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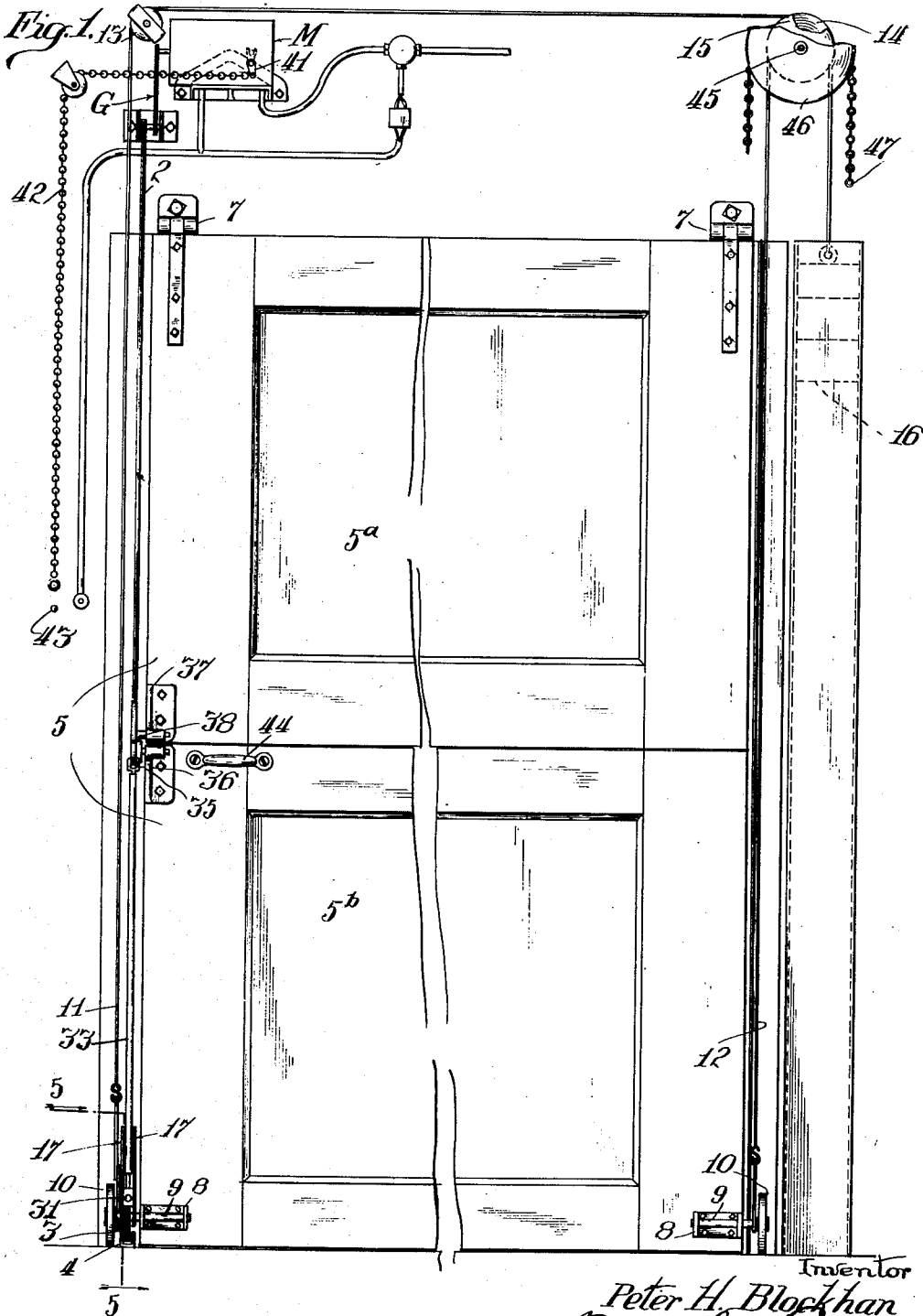
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P. H. BLOCKHAN

