Aug. 30, 1932. H. I. MORRIS 1,874,576

OPERATING MECHANISM

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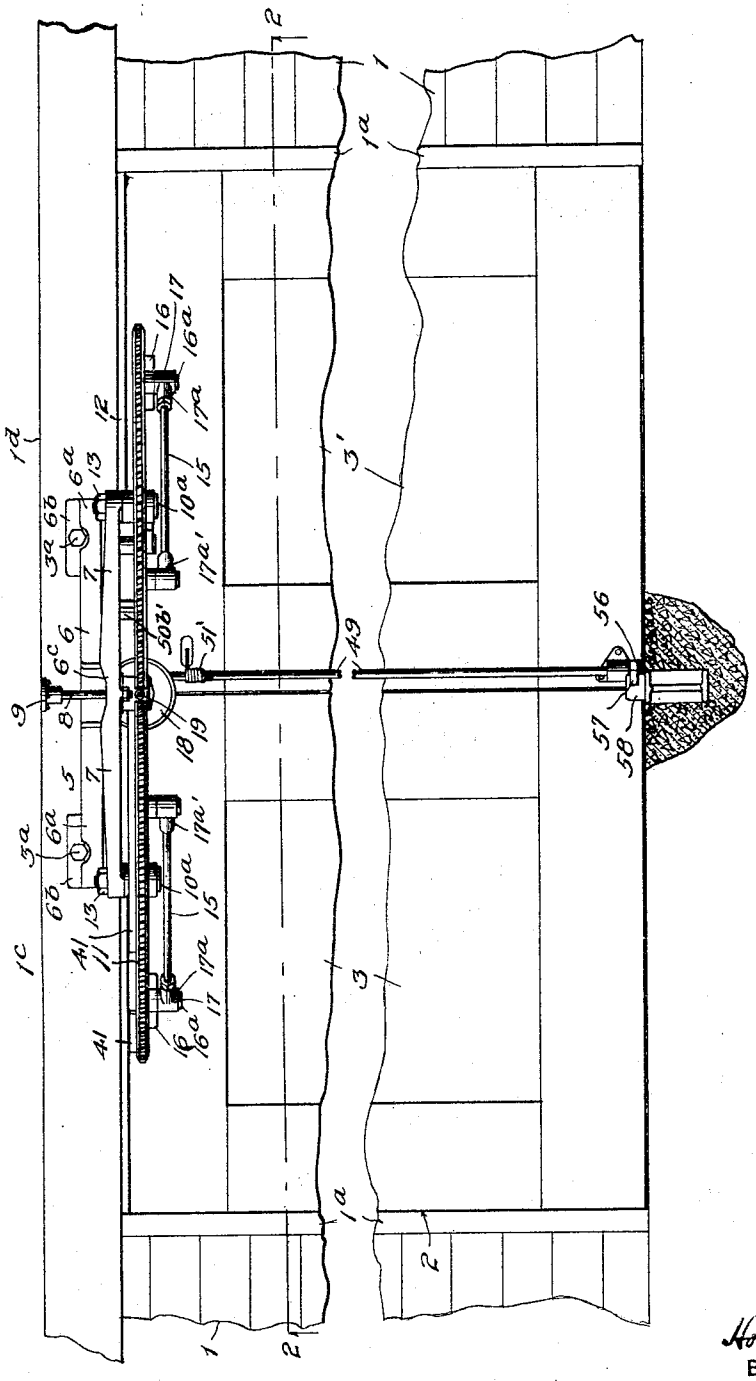


