other inside this building. Also, it will be understood that suitable limit switches will be utilized to

de-energize the motor when the door 26 has reached its fully opened or fully closed positions. Here again, the use of such limit switches is quite common in the operation of overhead doors and need not be further described other than to say that their actuation can be simply effected after a predetermined number of revolutions of the motor 38 or the gear reducer 40 in either direction.

The line shaft 36 functions as a common carrier for a number of drums for taking up and paying out the various cables that will be presently referred to. Obviously, the number of such drums and cables will depend upon the width of the door 26. For the sake of simplicity, it will be assumed that only two duplicate sets of drums and cables will be required for the particular door 26 that has been pictured.

Considering first the manner in which the lower end of the leaf 28 is raised, it can be seen from Figs. 1 and 2 that an outer cross member 48 extends across the lower end of this leaf 28. A pair of flexible hoist cables 50, each having diverging end sections 52, are connected to the outer cross member 48. The cables 50 pass over a pair of idler sheaves 54 rotatably supported on brackets 56 which are fixedly mounted to the front of the hangar 10 at an elevation above the header 16. Small openings in the panels 14 permit the cables 50 to enter the building.

To permit the cables 50 to be taken up and payed out at the proper rate in relation to other cables yet to be mentioned, these cables 50 are each attached to a movable pulley block 58. The pulley blocks 58, there being one for each cable 50, are actually parts of respective block and tackle arrangements intended to assist in lifting the door sections at the hinge connection therebetween and to slow down the lifting of the lower end of the upper leaf 28 in relation to the lower end of the bottom leaf 30, since this leaf end does not have to travel as far as the lower end of the leaf 30. The advantage derived from employing the block and tackle arrangement, however, will become more apparent as the description progresses. Because the specific ratio realized depends upon the relative heights of the door leaves 28 and 30, no need exists for describing this specific block and tackle arrangement in detail at this time. Nonetheless, it will be apparent that in the arrangement illustrated, a section of cable denoted 50*a* runs from the pulley block 58 to a pulley 60 that rotates about a fixed axis furnished by a bracket 62 welded or otherwise secured to the previously mentioned truss 24. After the cable encircles the pulley 60, a section 50*b* leads back to the movable pulley block 58, a further section 50*c* returning to the fixedly situated pulley 60. Then a cable section 50*d* continues directly to the line shaft 36.

It is relatively uninmportant how the line shaft 36 is supported. In the present instance, though, a plurality of shaft-supporting bearing brackets 64 are utilized, these brackets being anchored, as by welding, to the header 16 and truss 20, as best viewed in Fig. 4. The two cables 50, more specifically the sections 50*d*, can be wound directly on the line shaft 36, if of proper diameter, although drums may be used if desired. By providing a bearing bracket 64*a* on either side of the respective locations on the shaft where the cable sections 50*d* are to be wound, the cables are maintained in their proper relative locations on the shaft. To distinguish these particular brackets 64*a* which cooperate to restrict the cables from those brackets 64 playing only a shaft-supporting role, the former have been given the suffix "*a*".

A pair of extensible bracing struts or gust braces 66 are provided for the door 26, one of these being shown in Fig. 3. Each of these extensible struts includes an outer tubular member 68 into which is telescopically received an inner member 70. The lower end of the member 68 is pivotally connected by a pin 71 to a clevis member 72 bolted to the inner face of the lower end of the upper leaf 28 of the door.

The upper end of the upper member 70 is pivotally connected between a pair of fixed plates 73 by a pin 74. The plates 73 are connected to a gusset plate 76 which is fixed to inclined braces 78 and 80. The far end of the brace 78 is secured to the earlier mentioned bracket 62, whereas the far end of the brace 80 is secured to a bracket 82 associated with the truss 22. For a purpose later to be explained the telescopically received member 70 is provided with a collar 84 that can be set at the proper location and held fast in its adjusted position by a set screw 86.

A pair of axially spaced ears or lugs 88 and 90 are welded to the tubular member 68. One end of a coil spring 92 is anchored to the ear 88, and the other end of the spring 92 has a stop element 94 affixed thereto. To the element 94 is connected a door closing and locking cable 96, which retracts the strut members 68 and 70 into collapsed position. This cable 96 is trained about an idler sheave 98 rotatably carried by a pin 100 extending through the fixed plates 72. After partially encircling the sheave 98, the cable 96 passes onto a drum 102 fixedly mounted on the line shaft 36.