DOOR OPERATING MECHANISM

Filed June 25, 1925

3 Sheets-Sheet 1



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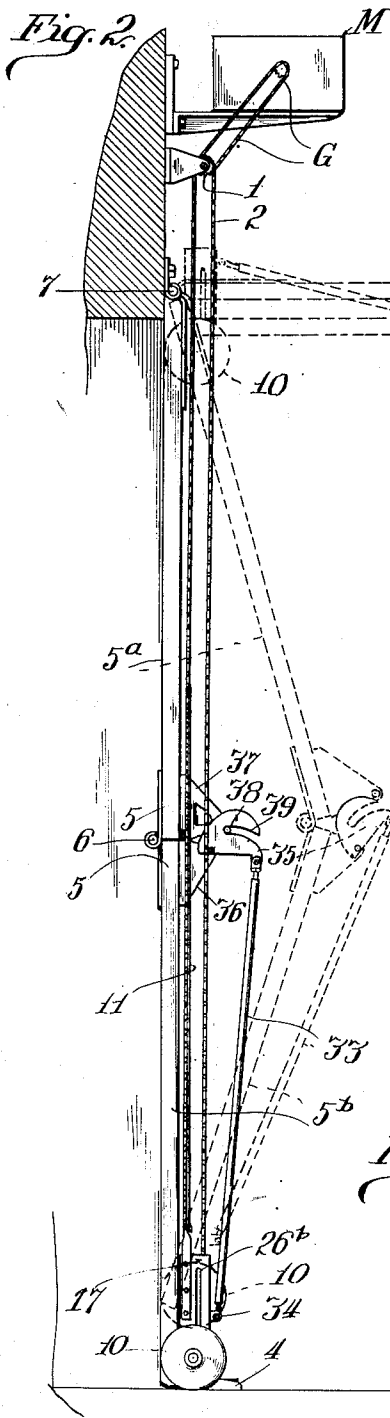
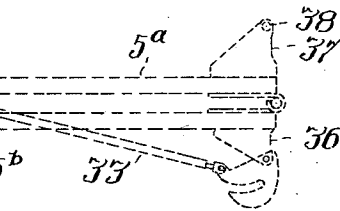
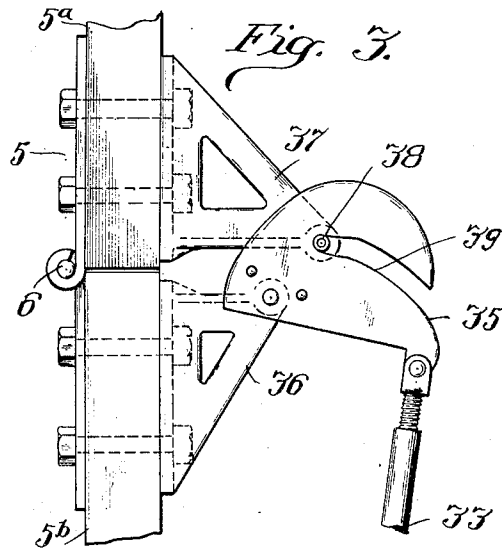
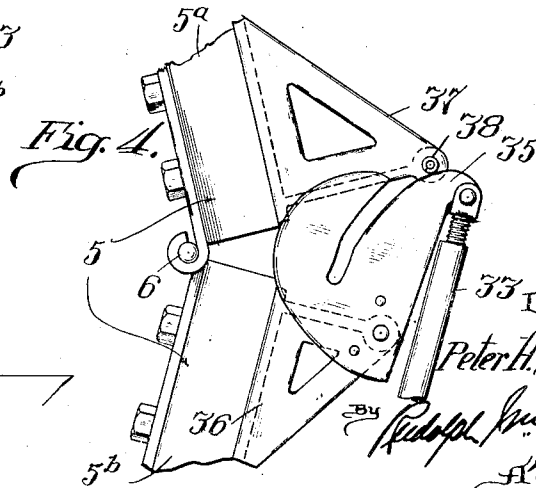
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DOOR OPERATING MECHANISM