Fig. 1

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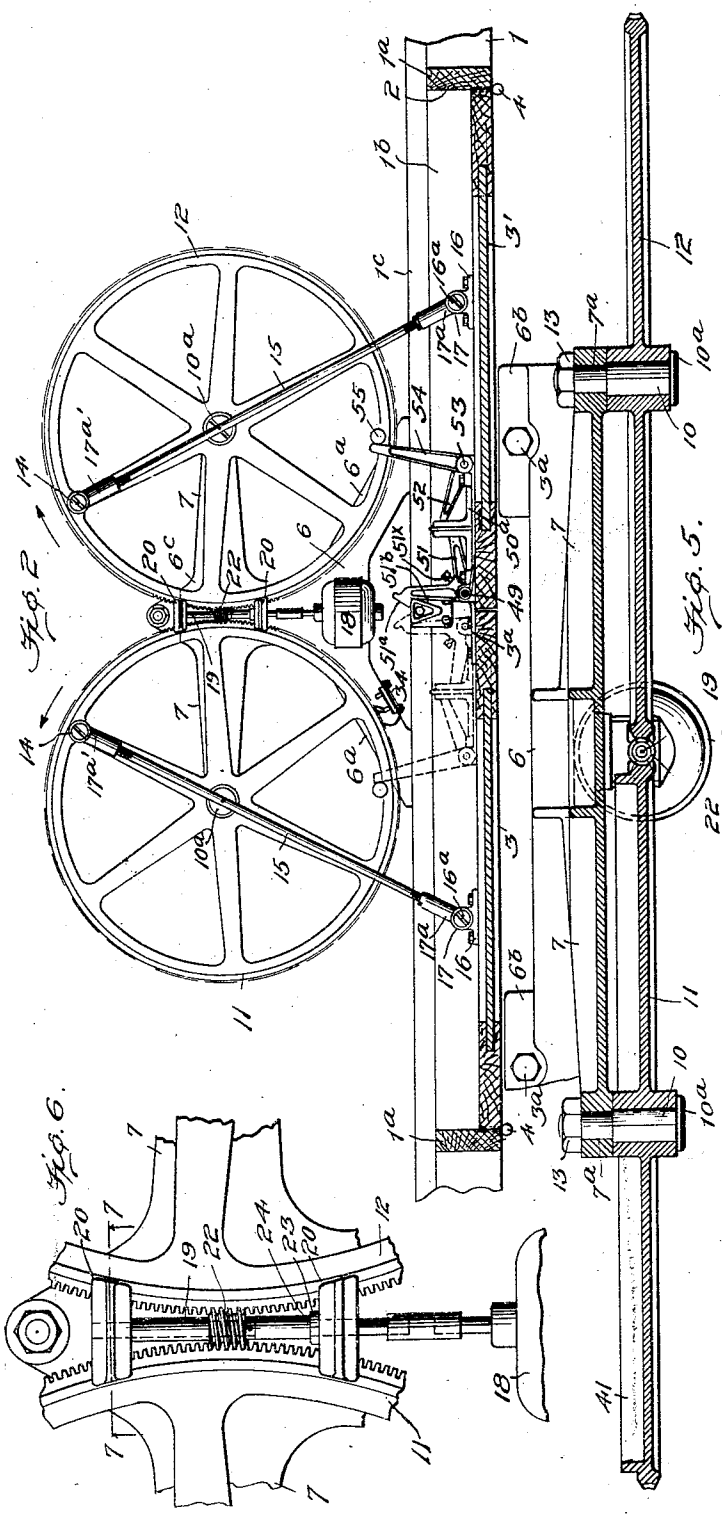


Fig. 5.

Fig. 6.

