Sept. 22, 1931. H. I. MORRIS 1,824,679

OPERATING MECHANISM

Original Filed Sept. 26, 1925 4 Sheets-Sheet 1

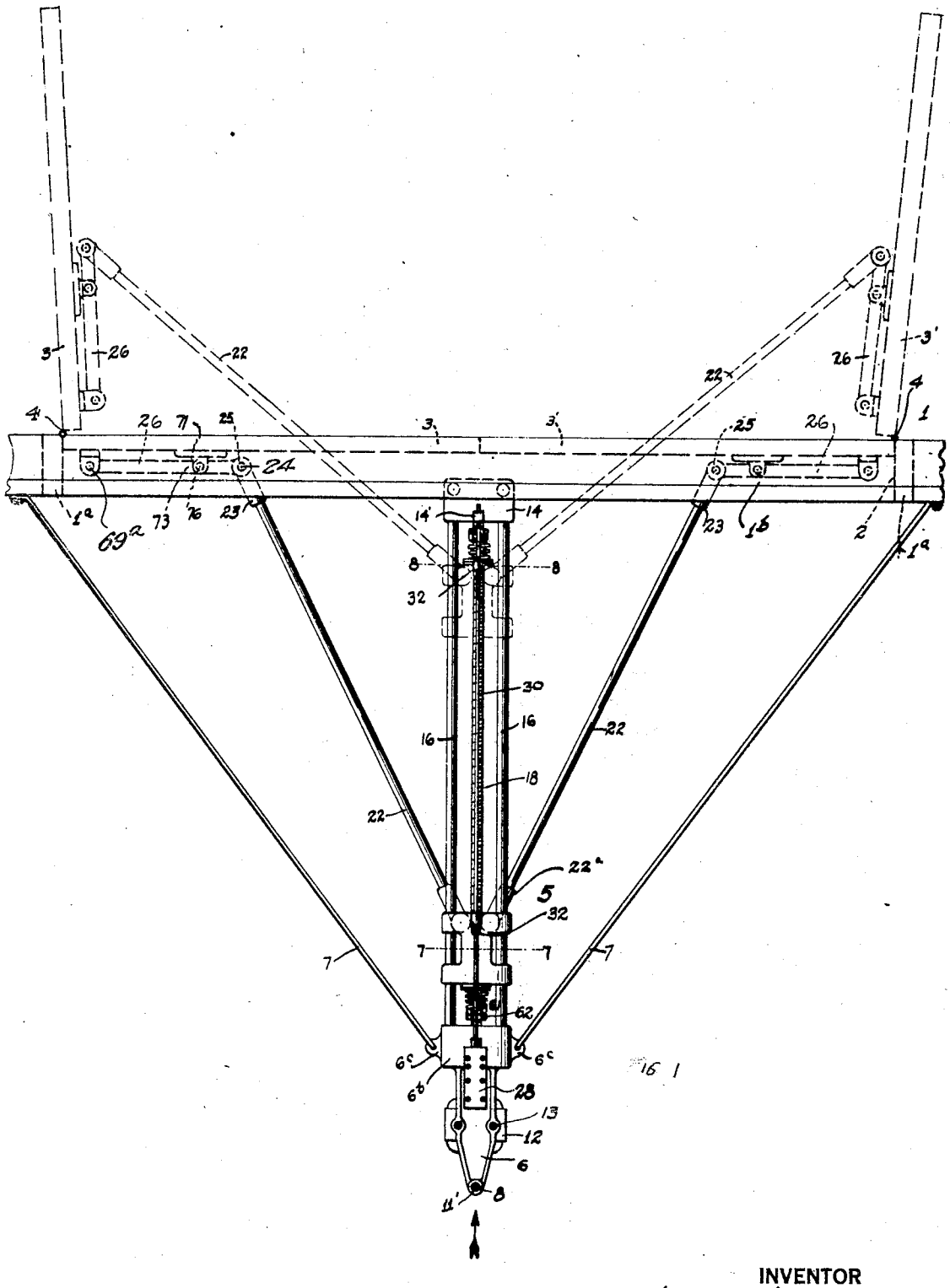


FIG 1

INVENTOR
Howard I. Morris
BY
Geo. A. Pitts
ATTORNEY

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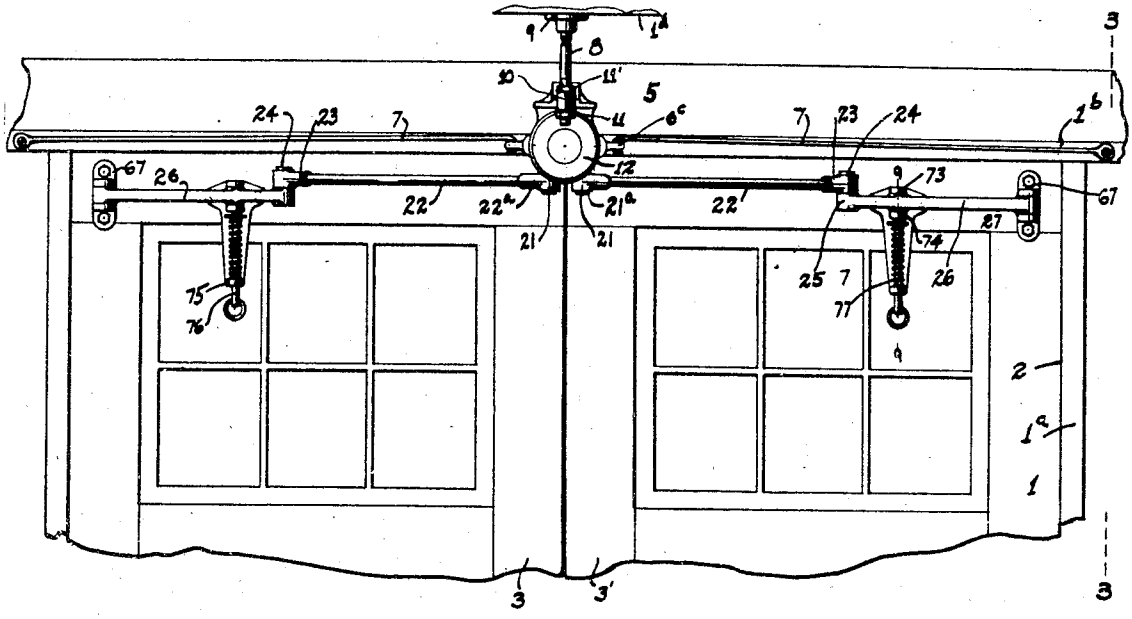