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3 Sheets-Sheet 2



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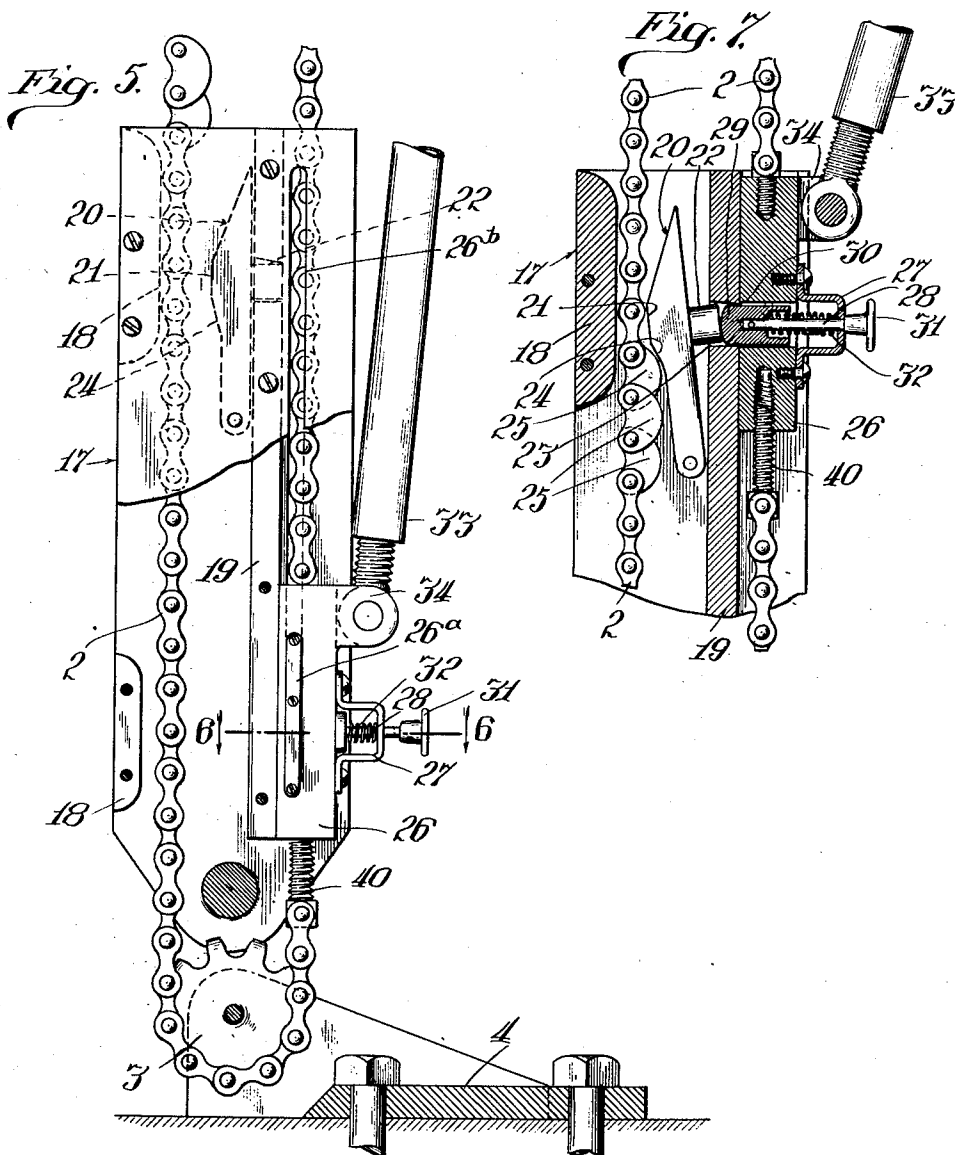
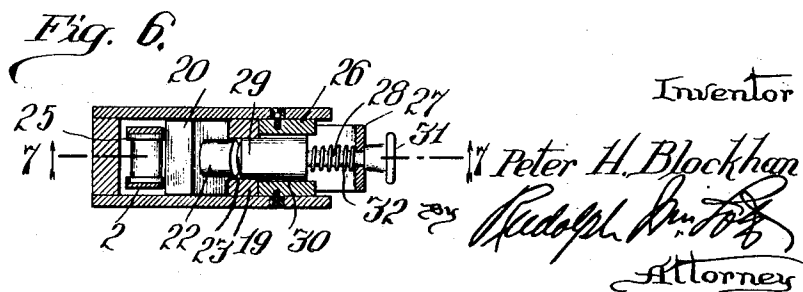
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DOOR OPERATING MECHANISM

Filed June 25, 1925

3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE.