As will become clearer when an operational sequence is presented, the cable 96 is responsible for assuring complete closing of the door sections 28 and 30 and thereafter bracing or retaining said sections in closed position. A door breaking or opening cable 104 produces extension of the strut members 68 and 70 to cause initial opening of the door sections 28 and 30. Accordingly, one end of this cable 104 is attached to one end of a coil spring 106, and the opposite end of the spring 106 is anchored to a clip element 108 welded to a stationary part of the hanger 10, such as to the header 16. From the spring 106 the cable 104 passes about an idler sheave 109 that can also be mounted on the header 16, as by a bracket 110 and pin 111. The cable 104 carries a suitably positioned stop element 112, a set screw 113 permitting original adjustment of this element for a reason hereinafter given. Another idler sheave 116 is rotatably supported on a pin 118 carried by a clevis 120 secured to the upper end of the lower strut member 68, each cable 104 passing about its corresponding sheave 116 to another drum 122 fixed to the line shaft 36.

From the foregoing it is believed readily apparent that in some installations the entire leaf door 26 could be made in a single section hingedly mounted at the top thereof. Largely to show the versatility of the invention, the door 26 has been illustrated as consisting of the two leaves or sections 28 and 30 which are hinged at 34, as already explained. In order to lift the lower end of the leaf 30, a cross member 124 having an inwardly extending web is mounted along the inside of this leaf adjacent the bottom thereof. Attached to this member 124 is a pair of hoist cables 126. Each cable 126 leads directly upward to a drum 128 fixedly carried on the line shaft 36.

Having provided the preceding information as to the construction of my door operating mechanism, it is believed that the manner in which such mechanism operates can now be readily comprehended. Assuming that the door 26 is in its fully opened position as depicted in solid lines in Fig. 2 and that it is desired to close the door, the motor 38 is energized via a switch (not shown), so as to rotate in a direction to cause the line shaft 36 to rotate in a counterclockwise direction, as viewed in Figs. 2 and 3. This immediately results in a paying out of the hoist cables 50 and 126, the cables 50 directly from the shaft 36 and the cables 126 from the drums 102, with the resulting lowering of the bottom edges of both leaves 28 and 30.

Simultaneously with the unwinding of the cables 50 and 126, each cable 104 is payed out from its associated drum 122. The bracing struts 66 are free to swing about the pin 74. During this swinging movement the member 70 is progressively telescoped into the tubular member 68, since the strut 66 is extended when the door 26 is open, as illustrated in Fig. 2. With the stop 112 prop-

erly positioned, it will leave its engaged relationship with the bracket **110** when the leaf **28** reaches a vertical position, the spring **106** taking up any cable slack.

Whereas the cables **50**, **104** and **126** are all being payed out during this closing operation, each cable **96** is being taken up on its particular drum **122**, it being remembered that the rotation of the line shaft **36** is in a counterclockwise direction as seen in Fig. 3. If the stop **94** has been properly positioned, it will engage the ear **90** as the leaf 28 approaches a vertical position, which of course is when the door **26** is not quite fully closed. It is the positive engagement of the stop **94** with the ear **90** that effects a direct tensional pull of the cable **96** against the lower end of the leaf **28** via the tubular member **68**. Since the flexible cables **50** can only permit the leaf **28** to gravitationally drop to almost a vertical position, the function of the take-up cables **96** is to automatically pull the door closed by taking over the task which the cables **50** and **126** are incapable of fully performing, that being to complete the closing of the door **26** and to hold the door in closed position.

When the line shaft **36** has rotated a sufficient number of revolutions to accomplish the above closing action, the particular limit switch (not shown) which stops the motor **38** does so. The upper end of the tubular member **68** will abut against the properly positioned collar **84** when the door has been fully closed. In this way, the lower end of the leaf **28** can move neither outwardly nor inwardly. It cannot move outwardly because the speed reducer **40** is self locking, being of the worm-gear type, and the stop **94** is now against the ear **90** so that the member **68** is positively restrained by take-up cable **96**. With the upper end of the member **68** bearing against the collar **84** it follows that inward movement is also precluded. In other words, the leaf **28** is completely locked against any movement, inward or outward. Due to the fact that the leaf **30** is hinged at its upper edge directly to the leaf **28** and comes up against the fixed stops **31** at the bottom, it too is positively restrained from movement.