Fig. 2

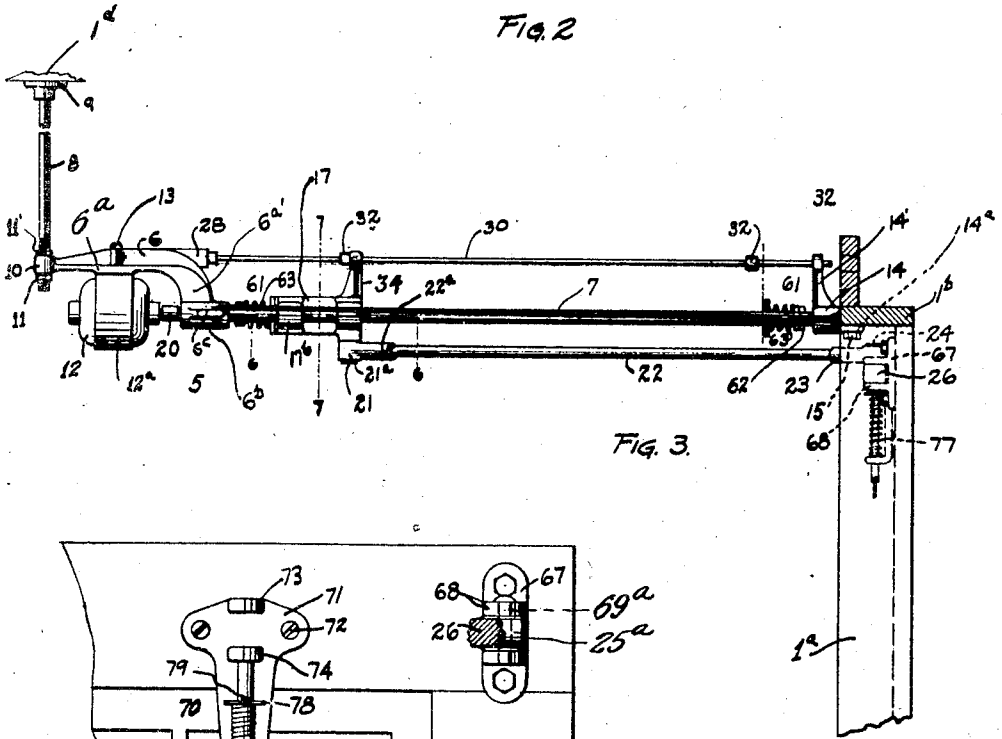


Fig. 3

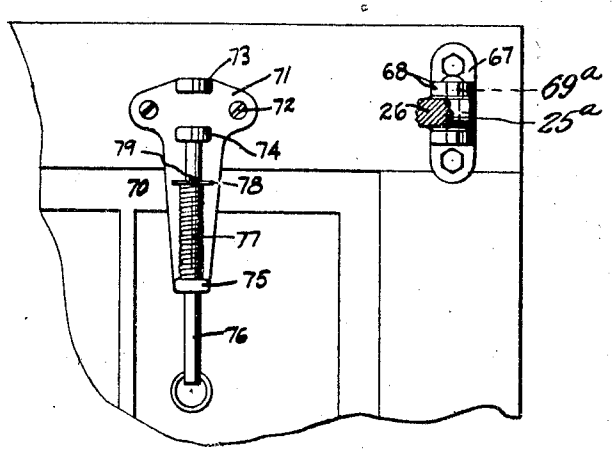


Fig. 4

INVENTOR
Howard I. Morris
BY
Geo. Pitts
ATTORNEY

Sept. 22, 1931. H. I. MORRIS 1,824,679

OPERATING MECHANISM

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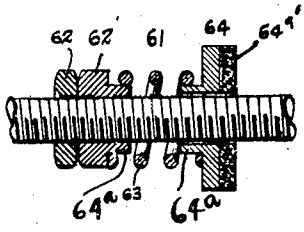


FIG. 6a

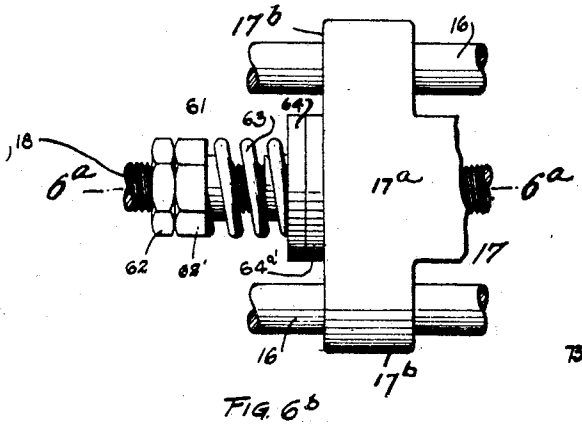


FIG. 6b

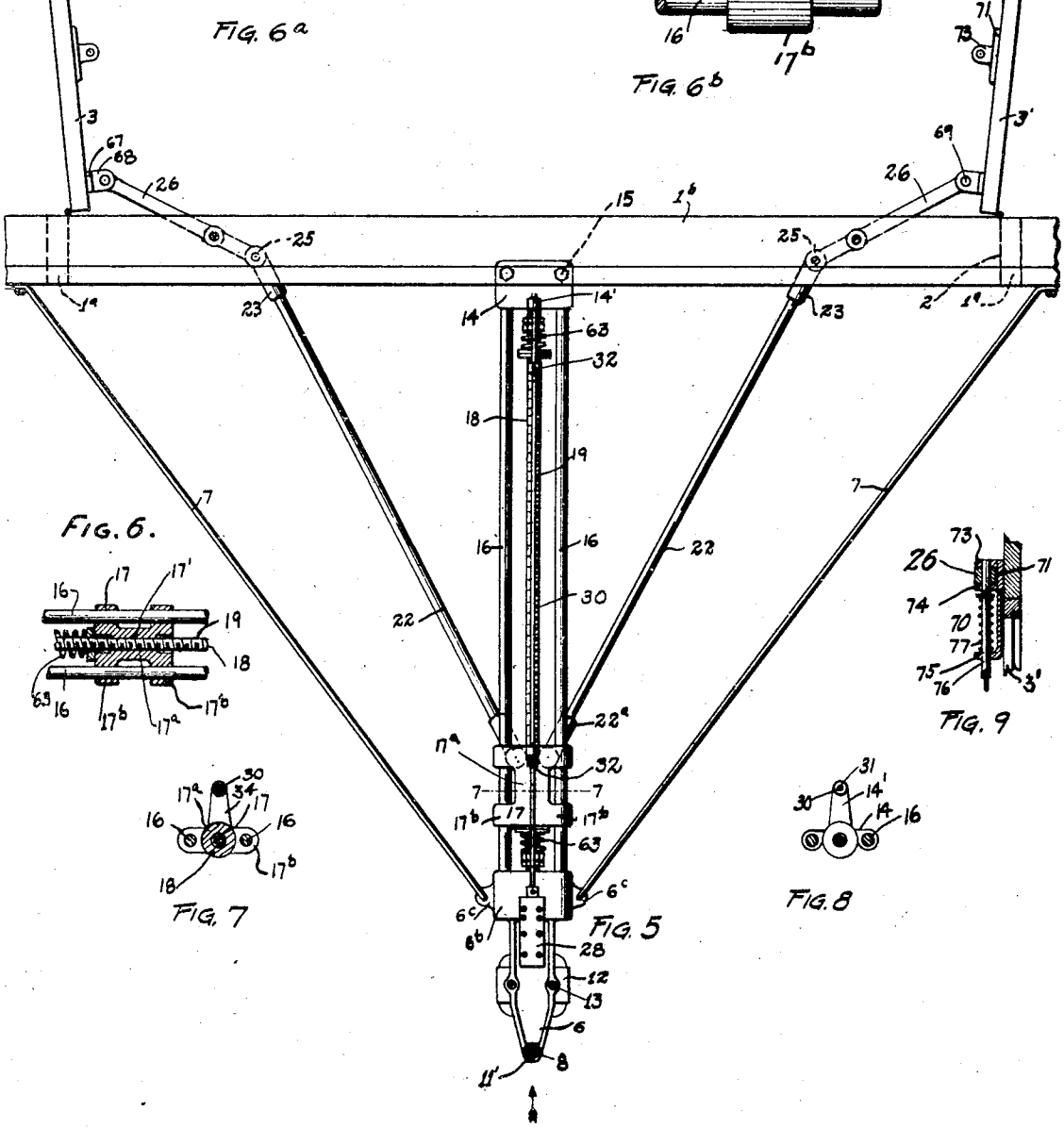


FIG. 6.