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DOOR-OPERATING MECHANISM.

Application filed June 25, 1925. Serial No. 39,505.

To all whom it may concern:

Be it known that I, PETER H. BLOCKHAN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Door-Operating Mechanism, of which the following is a specification.

This invention relates to power actuated door operating mechanism and more particularly to mechanism for operating the type of door which consists of a plurality of sections hinged together and engaged in guides for causing the same to fold together when opened.

The invention has for its particular object to provide mechanism which will initially cause the hinged meeting edges of a folding door of the aforesaid type to be thrown out of the plane of the guides in which the other edges of the door-sections are caused to travel during opening and closing of said doors in order to permit opening thereof and, vice versa; to finally restore said hinged edges to initial position in closing said doors and effecting this operation against resistance due to wind-pressure on the doors.

The mechanism embodying the invention is illustrated in the accompanying drawings as adapted for and applied to doors swinging on horizontal axes without, however, limiting the use of said mechanism for operating doors of this particular type.

In the accompanying drawings illustrating the preferred embodiment of the invention:—

Fig. 1 is a rear elevation (or view looking from within a building) of a folding door equipped with operating mechanism constructed in accordance with the invention.

Fig. 2 is an edge elevation of the same looking from the left hand side of Fig. 1.

Figs. 3 and 4 are fragmentary detail views on an enlarged scale of the hinged meeting edges of the door sections and the portions of the mechanism associated therewith.

Fig. 5 is a fragmentary detail section on an enlarged scale, on the line 5—5 of Fig. 1.

Fig. 6 is a plan section on the line 6—6 of Fig. 5.

Fig. 7 is a fragmentary detail vertical section on the line 7—7 of Fig. 6.

The present invention relates only to the mechanism, per se, which effects so-called "breaking" of the hinged connection or connections between the several door-sections, the motor and controls for effecting opening and closing of the door being of any kind adapted for that purpose.

Thus, in Fig. 1, the electric motor is diagrammatically indicated at M, and gearing such as a chain and sprocket drive for actuating the sprocket wheel 1, is shown at G. The motor or gearing must necessarily include reversing means of a suitable type.

The sprocket chain 2 is trained over the sprocket 1 at the top of the door frame at one side of and above the door-opening and over a similar sprocket 3 (Fig. 5) adjacent the floor, and mounted in a suitable carrier 4 secured to the floor. The chain travels parallel with the side edges of the door which is of the folding type. In the instance illustrated the door 5 consists of two leaves or sections 5^a and 5^b, respectively, joined by the hinges 6, (Fig. 2). The upper leaf 5^a is secured by hinges 7 to the top of the door-frame. The hinges 6 and 7 are so arranged as to cause the leaves or sections 5^a and 5^b to project into the building as the door opens though, of course, they may, when desired or necessary, be arranged otherwise.

Secured to the lower corners of the door section 5^b are the brackets 8, each of which carries a stud-shaft 9 on which an antifric-tion roller 10 is rotatably mounted, said rollers 10 riding on the inner face of the door-frame. Cables 11 and 12, respectively, are secured at one end each to the respective stud-shafts 9, and are trained over the sheaves 13, 14 and 15 and both secured to the counterweight 16 for counter-balancing the weight of the door 5.