When the door **26** is to be opened, the motor **38** is, of course, reversed and so is the direction in which the line shaft **36** rotates, the rotation now being clockwise as viewed in Figs. 2 and 3. The stop **112** on each cable **104** engages against the bracket **110** which is fixedly located on the fixed header **16**. Therefore, the cable **104** immediately begins to wind on the drum **122**. This develops a reactive pull on the sheave **116** which is transmitted to the leaf **28** via the tubular member **68** of the strut **66**. Consequently, the lower end of the leaf **28** is pushed outwardly to "break" the door **26** from the vertical plane in which it resides when fully closed, having been pulled into such a position by the cables **96** as previously explained.

Concurrently with the above "breaking" action is the taking up of the cables **50** which take over the lifting of the lower end of the leaf **28**, and overrun the cables **104**, this overrun being taken up by spring **92**. The cables **96**, quite obviously, are being constantly payed out during this opening period. The cables **126** in the meantime are being wrapped about their respective drums **128**, and thus are lifting the lower end of the leaf **30**. The end result is that the door **26** reaches its open, solid line position pictured in Fig. 2 whereupon the limit switch for stopping the motor de-energizes the same.

From Fig. 2 it can be discerned that during the opening of the two section door **26** the cables **126** must be taken up faster than the cables **50** for the obvious reason that the lower end of the leaf **30** must travel much farther than the lower end of the leaf **28**. Assuming for the sake of discussion that this ratio is 6:1, the drums **128** need only have a diameter twice as great as the line shaft **36**, because a speed reduction of 3:1 is achieved with the block and tackle arrangement owing to the use

of the movable pulley block **58** and the fixed pulley **60**, together with the several passes of the cable **50**. Thus, it will be appreciated that none of the drums on the line shaft **36** need be very large. Contrast, for instance, the required diameter of the drums **128** with the diameter of the shaft **36** upon which the cables **50** are wound directly, should the 6:1 ratio be obtained solely by way of differences in the relative drum diameters. Also, it will be noted that whereas in my patent the sheaves corresponding to the sheaves **56** would have to be displaced or offset a considerable distance from the front of the hangar **10** in order to produce an adequate moment arm for initially lifting the lower end of the leaf **28**; such is not the case here because of the use of the extensible struts **66** which give both a positive "breaking" action during the initial opening of the door **26** and a positive pulling action during the final stage of closing the door.

While I have described my invention as taking a particular form, it will be understood that various changes might be made without departing from the spirit thereof, and hence I do not limit myself to the precise construction set forth, but instead rely upon the scope of the appended claims including reasonable mechanical equivalents thereof.

What is claimed:

1. In a canopy type door having the upper portion pivotally mounted for swinging on a horizontal axis, and the lower free edge being constructed to be elevated into open position, means connected with the door and lying substantially adjacent the plane of the door when the same is in a closed substantially upright position for raising the lower end of the door and thereby causing said door to swing on said horizontal axis, extensible diagonal strut means connected at its upper end to a fixed pivot point inwardly of the door and connected at its lower end to a pivot point on the door, and means associated with said strut means for causing retraction thereof to produce the final closing action of the door.

2. A canopy type door in accordance with claim 1 including means associated with said strut means for holding the door in closed position.

3. A canopy type door in accordance with claim 2 including means for causing extension of said strut means to produce the initial opening action of the door.

4. In a canopy type door structure, a door leaf having its upper portion pivotally mounted for swinging movement on a horizontal axis, a cable connected to the outer side of the leaf adjacent the lower end of said leaf, means directing said cable into substantially the plane of the leaf when said leaf is in closed position, means connected to the inner side of the leaf adjacent the lower end thereof for pulling said lower end inwardly, reversible drive means for taking up said cable to open said leaf and paying out said cable to permit closing of said leaf, and means synchronized with said drive means for actuating said pulling means as said leaf approaches closed position to complete the closing of said leaf.