FIG. 7

FIG. 9

FIG. 8

FIG. 5

INVENTOR
Howard I. Morris
BY Geo B Pitts
ATTORNEY

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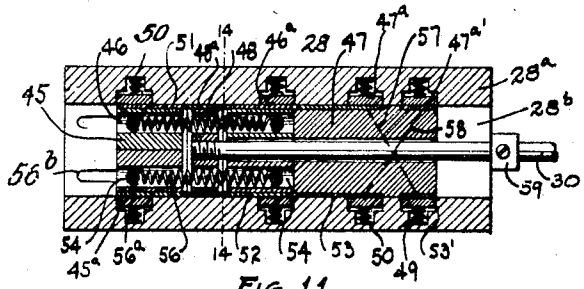


FIG. 11.

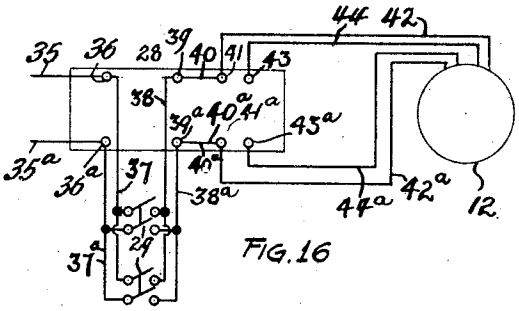


FIG. 16

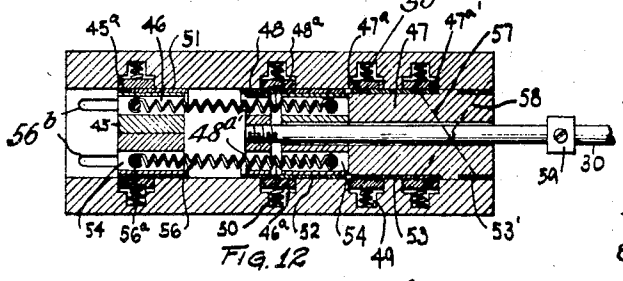


FIG. 12

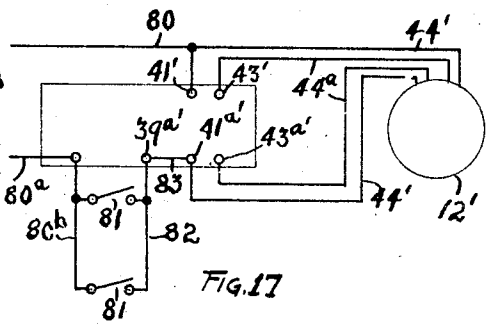


FIG. 17

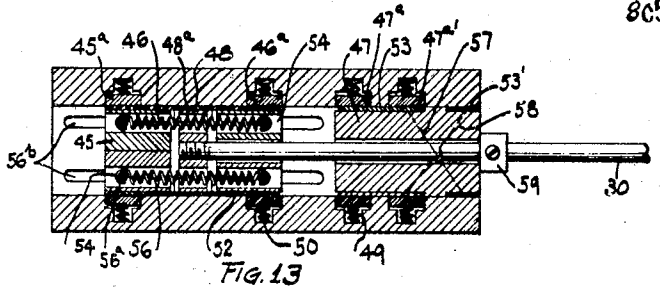


FIG. 13

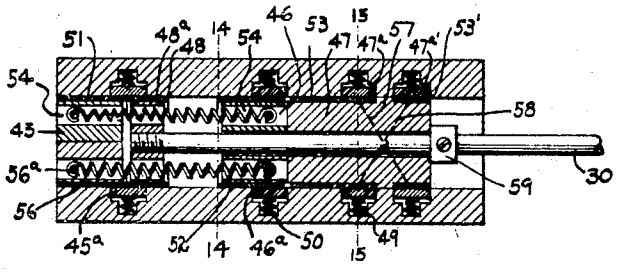


FIG. 10

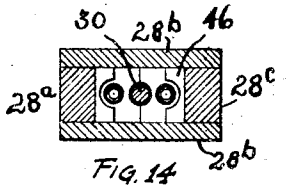


FIG. 14

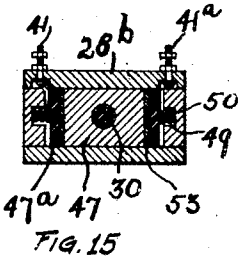


FIG. 15

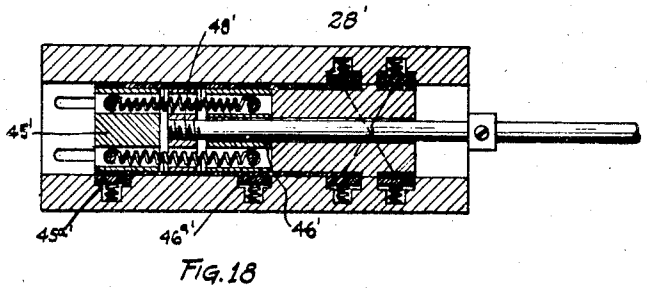


FIG. 18

INVENTOR

Howard I. Morris

BY

ATTORNEY

Patented Sept. 22, 1931

1,824,679

UNITED STATES PATENT OFFICE

HOWARD I. MORRIS, OF LAKEWOOD, OHIO, ASSIGNOR TO THE YODER-MORRIS COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO

OPERATING MECHANISM

Application filed September 26, 1925, Serial No. 58,706. Renewed August 13, 1931.

This invention relates to a mechanism for operating one or more members which are mounted to move from one position to another and then back again. The invention may be used to open and close a door and particularly a door of the hinged type; in the preferred application of the invention I have applied it for use in opening and closing a pair of doors.

One object of the invention is to provide a mechanism for operating a member from one position to another and back again of relatively simple construction.

Another object of the invention is to provide a mechanism for operating a door from closed position to open position and vice versa in a ready and simple manner and by the provision of a relatively simple control mechanism.

Another object of the invention is to provide in mechanism of this character improved switch means for stopping the motor and setting the circuit to effect a reversal thereof for the succeeding operation.

Another object of the invention is to provide in mechanism of this character improved means for braking the motor shaft to stop the motor, whereby positive operation of the movable members to a closed position or to their open position results.

Another object of the invention is to construct an improved motor driven mechanism provided with a means which is acted on by said mechanism to put it under tension, whereby it is conditioned to impart rotative effort to the motor shaft to assist it in starting.

Other objects of the invention will be apparent to those skilled in the art to which my invention relates from the following description taken in connection with the accompanying drawings, wherein

Fig. 1 is a plan view of a mechanism embodying my invention and a fragmentary portion of a building structure having doors which are to be opened and closed; the doors being shown in this latter position.

Fig. 2 is an elevation of the parts shown in Fig. 1, looking in the direction of the arrow.

Fig. 3 is a section on the line 3—3 of Fig. 2, showing the mechanism in side elevation.

Fig. 4 is a fragmentary view, with parts omitted, to illustrate the means for detaching the door from the operating means, whereby they may be operated independently of the latter.

Fig. 5 is a plan view similar to Fig. 1 but showing the doors moved to open position without operation of the operating mechanism.

Fig. 6 is a section on the line 6—6 of Fig. 3.