Mounted on one of said stud-shafts 9 is a carriage 17 comprising parallel side plates, spacing members 18 and a plate or rail 19 which also constitutes a spacing element. The upper spacing element 18 also constitutes a guide or cam-block as hereinafter pointed out. Pivottally mounted between said side plates is a cam-element 20 having a beveled or tapered free end and a high point or surface portion 21 opposed to one

portion of the sprocket chain 2. On its rear-face the said cam-element is provided with a projection 22 which normally engages in an opening 23 in the plate or rail 19. A beveled surface 24 extends from the high point 21 of the cam-element to the pivoted end thereof. Constituting a portion of the sprocket chain 2 are special or cam links 25 which project toward the opposed portion of said chain and are adapted to engage the surface portion 24 of the cam-element 20 to throw the same from the position shown in Fig. 3 to the position shown in Fig. 2 as hereinafter described. The upper spacing member 18 is so spaced from the plate 19 as to prevent the cam-links 25 of the chain from yielding to resistance of the cam element 20 to movement in the direction to eject the plunger head 28 from the opening in the plate 19 against the action of the spring 32 as hereinafter described.

Interposed in the sprocket chain 2 is the block 26 equipped with the yoke 27 through which one end of a spring-held plunger 28 projects, said plunger including the head 29 reciprocable in the opening 30 and the knob 31 which coacts with the yoke to limit the inward stroke of the head 29 and also permits manual operation of the plunger. The spring 32 is associated with the said yoke 27 and plunger head and is of the helical compression type. The block 26 is provided with guide ribs 26^a engaging in the guide-slots 26^b of the side plates of the carriage 17. The said guide ribs 26^a and slots 26^b are so arranged that the former contact with the upper end walls of the latter when the plunger head 29 is opposed to the opening in which it engages to thereby relieve said plunger of strain in an obvious manner. Said guide-ribs 26^a and slots 26^b also prevent separating movement between plate 19 and block 26.

One end of a connecting-rod 33 is pivotally disposed between a pair of ears 34 on the block 26 and the other end of said rod is pivotally secured to the outer end portion of a rocking cam 35 which is pivotally mounted on a bracket 36 secured to the door section 5^b adjacent its upper edge, the pivot of said cam being thus spaced from the inner face of said door section 5^b.

A similar bracket 37 secured to the inner face of the door section 5^a carries a stud 38 carrying an anti-friction roller disposed somewhat farther from the inner face of the door 5 than the pivot of said cam and is adapted to engage in the partly arcuate and partly straight slot 39 of said cam, the said slot being generally eccentric to the pivotal axis of the cam so that as the latter is turned anti-clockwise from the position shown in Fig. 3, the stud 38 will be caused to ride upon the lower wall of said slot to thereby force said stud away from the pivotal axis

of the cam and thus cause the door sections 5^a and 5^b to be swung relatively to each other on the hinges 6 as shown in Fig. 4.

This movement of the cam is effected by a relative movement in one direction between the block 26 and the carriage 17; and this relative movement occurs during the initial movement of the sprocket chain 2 in a direction to open the door by elevating the sections 5^a and 5^b thereof.

It will be obvious that when the door 5 is closed, the sections 5^a and 5^b thereof being then flush with each other, the block 26 is at the lower limit of its movement. Upon starting the motor M, the portion of the chain 2 disposed farthest from the inner face of the door, will move upwardly to thereby actuate only the connecting rod 33 and cam 35 until the plunger head 29 becomes disposed opposite to and springs into the opening 30. This occurs when the cam 35 has attained the position shown in Fig. 4 and, in dotted lines, in Fig. 2. The door sections 5^a and 5^b are now angularly disposed relatively to each other so that the movement of the carriage 17 with the block 26, which now occurs because of the fact that the guide ribs 26^a have engaged the upper end walls of the guide slots 26^b, the lower edge of the lower door section will rise at the same time that it moves pivotally relatively to the upper section and the door frame. This movement continues until the door sections 5^a and 5^b are folded against each other and both disposed substantially horizontally.

The projection of the plunger-head 29 into the opening 30 causes the cam-element 20 to be thrown over to the position shown in Fig. 7. This occurs just after the links 25 (which may be designated "cam-links") have passed the high point 21 of the cam-element 20 during the downward movement of said cam-links 25 as the block 26 is initially moved upwardly to the point at which the plunger-head 29 engages in the opening 30.

During the balance of the upward travel of the carriage 17, the cam links pass downwardly and then upwardly, but upon closure of the door 5, they function by coaction with the upper spacing members 18 to throw the cam-element 20 back to the position indicated in dotted lines in Fig. 5 to thereby throw the plunger-head out of engagement with the opening 30. This occurs when the door sections 5^a and 5^b have returned to substantially the position shown in Fig. 4 and is followed by a relative movement between the carriage 17 and block 26 until the latter has again attained its initial position.