5. A door structure in accordance with claim 4 in which said pulling means includes a second cable having a positive connection with said leaf when said leaf approaches its closed position.

6. A door structure in accordance with claim 5 in which said last means further includes a diagonal strut member pivotally attached at its lower end to said leaf, said strut and second cable each carrying interengageable elements engageable upon the taking up of the second cable to effect said positive connection of the second cable with said leaf.

7. A door structure in accordance with claim 6 including means synchronized with said reversible means for causing said strut to be pushed outwardly during at least the initial taking up of said first cable.

8. A door structure in accordance with claim 7 in

which said outward pushing means includes a third cable acting upon said strut.

9. In a canopy type door structure, a door leaf having its upper portion pivotally mounted for swinging movement on a fixed horizontal axis, a line shaft rotatably mounted on a second horizontal axis inwardly of said leaf, first cable means connected to the outer side of the leaf adjacent the lower end thereof and to said shaft, pulley means directing said first cable means upwardly in a plane substantially parallel to said leaf when said leaf is closed and then inwardly to the line shaft so that rotation of said shaft in one direction will take up the first cable means to raise the lower end of said leaf and so that rotation of said shaft in an opposite direction will pay out said first cable means to lower said leaf end, inclined extensible strut means including one member pivotally connected at one end to the inside of said leaf adjacent the lower end thereof and a second member telescopically engaged with said one member having its projecting end pivotally connected to a fixed axis at a locus inwardly spaced from said leaf and at an elevation above the lower end of said leaf when closed, second cable means connected to said one strut member and to said line shaft, pulley means directing said second cable means first substantially axially of said one strut member and then toward said line shaft so that said second cable means will be taken up when said shaft is rotated in said opposite direction and payed out when said shaft is rotated in its said one direction, the taking up of said second cable means exerting a pull on said one strut member to close fully said door leaf, third cable means connected to a fixed locus and to said line shaft, and pulley means carried on said one strut member directing said third cable means in a direction so that said third cable means will exert a compressional force on said one strut member when said line shaft is rotated in said one direction to cause the lower end of said door leaf to be pushed outwardly.

10. A canopy type door structure in accordance with claim 9 including a second leaf hingedly attached to the lower end of the first leaf, fourth cable means connected to the inner side of the second leaf adjacent the lower ends thereof and extending upwardly to said line shaft so as to be taken up when said shaft is rotated in said one direction to raise the lower end of the second leaf, and block and tackle means included in said first cable means for operating said first cable means at a preferred rate of speed that is slower in relation to the rate of operation of said fourth cable means.

11. In a canopy type door having the upper portion pivotally mounted for swinging movement on a horizontal axis, said door comprising a pair of horizontally hinged sections, hoisting means connected with the upper section at the lower portion thereof and hoisting means for elevating said two sections from vertical to horizontal position, a take-up member connected with an intermediate portion of at least one of said sections to positively shift the same into a common plane when in closed position and securely holding said sections in said common plane.

12. The structure set forth in claim 11 and said take-up means including power means operable at the end of the closing operation with locking means for holding the same in take-up position.

13. The structure set forth in claim 11 and a single common power operator connected with said hoisting means and said take-up means for operating both of said means in predetermined sequence.

14. In a canopy type two section door having the upper portion pivotally mounted for swinging on a horizontal axis, the two sections thereof being piovtally connected at their horizontal adjacent edge portions, hoisting means elevating the lower edges of said two sections into substantially horizontal position in back to back relation for opening the door, at least one extensible bracing strut member having its upper end mounted for swinging movement on a fixed pivotal axis in inwardly spaced relation to the door and its lower end pivotally connected to one of said door sections in close association to the hinge connection therebetween, means for forcibly projecting said strut member into extended position to force said door sections out of the common plane in closed position to initially "break" the door, and take-up means causing retraction of said extensible strut member to pull said sections into a common plane for final closing thereof.

15. The structure set forth in claim 14 and positive stop means limiting the retraction of said strut member and locking means for securely holding said strut member in retracted position to positively brace the intermediate portion of the door when closed.

16. The structure set forth in claim 14 and common power driven means for actuating said hoisting means, said strut projecting means, and said-take up means.

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