Fig. 6*a* is a fragmentary section on the line 6*a*—6*a* of Fig. 6*b*.

Fig. 6*b* is a fragmentary plan view showing the engagement of the cross head with the stopping means for the feed screw.

Fig. 7 is a section on the line 7—7 of Figs. 1 and 5.

Fig. 8 is a section on the line 8—8 of Fig. 1.

Fig. 9 is a section on the line 9—9 of Fig. 2.

Fig. 10 is a sectional view of the switch mechanism showing the position of the parts thereof when the doors are in closed position and ready to close the motor circuit across the main switch or switches following the operation of the motor to effect opening of the doors.

Fig. 11 is a view similar to Fig. 10, but showing the position of parts after the motor circuit has been closed by the operation of the motor and movement of the cross head to open the doors.

Fig. 12 is a view similar to Fig. 10, but showing the position of the parts when the doors are in open position, with the motor circuit reversed and ready to close the motor circuit across the main switch or switches when the motor is operated to effect closing of the doors.

Fig. 13 is a view similar to Fig. 12, but showing the position of the parts after the motor circuit has been closed by the operation of the motor and movement of the cross head to close the doors.

Fig. 14 is a section on the line 14—14 of Figs. 10 and 11.

Fig. 15 is a section on the line 15—15 of Fig. 10.

Fig. 16 is a diagram of the circuits for the motor when a switch mechanism of the construction shown in Figs. 10, 11, 12 and 13 is used.

Fig. 17 is a diagram of a circuit for the motor, where one of the leads is connected to the motor and the main switch or switches are interposed in the other lead.

Fig. 18 is a sectional view of a switch mechanism slightly different from that shown in Figs. 10, 11, 12 and 13, for use in connection with a circuit such as shown in Fig. 17.

My invention is herein illustrated as applied to the opening and closing of an opening or space by one or more members such as a gate or a door or doors, which opening may be formed in a wall, partition or a building structure. The member or members may be supported to swing in either direction or to slide in suitable guides. For illustrative purposes, I have shown a building structure, such as a garage, indicated at 1, having an opening 2 formed by side walls or jambs 1*a*, and a sill or cross member 1*b*. The opening 2 is preferably closed by two doors, 3, 3′, each hinged at 4 to the adjacent jamb 1*a*. The mechanism for operating the doors, that is, for opening and closing them, is indicated as an entirety at 5. It is mounted above the opening 2 and is correlated with the walls of the opening 2 and doors 3, 3′, to swing the latter on the hinges 4, but it will be understood that this illustration is merely for the purpose of showing the preferred arrangement and manner of applying the invention in actual use; it being obvious that the doors may be movable in guides or on trolleys and also swingable on horizontal axes instead of vertical axes.

In the preferred form of construction, as already set forth, I have applied my invention for the simultaneous operation of a pair of doors, but the mechanism operates in the same manner whether the opening is closed by a single door or by two doors.

Of the operating mechanism 5, 6 indicates a support rigidly secured at a point about the doors 3, 3′. As shown in Fig. 3, the support 6 preferably comprises a frame having a base portion 6*a* and a downwardly extending arm 6*a*′. The arm 6*a*′ terminates in a bracket 6*b* having lateral lugs 6*c* to which are connected the outer ends of diverging brace rods 7, their inner ends being bolted or otherwise secured to the walls of the building 1 as shown in Figs. 1 and 2. The outer end of the support 6 is connected to a depending member 8, which may be connected to a flange 9 by means of a set screw. The flange 9 is secured to the ceiling or a suitable cross member 1*d* (see Figs. 2 and 3) forming part of the building 1. The connection between the support 6 and depending member 8 consists of a hollow boss 10 on the support to receive the threaded free end of the member 8 and nuts 11 and 11′ between which the boss 10 is clamped. If vertical adjustment of the support 6 is to be made it may be effected by running both nuts up or down relative to the member 8 to the desired position and then clamping the boss 10 between them.

12 indicates an electric motor preferably of the induction type, that shown and heretofore used by me being a 60 cycle single phase induction motor having four running coils capable of producing a speed of 1800 R. P. M. and four starting coils, which latter coils are reversed to effect a reversal of rotation of the motor shaft. As the motor 12 is of standard form, it is not necessary to illustrate the same. The motor casing 12*a* is secured to the underside or face of the base portion of 6*a* of the support 6 by a plurality of cap screws 13; the abutting walls of the base portion 6*a* and motor casing 12*a* being fashioned to insure a rigid mounting of the motor on the base portion. 14 indicates a supporting element mounted on the inner face of the wall of the building 1 above the doors 3, 3′, preferably seated against the inner edge of the sill 1*b* in alignment with the bracket 6*b* and held on the sill by a suitable flange 14*a*, which extends under the sill 1*b* and is secured thereto by screws 15. The supporting element 14 is provided with a standard 14′, the purpose of which will later be set forth. 16 indicates a pair of guides supported in parallel relation at their opposite ends by the bracket 6*b* and supporting element 14 and serving to slidably support a cross head 17. The guides 16 may comprise rods or tubes and their ends may be tightly fitted or screwed into suitable openings formed in the bracket 6*b* and supporting element 14, and hence co-operate with the rods 7 and depending member 8 in supporting the support 6 and motor 12. 18 indicates a feed screw arranged between the guides 16 and provided with threads 19. The screw is rotatably mounted at its inner end in a suitable bearing provided in an opening formed in the supporting element 14. The feed screw extends through a threaded opening 17′ formed in the cross head 17, and through an opening formed in the bracket 6*b* (which opening is lined with a suitable bushing to form a bearing for the screw), so that its outer end may be connected by a coupling 20 with the armature shaft of the motor 12. The cross head 17 preferably comprises a body portion 17*a* and pairs of hollow bosses 17*b* at either side thereof through which the guides 16 extend. As will be apparent, the closing of the circuit to the mo-

tor 12 will rotate the feed screw 18, which will effect movement of the cross head along the guides 16 from one end thereof to the other.

21 indicates pins depending downwardly from the inner end of the cross head 17, at either side of the threaded opening therethrough, and forming pivot connections for the outer ends of a pair of thrust and pull rods 22. The rods 22 are pivotally connected at their inner ends to the doors 3, 3′, and when given a thrust movement, due to movement of the cross head 17 from the position shown in full lines in Fig. 1 to the position shown in dotted lines, they serve to swing the doors open, and when given a pull movement, due to the movement of the cross-head in the reverse direction, they serve to close the doors. For this purpose, the feed screw is provided with threads 19 throughout its length sufficient to effect opening and closing of the doors through an arc slightly greater than a right angle; but by making the screw longer and extending its threaded portion along a greater distance, the doors may be swung any desired distance, except as they may be limited by engagement of the rods 22 with the doors or door jambs.

The pins 21 may be provided with heads 21*a* and their inner ends may be threaded into threaded openings formed in the body portion 17*a*; this construction forming a detachable connection for the outer ends of the rods 22. The outer ends of the rods may be provided with sleeves 22*a* having at their outer ends hollow bosses through which the pins extend. As the sleeves 22*a* are screw threaded on the adjacent rod ends, their rotation thereon will serve to lengthen or shorten the rods, for a purpose that will later appear. Likewise, the inner ends of the rods 22 are provided with sleeves 23, having hollow bosses through which extend pins 24. The pins 24 are mounted in bosses or knuckles 25 on the inner ends of levers 26, each of which forms one element of an intermediate connection 27 between the rod 22 and the adjacent door. The connections 27 are for the purpose of detaching the doors 3, 3′, from the rods 22, while maintaining and supporting the latter in operative relation, so that the doors (or either thereof) may be opened and closed manually without operation of the motor; for example when supply of current from the supply mains is cut off or the mechanism requires repairs. The connections 27 will be later described.