During the last-mentioned movement of said block 26, the cam 35 is rotated on its axis to cause the stud 38 to engage in the cam-slot and returned to its initial position, the door sections 5^a and 5^b being thereby

forcibly brought flush with each other against wind-pressure or other resistance. Obviously, when the sections are flush with each other they are locked by the cam 35 against relative movement.

When the door is fully open, as indicated in dotted lines in Fig. 2, the anti-friction rollers 10 bear upon the door-frame below the horizontal plane of the now lower face of the section 5^b and thus serve to support said door sections in said position.

The connection of the sprocket chain 2 with the block 26 includes adjusting means which, in the instance illustrated, consists of the set-screw 40, the head of which is detachably connected with a pair of links at one end of the chain. The latitude of adjustment afforded by the set screw 40 is equal to or greater than the length of a link of the chain. The connection of the rod 33 with the block 26 also includes the set-screw 41, the head of which is detachably pivotally associated with the ears or projections 34 of the block 26. These adjusting means are necessary in order that the cam-links of the chain may be coordinated with respect to the plunger-head 29 and guide elements 26^a and 26^b in an obvious manner.

The knob 31 of the plunger 38 permits manual operation of said plunger, this being sometimes desirable.

The motor is suitably controlled to automatically stop as the door sections 5^a and 5^b attain the respective limits of their movement and is further controlled by switches to cause it to rotate in the proper direction and prevent it from rotating in the wrong direction. Obviously, the electric motor mentioned may be replaced by any other type adapted to the purpose.

Interposed in the gearing between the motor and the sprocket chain 11 is a manually operable clutch within the motor casing operable by the lever 41 (Fig. 1.), by means of which the motor may be dissociated from said chain so that the door may be manually operated. The said clutch is spring-held for normally maintaining the motor associated with the sprocket chain 11 and said clutch is operated against the action of said spring by the chain 42 which is then engaged with a pin 43 on the door-frame. This dissociation of the motor from the chain 11 serves to overcome the locking action of the cam 35 so that upon pulling on the handle 44 on the lower door section, the initial relative pivotal movement of said sections is accomplished, the free movement of the chain 11 permitting the cam 35 to accommodate itself to this movement. The further opening movement of the door is now effected by pull on the counter-weight or cable connecting the same with the door, or, it may, in cases where the door is extraordinarily large and heavy, be effected by forced rotation of

the sheaves above the counter-weight well over which the cables are trained. To this end the shaft 45 carrying said sheaves is provided with a large diameter sprocket or chain-sheave 46 over which the manually operable chain 47 is trained.

In so operating the door the block 26 will be disposed at the lower limit of its movement relatively to the carriage 17 when the door is fully open but upon effecting closure thereof said block will retain its position while the carriage 17 makes its initial downward movement. When the limit of relative movement of the block 26 and carriage 17 has been attained, the plunger-head 29 will engage in the opening in plate 19 and the cam will obviously be thus properly positioned to engage the stud 38 as heretofore described.

I claim as my invention:—

1. Operating means for folding doors of the kind specified, including a motor, a mechanism associated with the hinged edges of the connected door-sections for forcibly imparting relative pivotal movement thereto to throw them out of and into a common plane as the doors are opened and closed respectively, connection between said motor and said mechanism for actuating the latter, a traveling member associated with one of said door-sections and the door-frame for movement longitudinally of one wall of the latter on the opening and closing of the door, connection between said traveling member and said mechanism for permitting limited relative movement between the same at predetermined intervals and for automatically locking the same against relative movement during travel of said traveling member as said mechanism attains a predetermined position, and means associated with said traveling member and said mechanism for automatically releasing the same from locked position as said traveling member attains a predetermined position.
2. Operating means for folding doors of the kind specified including a motor, a member associated with the door-frame and with one of the door-sections for imparting movement to the several door-sections, mechanism associated with the hinged edge-portions of contiguous door-sections for forcibly imparting relative pivotal movement thereto at predetermined intervals, connection between said motor and said mechanism for actuating the latter, and automatic trip connection between said mechanism and said member for interlocking the same at a predetermined point in the movement of said mechanism and releasing the same at a predetermined point in the travel of said member.
3. In a door-operating mechanism of the kind specified, brackets associated with the hinged edge portions of a pair of door-sections, a rocking cam pivotally mounted on