28 indicates as an entirety a switch mechanism which is connected to and inter-related with the mechanism 5 operated by the motor 12, whereby it serves to (1) complete the motor circuit from the supply mains following the starting of the motor, so that the main switch, indicated at 29 (see Fig. 16), may be released or opened; (2) automatically open such circuit when the doors have swung into either position; and (3) set the switch elements in position to rotate the motor in the opposite direction when the main switch is again closed.

The switch mechanism 28 is connected with and controlled by the operating mechanism 5 by means of a rod 30. The rod 30 is supported at its outer end within the casing 28*a* of the switch mechanism 28 in the manner to be later set forth; the inner end of the rod 30 is slidably supported in an opening 31 formed in the standard 14′ carried by the supporting element 14. The rod 30 carries a pair of tappets 32, each adjustably secured to the rod 30 in any desired manner, preferably by means of a set screw 33. The tappets 32 are fixed in position to be engaged by an arm 34 extending upwardly from the cross head 17 so that when the latter moves to or approaches either of its extreme positions, the arm 34 will strike the adjacent tappet 32 and thus move the rod 30 endwise and effect the operations above enumerated.

35, 35*a*, indicate a pair of leads connected to the electric supply mains (not shown). The leads 35, 35*a*, are connected to terminals 36, 36*a*, for a purpose that will later appear. To the terminals 36, 36*a*, leads 37, 37*a*, are connected, and these leads in turn are connected to a pair of suitable terminals of the main switch 29. The main switch 29 is located at some suitable point, such for example at a convenient position within the structure 1 or within the house adjoining the structure 1 and if desired two or more such switches may be provided as shown in Fig. 16; furthermore, where the structure 1 is used as a garage one of the main switches 29 may be supported alongside of the driveway leading to such garage and its movable elements controlled by a key operated lock. The main switches 29 are connected in parallel, so that the operation of either one will close the motor circuit. From the other pair of terminals for the main switch 29, leads 38, 38*a*, extend to terminals 39, 39*a*, which in turn are connected by leads 40, 40*a* with terminals 41, 41*a*. 42, 42*a*, indicate leads extending from the terminals 41, 41*a*, and connected to the opposite ends of the running coils for the motor 12. 43, 43*a*, indicate terminals mounted in the casing 28*a* and connected by leads 44, 44*a*, with the opposite ends of the starting coils for the motor 12. The direction of rotation of the motor 12 is preferably reversed by changing the connections of the starting coils of the motor 12 with the leads connected to the running coils therefor and such reversal is automatically effected by the switch mechanism 28 in the manner to be later set forth under control of the rod 30.

The casing 28*a* is preferably formed from suitable insulating material, such as fibre, and comprises top and bottom walls 28*b*, 28*b*, and side walls 28*c*, secured together in any well known manner, for example at right angles to each other, so that their inner walls may serve as guides for a plurality of switch elements 45, 46, 47 and an operating element 48 slidably fitted therein; the elements 45, 46, serving to close or shunt the motor circuit across the main switch that may be closed at any time to effect rotation of the motor 12, the element 47 serving as the reversing switch or device and the element 48 serving as an operating and contact member, as will be later set forth. As will be understood from the diagram shown in Fig. 16, the terminals 36—36*a*, 39—39*a*, 41—41*a* and 43—43*a* are mounted in the walls of the casing 28*a*, so that provision may be made for closing and opening as well as reversing the circuit by the elements just referred to. For this purpose the side walls 28*c* are formed on their inner sides with recesses 49 shaped to receive pairs of contact plates 45*a*, 46*a*, 47*a* and 47*a*′ and coiled springs 50 each disposed between the bottom surface of its recess and the adjacent contact plate and normally tending to press or force the latter inwardly and against contact plates 51, 52, carried by the opposite side walls of the elements 45, 46, respectively and contact plates 53, 53′, carried by the switch element 47. The contact plates 45*a* are connected to the terminals 36, 36*a*; the contact plates 46*a* are connected to the terminals 39, 39*a*; the contact plates 47*a* are connected to the terminals 41, 41*a*; and the contact plates 47*a*′ are connected to the terminals 43, 43*a*. Each of the switch elements 45, 46, comprises an insulating block preferably formed from fibre and the plates of conducting material 51, 52, (already referred to) on their side walls, extend from end to end thereof, to allow sliding of the elements while maintaining contact with the plates 45*a*, 46*a*, respectively. The plates 51, 52, extend beyond the inner edges of the blocks to engage with the contact plates 48*a* carried on the opposite sides of the operating member 48, so that when the switch-elements 45, 46, and member 48 are in normal position (see Figs. 11 and 13), the plates 51, 52, 48*a*, will form electrical connections between the plates 45*a*, 46*a*, thus completing or shunting the circuit across the terminals 36—39 and 36*a*—39*a* and permitting the main switch, which was operated to close the motor circuit, to be cut out. The blocks are formed with longitudinal openings 54, each opening in one block being aligned with an opening in the other block, so that coiled springs 56 may be mounted in these openings and connected to the blocks by cross pins 56*a* and thus normally tend to move the switch elements 45, 46, toward each other. The movement of the elements toward each other is limited in any suitable manner, preferably by providing the bottom wall 28*b* with pairs of elongated slots 56*b* and extending the pins 56*a* thereinto, whereby they may engage the inner end walls of the slots 56*b*, when they move inwardly under the influence of the springs 56. The inner ends of the slots 56*b* are so spaced from each other that they permit engagement of the switch elements 45, 46, with the operating member 48 when moved together under the influence of the springs 56, but when one of the elements is operated to its abnormal position or away from the other element (to break the circuit as will later appear), the latter is held by the end walls of the adjacent slot, so that the springs 56 are put under tension by the movement of the operated element and thus are enabled to return such element and the member 48 back to normal position when the motor is operated in the opposite direction.

The operating member 48 is adjustably fixed to and operated by the rod 30, this member being formed with openings 48*a*′ aligned with the openings 54 to permit the springs 56 to extend through them. As will later appear, the springs 56 are strong enough to not only move each switch element 45, 46, from its abnormal position (upon the starting of the motor 12) to its normal position, but also through such element to move the operating member 48 and rod 30 back to its mid or normal position. The reversing switch element 47 comprises a slidable block, preferably formed from fibre, pairs of contact plates 53, 53′ (already referred to) mounted on its opposite sides, and wires 57, 58, each connecting one plate 53 on one side of the block with the plate 53′ on the other side of the block. The plates 53 serve to connect the plates 47*a*, 47*a*′, together when the element 47 is in one position (see Figs. 12 and 13) and thus connect the running coils and starting coils together to operate the motor in one direction, that is, to close the doors. When the element 47 is moved to its other position (see Figs. 10 and 11), the plates 53 move out of contact with the plates 47*a*′ and the plates 53′ contact therewith; but since the plates 53, 53′, on one side of the block are connected respectively with the plates 53′, 53, on the opposite side thereof, the connection between the running coils and starting coils of the motor will be reversed, so that upon the closing of the motor circuit, the motor 12 will run in the opposite direction, that is, to open the doors 3, 3′.

Each block 45, 46, is made of two sections and each spring 56 connects one section on one block and the adjacent section of the other block. Accordingly, the sections connected by one spring will act independently

of the sections connected by the other spring and thus insure contact between the plates 51, 52, 48*a*, at either side of the switch elements independently of each other. Otherwise if each element was made from a single section of material, contact might only be effected on one side.

The operation of the operating mechanism 5 and switch mechanism 28 may now be described. Fig. 3 shows the doors 3, 3′ closed and the cross head 17 in its extreme outer position, with the arm 34 engaging the outer tappet 32 and through it holding the rod 30 in its operated position. In this position (see in Fig. 10), the rod 30 has moved the operating member 48 out of contact with the switch element 46 (which operation opened the motor circuit in the previous operation of closing the doors 3, 3′) and the operating element 48 in turn has moved the switch element 45 to its abnormal position; also a lug or collar 59, adjustably fixed to the rod 30, has engaged and moved the reversing switch element 47 outwardly, thereby connecting the terminals 41 and 41*a* with the terminals 43*a* and 43, respectively. If now one of the main switches 29 be operated, the motor circuit will be closed and the motor 12 set running; one side of the circuit comprising lead 35, terminal 36, lead 37, through the switch 29, lead 38, terminal 39, lead 40, terminal 41, plate 47*a*, plate 53, lead 57, plate 53′, plate 47*a*′, terminal 43*a* and leads 44, 44, to the motor coils; and the other side of the circuit comprising lead 35*a*, terminal 36*a*, lead 37*a*, through the switch, lead 38*a*, terminal 39*a*, lead 40*a*, terminal 41*a*, plate 47*a*, plate 53, lead 58, plate 53′, and leads 42*a*, 44*a*, to the coils. The operation of the motor 12 rotates the feed screw 18, which in turn moves the cross head 17 and arm 34 inwardly; the cross head 17 operating through the rods 22, swings the doors 3, 3′, to the position shown in dotted lines in Fig. 1. In the first part of this movement, the rod 30 is released by the arm 34, which permits the springs 56 to act on and move the switch element 45 back to its innermost or normal position and through it move the operating member 48 to its mid or normal position, bringing the contact plates 51, 52, 48*a*, into engagement and establishing the motor circuit from the terminals 36, 36*a*, through these plates to the terminals 39, 39*a*, respectively (as shown in Fig. 11), whereupon the main switch 29 may be opened. As the cross head 17 approaches the end of its inward movement, the arm 34 engages the inner tappet 32 and through it moves the rod 30 endwise inwardly; a hole 60 being formed in the wall 15′ (see Fig. 3) to permit of this movement where sufficient space does not otherwise exist. Movement of the rod 30 inwardly will operate the operating member 48 from the position shown in Fig. 11 to the position shown in Fig. 12, thereby breaking the motor circuit and stopping the motor 12 with the doors 3, 3′, in open position, and the operating member 48 in turn will move the switch element 46 to its abnormal position and through it shift the reversing switch element 47 to its other position—thus reversing the relationship of the starting and running coils; the latter figure showing these parts after these operations have been effected.

To close the doors, one of the main switches 29 is closed. This closes the motor circuit through the connections as previously described, except that the connection of the starting coils with the running coils have been reversed as above set forth, so that the motor 12 will run in the necessary direction to so rotate the screw 18 that the cross head 17 will move outwardly. In the first portion of its movement, the rod 30 will follow the arm 34 due to the tension of the springs 56 acting on the switch element 46 and through it serving to move the operating member 48 back to its mid position, thereby completing the motor circuit across the terminals 36—39 and 36*a*—39*a* by the contact plates 51, 52, 48*a*, as shown in Fig. 13, whereupon the main switch 29 may be opened; these parts remaining in this position until the cross head 17 and arm 34 approach their outer-most position, that is, that position in which the doors 3, 3′, are completely closed, at which time the arm 34 engages the outer tappet 32 and moves endwise the rod 30 which in turn, through the operating member 48 and lug 59 slide the switch element 45 and reversing switch element 47 to the respective positions shown in Fig. 10, the effect of which is to break the motor circuit and stop the motor 12 and to reverse the starting coils of the motor, so that when one of the main switches 29 is again closed the motor will rotate in the direction required to open the doors 3, 3′.

It will be noted that the circuit for the motor is opened as soon as the contact between the plates 51, 52 and 48*a* is broken by a movement of the rod 30 in either direction and that further movement of the rod due to the momentum of the screw 18 and shaft of the motor is utilized to (1) move the lug 59 into engagement with the reversing switch element 47 to operate the latter in one direction and (2) move the switch element 46 far enough to move the reversing switch element 47 to operate the latter in the opposite direction according to the direction of rotation of the screw 18.

61 indicates as an entirety a means disposed adjacent either end of the feed screw 18 in the path of movement of the cross head 17, and constructed and arranged to (1) stop the rotation of the feed screw following the opening of the motor circuit and (2) act on the feed screw in a rotative di-

rection when the motor is again started to move the cross head back to its previous position, thereby tending to start the shaft rotating to effect this operation; this latter function being particularly advantageous when an induction type of motor is used since it has very little starting torque action. These means in functioning to brake the rotation of the feed screw and movement of the cross head serve to relatively quickly stop them at predetermined positions to the end that the doors 3, 3′, are adequately controlled and will come to rest at predetermined positions, that is, their closed position and full open position. The means 61 for effecting the stopping of the motor 12, cross head 17 and doors 3, 3′, at either position of the latter and starting the screw and motor shaft are similar in construction, so that the following description of one will apply to both such means, 62, 62′, indicate nuts engaging the threads 19 of the screw or rod 18, and forming an abutment for the outer end of a compression spring 63 coiled therearound. Two nuts are preferably provided so that one may serve as a lock nut. 64 indicates a disk or collar slidably and rotatively mounted on the screw 18. The opposite ends of the spring 63 are secured, in any desired manner to the disk 64 and the adjacent nut 62′, the latter serving as a rigid connection for the outer end of the spring 63 with the screw 18. This connection may be made by providing on the opposing faces of the nut 62′ and disk 64 collars 64*a* to fit within the outer coils of the spring and then welding or bracing the spring ends to these collars. Due to the fact that the disk 64 is free to slide and rotate on the screw 18, as already set forth, it will be seen that if rotation of the disk with the screw 18 is retarded or it is held against rotative movement, the secured end of the spring 63 will be twisted relative to its free end and thus be put under tension in a torque direction, the effect of which, upon the release of the force acting to hold the shaft or screw, will be to react on and through the nut 62′ to rotate or tend to rotate the screw 18 in a reverse direction; accordingly, when the main switch is again closed to start the motor in the reverse direction, the torque tension stored in the spring 63 will assist the motor in starting its shaft.

Each of the stopping and starting means 61 may be adjusted along the screw 18 by loosening the nut 62 and running the nut 62′ along the threads 19 to the desired position and then tightening the nut 62 against it. Each stopping and starting means 61 is positioned so as to be engaged by the cross head 17 in approaching its limit of movement in one direction and is adjusted on the screw 18, relative to the operation of the switch mechanism 28 in opening the motor circuit, to be actuated by the cross head immediately following the opening of the circuit. The cross head 17, in moving along the guides 16, engages the disk 64 and slides it on the screw 18 and at the same time tends to retard its rotation due to the friction between the disk and cross head. As the friction between these parts is increased due to the compression of the spring, the retardation of the disk is rapidly increased so that it is put under relatively great tension, both longitudinally and torque-wise.