one of said brackets, a device on the other of said brackets for engagement with said cam for effecting forced relative pivotal movements of said sections as said cam is rocked, a reciprocable member connected with said cam for rocking the same, connection between said reciprocable member and a motor, a second reciprocable member mounted for travel along a side of the door-frame and connected with one of said door-sections, said last-named reciprocable member carrying said first-named reciprocable member, and means on said members for permitting limited relative movement thereof to cause the first-named member to actuate the second one following initial operation of said cam.

4. Means for operating doors of the kind specified, including a motor, a mechanism for locking contiguous hinge-connected door-sections against relative pivotal movement and for imparting forced relative pivotal movements thereto, connection between said mechanism and said motor, a member associated with the door-frame and one of said door-sections for imparting movement to the several door-sections, and automatic trip mechanism operatively associated with said member and said first-named mechanism for interlocking the latter and said member following initial operation of said mechanism in effecting opening of the door and disengaging the said member from the first-named mechanism as the door attains substantially closed position.

5. Means for operating folding doors of the kind specified comprising a motor, a continuous sprocket chain actuated thereby, a mechanism including a rocking cam for locking the door-sections against relative pivotal movement and for imparting forced relative pivotal movement thereto, said mechanism including a member interposed in said sprocket-chain, a member mounted on the door-frame for travel parallel with said sprocket-chain and connected with one of said door-sections, a sliding connection between said respective members, and means for limiting their relative movement in one direction to thereby cause them to move in unison as said first-named member attains a limit of its movement relatively to the other member.

6. Means for operating hinged folding doors of the type specified comprising a motor, a sliding element mounted on the door-frame for reciprocation in a path perpendicular to the hinge-axes of the door and connected with one of the door-sections, a member reciprocably mounted on said element, means for limiting the relative movements of said member and said element, connection between said member and said motor for actuating the same and said element as said member attains a limit of its movement rela-

tively to said element, a rocking cam mounted on one of said door-sections, a rod connecting the same with said member for actuation as said member moves relatively to said element, and a device on the other of said door-sections disposed for engagement by said cam to effect forced relative pivotal movement of said member relatively to said element and locking said door-sections against relative pivotal movement as said member attains one limit of its movement relatively to said element.

7. In a door operating device of the class specified, a door comprising two sections hinged together, one of said sections hinged to the door-frame on an axis parallel with the hinged axis of said sections, a bracket mounted on each of said sections at one side edge thereof and adjacent the hinge connection between said sections, a rocking cam mounted on one of the brackets, and having an arcuate slot eccentric to its axis of rotation, a projection on the other bracket disposed in the path of and adapted to engage in said slot, means associated with the door-section carrying said cam for bodily moving the same into and out of folded relation to the other of said sections and transmitting coordinate movement to the latter, a device associated with said means and said cam-carrying door-section and also connected with said cam for rotating the latter in a direction to disengage said projection from said cam slot in advance of movement of said cam-carrying door-section by said means to thereby impart initial relative pivotal movement to said door-sections in a direction to effect folding thereof and to impart final relative pivotal movement reversely to the aforesaid initial movement to throw said door-sections into a common plane as the door-sections are unfolded.

8. In a door operating means of the kind specified, a door comprising a section hinged at its upper end to the top of the door-frame, a section hinged at its upper edge to the lower edge of said first-named section, a motor, means associating the same with the lower end of the lower section for raising the latter to thereby effect folding of said sections in a substantially horizontal plane at the top of the door-frame, a rocking-cam pivotally mounted on one of said door-sections, a projection on the other of said door-sections disposed for engagement by said cam to lock said sections against relative pivotal movement when they are disposed flush with each other and for imparting relative pivotal movement thereto as said cam is rotated from and to the locking positions, a rod for rocking said cam, and a member connected with said rod and same means for actuating said cam before imparting lifting movement to said door-sections.

tions and for reversely actuating said cam following completion of closing movement of said door-sections.