As a result of this operation, the means 61 serve to relatively quickly stop the (1) sliding movement of the cross head 17 and (2) rotation of the shaft or screw 18 and motor shaft without unduly swinging the doors 3, 3′, after the opening of the motor circuit, thus enabling me to readily adjust the tappets 32 or means 61 to bring the doors to a stop at the desired positions. Due to the friction between the disk 64 and the end wall of the cross head 17, the spring 63 will be held under tension when the parts stop until the motor circuit is closed to move the cross head in the opposite direction. When the motor circuit is again closed for this latter purpose, the torque tension of the spring is released and reacts in a rotative direction on the screw 18 and through it on the motor shaft; accordingly this spring tension is utilized to supplement the torque action of the motor so that its shaft and the screw will quickly start and attain full speed. The end walls of the cross head 17 are shaped to provide a flat surface for the disk 64 to engage with and preferably the latter is faced with suitable friction material 64*a*′ to increase the friction between them.

In my form of construction, I interpose the stopping and starting means between two parts which move relative to each other in different directions so that such relative movement may be utilized to quickly and effectively bring all of the moving parts to a stop. In this arrangement I am not only enabled to control the stopping of the doors at substantially predetermined positions, but the stopping and starting of the screw 18 and motor 12 are effected without strain on the supporting elements for the apparatus. By adjustment of the nuts 62, 62′, the disk 64 may be positioned along the screw 18 for engagement by the cross head 17 in cooperative timed relation with the engagement of the arm 34 with the adjacent tappet 32 to effect stopping of the doors 3, 3′, at the desired position; or the tappet may be adjusted on the rod 30; or both may be adjusted as circumstances require.

Under some circumstances, it may be desirable to swing the doors 3, 3′, to open and close position manually, that is, without

operation of the mechanism 5; for example, due to breakage or failure of current supply or otherwise. For this purpose I interpose between each rod 22 and the adjacent door the attachment or connection 27. Of this attachment, 26 indicates a lever or link (already referred to) pivotally connected at one end to the door and at its opposite end to the outer end of the rod 22. The pivot connection between the link and door may comprise a plate 67 secured to the door and having a pair of projecting lugs 68. The lugs are formed with aligned openings 68*a* and receive between them the knuckle 25*a* on the end of the link, so that a pin 69 may pivotally connect the link and lugs together. The knuckle 25 at the other end of the link is formed with an opening to receive the pin 24, whereby it is pivotally connected to the sleeve 23, as already set forth. 70 indicates devices for detachably connecting the link 26 to the door. These devices preferably comprise the following instrumentalities: 71 indicates a plate secured to the door by screws 72 and provided with a plurality of upstanding lugs, for example three lugs 73, 74, 75, formed with aligned openings to slidably receive a rod 76, the upper lugs 73, 74, being spaced to receive between them the link 26 and the other lug 75 serving as a guide for the rod 76. The link 26 is formed with an opening which registers with the openings in the lugs 73, 74, 75, so that the rod 76 may extend therethrough and secure the link 26 to the plate 71 and through it co-operate with the plate 67 and lugs 68 to hold the link 26 in rigid relation to the door and substantially parallel therewith. The rod 76 is yieldingly maintained in the position shown in Figs. 2, 3 and 9 by a compression spring 77 coiled around the rod and interposed between the lug 75 and a collar 78 preferably fixed to the rod by a cotter pin 79. To release the link 26, the rod 76 is pulled downwardly to the position shown in Fig. 4, thereby retrieving its upper or free end from the openings in the lug 73 and link 26. When in this position, the doors 3, 3′, may be swung open to the position shown in Fig. 5, the links 26 remaining substantially stationary during this operation.

By this arrangement, it will be seen that the doors 3, 3′, may be opened and closed without movement of the cross-head 17 or operation of the motor, and when so operated the operating rods 22 are supported by the links 26 in operative position, so that upon the closing of the doors, and connection of the links 26 to the plates 71, the operating mechanism 5 may be operated in the manner set forth.

Fig. 17 illustrates a diagram of the electric circuits, switch closing and opening mechanism and reversing switch for the motor wherein each of the main closing switches is of the single pole or contact type. In this view 12′ indicates the motor, which is similar to the motor 12, having its coils connected by leads 44′, 44*a*′, to terminals 41′, 41*a*′, 43′, 43*a*′, respectively. 80 indicates a supply lead connected to the lead 44′. 80*a* indicates the other supply lead connected to the terminal 36*a*′. 80*b* indicates a lead extending from the terminal 36*a*′ to contacts of main switches 81. From the other contacts of these switches a lead 82 extends to a terminal 39*a*′, which in turn is connected by a lead 83 to the terminal 41*a*′. The switch mechanism 28′ for the circuit shown in Fig. 17 is illustrated in Fig. 18 and is similar to the mechanism shown in Figs. 10 to 13, inclusive, except that the plates 45*a*′, 46*a*′ for the terminals 36*a*′, 39*a*′ only are required to form an electric connection across these terminals through the switch elements 45′, 46′ and operating member 48′ since one side of the supply circuit is connected to the motor and the motor circuit is opened and closed on the other side only of the circuit, as above set forth. The operation of the switch mechanism 28′ is similar to the operation of the mechanism 28, so that a description of such operation will not be necessary.

As herein set forth, the rods for operating the doors 3, 3′, have screw threaded connection at their opposite ends with sleeves 22*a*, 23. By making these connections with right and left hand threads, it will be seen that the effective length of the rods may be changed to insure complete closing of the doors when the cross head comes to rest at its extreme position, as shown in Fig. 1.

To those skilled in the art to which my invention relates, many changes in construction and widely differing embodiments and applications of my invention will suggest themselves without departing from the spirit and scope thereof. My disclosures and the discription herein are purely illustrative and are not intended to be in any sense limiting.

What I claim is:

1. In apparatus of the class described, the combination with a structure having an opening and a movable body for closing said opening, of a guide frame disposed in operative relationship to said structure and extending therefrom at substantially right angles, a cross head slidably mounted on said guide frame, a screw engaging said cross head for moving it, means for rotating said screw, an operating connection between said cross head and said body, and means connected to the screw for stopping said cross head when moving in one direction.

2. In apparatus of the class described, the combination with a structure having a

door, of a guide frame, a cross head mounted to reciprocate thereon, a rod between and operatively connected to said cross head and said door, means for moving said cross head in either direction, means for cutting off the power to said moving means as said cross head approaches a predetermined position in either direction of movement, and separate means connected to said screw and disposed in the path of movement of said cross head at one end of its movement along said guide frame for stopping said moving means.

3. In apparatus of the class described, the combination with a structure having an opening and a movable door for closing said opening, of a guide frame disposed in operative relationship to said structure, a cross head slidably mounted on said guide frame, a screw engaging said cross head for moving it, means for rotating said screw in either direction, connections between said cross head and said doors, a coiled spring surrounding said screw near one end thereof, and means for securing the outer end of said spring to said screw.

4. In apparatus of the class described, the combination with a structure having an opening and a movable body for closing said opening, of a guide frame associated with said structure, a member slidably mounted on said guide frame, a screw engaging said member for moving it, an operating connection between said member and said body, means for rotating said screw and means connected to and rotatable with said screw, and arranged to be engaged by said member for stopping the rotation of said screw.