9. In a mechanism for operating doors of the kind specified, a hinged door consisting of a pair of sections hinged together for folding, a motor, a sprocket-chain extending perpendicularly to the hinge axes of the door, a member interposed in the sprocket-chain, a carriage connected with one of the door-sections and carrying said member, the latter reciprocally mounted on said carriage for limited movement relatively thereto, a rocking cam carried by the door-section connected with said carriage, a rod connecting said cam with said member, a projection carried by the other door-section and engaged with said cam when said sections are flush with each other for locking the same against relative pivotal movement, said cam and said projection coacting to impart relative pivotal movement to said sections out of and into said flush position as said cam is rotated in respectively opposite directions, said member disposed relatively to said carriage at the limit of its movement at which the cam is in locking position when the door-sections are flush and being moved to the other limit of its movement relatively to the carriage prior to movement of the latter to thereby impart initial relative pivotal movement to said sections and unlock the same to permit folding thereof during travel of said carriage.

10. Door operating means including a door-frame, a door hinged to the top thereof and consisting of two substantially equal sections hinged together for folding, stud-shafts mounted on the lower corners of said door, anti-friction rollers mounted on said stud shafts for travel along the sides of the door-frame as said door is folded for opening and unfolded for closing, a carriage pivotally mounted on one of said stud-shafts, a member reciprocally mounted for movement longitudinally of said carriage, a spring-held latch for locking said carriage and said member against relative movement as the latter attains the upper limit of its movement relatively to the carriage to thereby cause the latter to move in unison with said member to fold and unfold the door-sections, mechanism mounted on said door-sections for locking the same against relative pivotal movement and for forcing their relative pivotal movement as said member is moved relatively to the carriage for throwing said sections out of and into flush relation to initiate opening and effect final closure of the door, and trip mechanism associated with said latch for releasing the same as said carriage returns substantially to the point in its travel at which said latch engages to thereby permit return of said

member to the lower limit of its movement relatively to the carriage to effect forced return of the door-sections to flush position and lock the same in said position.

11. Door operating means including a door-frame, a door hinged to the top thereof and consisting of two substantially equal sections hinged together for folding, stud-shafts mounted on the lower corners of said door, anti-friction rollers mounted on said stud shafts for travel along the sides of the door-frame as said door is folded for opening and unfolded for closing, a carriage pivotally mounted on one of said stud-shafts, a member reciprocally mounted for movement longitudinally of said carriage, a spring-held latch for locking said carriage and said member against relative movement as the latter attains the upper limit of its movement relatively to the carriage to thereby cause the latter to move in unison with said member to fold and unfold the door-sections, a rocking cam mounted on one of said door-sections, a member on the other thereof disposed for engagement by said cam, a rod connecting said cam with said reciprocable member for actuating said cam during movements of said member relatively to said carriage to thereby effect forced relative pivotal movement of said door-sections to initiate opening and effect final closure of the door, and trip mechanism associated with said sprocket-chain and said latch for releasing the latter as said carriage returns to substantially the point in its travel at which said latch became engaged to thereby permit return of said member to the lower limit of its movement relatively to the carriage.

12. Folding door operating mechanism of the type specified including mechanism on the door-sections for locking the same against relative pivotal movement and for imparting forced relative pivotal movement thereof to initiate opening and effect final closure of the door, a motor for effecting folding and unfolding of the door-sections, a member connected with said motor and said mechanism for actuating the same, a carriage connected with one of said door-sections, trip-mechanism associated with said carriage and said member for coupling the same as said member attains a predetermined position following actuation of said mechanism for initiating relative folding movement of the door-sections to thereby effect travel in unison of said member and said carriage to complete folding of said sections and to thereafter effect unfolding thereof, and means included in said trip-mechanism for releasing said member from coupled relation to said carriage as the latter returns substantially to the point in its travel at which coupling with said member occurs.

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