5. In apparatus of the class described, the combination with a structure having an opening and a movable body for closing said opening, of a guide frame associated with said structure, a member slidably mounted on said guide frame, a screw engaging said member for moving it, an operating connection between said member and said body, means for rotating said screw, and means interposed between said rotatable and slidable elements and secured to one and arranged to frictionally engage the other, whereby their movement is stopped.

6. In apparatus of the class described, the combination with a structure having an opening and a movable body for closing said opening, of a guide frame associated with said structure, a member slidably mounted on said guide frame, a screw engaging said member for moving it, an operating connection between said member and said body, means for rotating said screw, and means interposed between said rotatable and slidable elements and secured to one thereof and constructed and arranged to stop their movement and to effect torque action on said rotatable element when said rotating means is set in operation.

7. In apparatus of the class described, the combination with a structure having an opening and a movable body for closing said opening, of a guide frame associated with said structure, a member slidably mounted on said frame, an operating connection between said member and said body, a screw operatively connected with said member for moving it, an electric motor for rotating said screw, means for opening the circuit to said motor at a predetermined position in the movement of said member in one direction, and means connected to said screw and arranged to be tensioned by the relative movements between it and said member, whereby rotative effort is imparted to said shaft when the circuit to said motor is closed to set it in operation to move said member in the opposite direction.

8. An apparatus as claimed in claim 7 in which the last mentioned means serves to stop the rotation of said screw.

9. An apparatus as claimed in claim 7 in which the means to be tensioned is adjustable along said screw.

10. In apparatus of the class described, the combination with a structure having an opening and a movable body for closing said opening, of a guide frame associated with said structure, a member slidably mounted on said frame, an operating connection between said member and said body, a screw operatively connected with said member for moving it, an electric motor for rotating said screw, means for opening the circuit to said motor at a predetermined position in the movement of said member in one direction, and a coiled spring surrounding said screw and connected thereto at one end, its opposite end being free and arranged to be engaged and held against rotation by said member, whereby said spring is compressed and one end is rotated relative to its other end.

11. An apparatus as claimed in claim 10 in which the connection between said spring and said screw is adjustable.

12. An apparatus as claimed in claim 10 in which friction means is provided on the free end of said spring.

13. In apparatus of the class described, the combination of a guide frame, a cross head movable along said guide frame and connected with a member to be operated, a feed screw operatively connected with said cross head, means for rotating said screw, means for cutting of the power to said rotating means, and yieldable means connected to and rotatable with said screw and arranged to be engaged by said cross head as it moves in one direction and operating by frictional engagement therewith to stop the rotation of said screw.

14. In apparatus as claimed in claim 13 in which the engaging element of said stopping means is slidable on said screw and a spring is put under tension by the movement of said cross head to increase the friction between said element and cross head.

15. In apparatus of the class described, the combination of a guide frame, a member movable along said frame and operatively connected to a body to be moved, a feed screw operatively connected to said member, means for rotating said screw, and stopping means for said member at one end of said frame, said stopping means comprising an abutment fixed to said shaft, a friction element slidable on said screw and a compression spring between said abutment and said friction element.

16. In apparatus of the class described, the combination of a guide frame, a member movable from end to end of said frame in either direction, a connection between said member and the body to be moved, a reversible motor having connection with said member to move it, a switch mechanism having relatively movable switch elements through which the circuit to said motor is established, means for normally holding said elements in contact, devices actuated by said member for separating said elements when said member approaches the end of its movement in either direction, means for reversing said motor, and a main switch and a circuit through which the motor circuit is established to start movement of said member in the opposite direction, whereby the switch elements contact to close the motor circuit across said main switch.

17. An apparatus as claimed in claim 16 in which the reversing means is actuated by the movement of said member following the separation of said switch elements.

18. In apparatus of the class described, the combination of a guide frame, a member movable in either direction from end to end of said guide frame, a connection between said member and the body to be moved, a motor, driving connections between said motor and said member, a slidable rod carrying tappets disposed in position to be engaged by said member as it approaches the end of its movement in either direction, a switch mechanism comprising a pair of switch elements and an operating device arranged to make contact with each element to establish a circuit to said motor, means normally tending to maintain said switch elements and operating device in contact, said operating device being operatively connected to said rod, whereby the engagement of said member with a tappet in moving in either direction will operate said rod and through it and said operating device effect a movement of one of said switch elements to open the motor circuit.

19. An apparatus as claimed in claim 18 in which a reversing switch is operatively connected with said rod and is operated thereby following the opening of the motor circuit to effect the reversal of the motor and a main switch is provided to close the motor circuit to move said member in the opposite direction.

20. In apparatus of the class described, the combination of a guide frame, a member slidable thereon from end to end in either direction, means for moving said member, a rod pivotally connected at one end to said member, and operating connections between the other end of said rod and the body to be moved whereby the body may be moved without disassembly of said rod, said connections comprising a link pivoted at its opposite ends to said rod and said body and means for removably holding said link against pivotal movement about the pivot at one of its ends.

21. In mechanism of the class described, the combination of an electric motor, a circuit for said motor and a switch interposed in said circuit, a reciprocatable member connected to and operated by said motor, a switch mechanism connected in said circuit and normally closed to shunt the circuit across said switch, a reversible switch connected in said circuit, and mechanism controlled by said member as it approaches the limit of its movement in either direction to actuate said switch mechanism to open the circuit and operate said reversible switch.

22. In apparatus of the class described, the combination with a structure having an opening and a hinged door for closing said opening, and operating means for swinging said door in opposite directions, said means including a member comprising pivoted sections, one connected to the movable member of said operating means and the other connected to said door and means for detachably connecting the latter section to the door to permit movement of the door on its hinges independently of the movement of said operating means while maintaining said member in operative relation.

23. In apparatus of the class described, the combination with a body to be operated, of a reciprocable member operatively connected to said body, an electric motor, operating connections between said motor and said member, an electric circuit, a main switch in said circuit for setting said motor in operation, a switch mechanism arranged to shunt said circuit after the motor is set in operation, a reversing switch in said circuit, a movable device operable by said reciprocatable member at the end of its movement in either direction to open the shunt switch mechanism and operate said reversing switch, and means for operating said device to close the shunt switch mechanism

when said motor is again set in operation.

24. An apparatus as claimed in claim 23 in which said operating means comprises a spring which normally tends to close the shunt switch mechanism.

25. An apparatus as claimed in claim 23 in which the shunt switch mechanism comprises a pair of movable contacts and an operating contact between them connected to said movable device.

26. An apparatus as claimed in claim 23 in which the shunt switch mechanism comprises a pair of movable contacts and an operating contact between them connected to said movable device, and said operating means comprises an expansion spring connected to said movable contacts.

27. Door operating mechanism comprising a shaft, a connecting rod operable by the shaft, a door, means pivotally connected with the connecting rod and the door for permitting lost motion in the connections whereby the door may be swung independently of the connecting rod, a keeper carried by the door for releasably locking the said means in operative connection with the door and means for actuating the shaft.

28. Door operating mechanism comprising a shaft; a slide; means whereby the shaft actuates the slide; a connecting rod, pivotally connected to the slide; a door to which the connecting rod is pivotally connected; means for permitting lost motion in the connections whereby the door may be swing independently of the connecting rod; a releasable locking device including a manually operable part whereby the connecting rod is normally held in operative connection with the door but may be released at will; and means for actuating the shaft, the releasable looking device being adapted to automatically re-establish an operative connection between the connecting rod and the door when either one of the last named parts is sufficiently moved relative to the other.

In testimony whereof, I have hereunto subscribed my name.

HOWARD I. MORRIS.