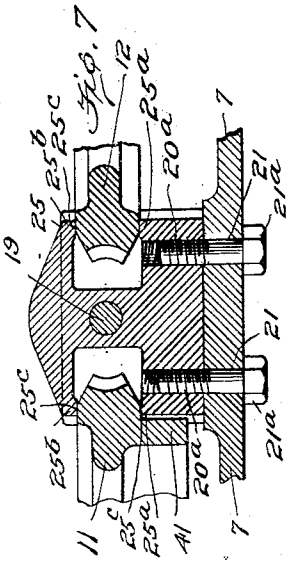


Fig. 7

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OPERATING MECHANISM

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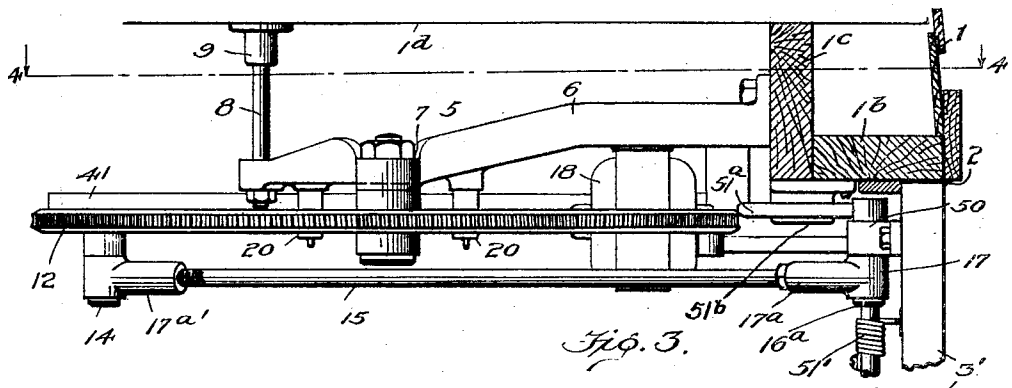
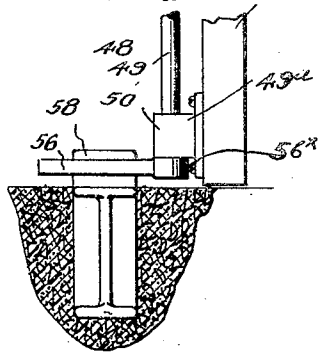


Fig. 3.



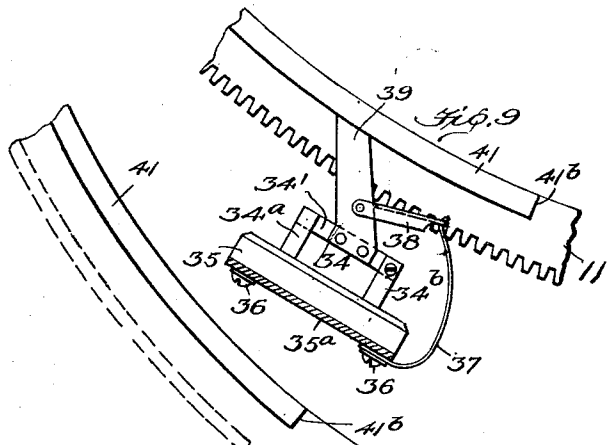


Fig. 9

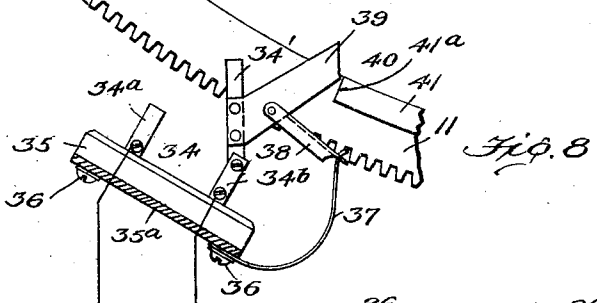
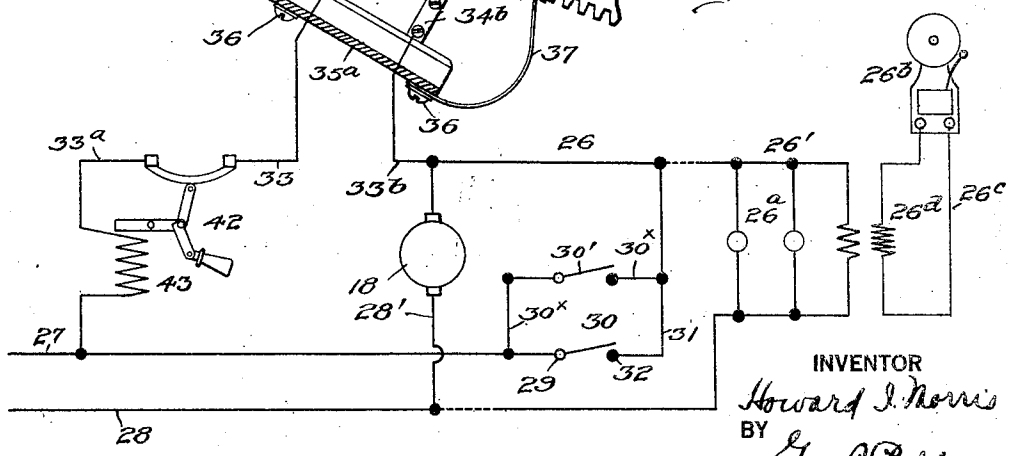


Fig. 8



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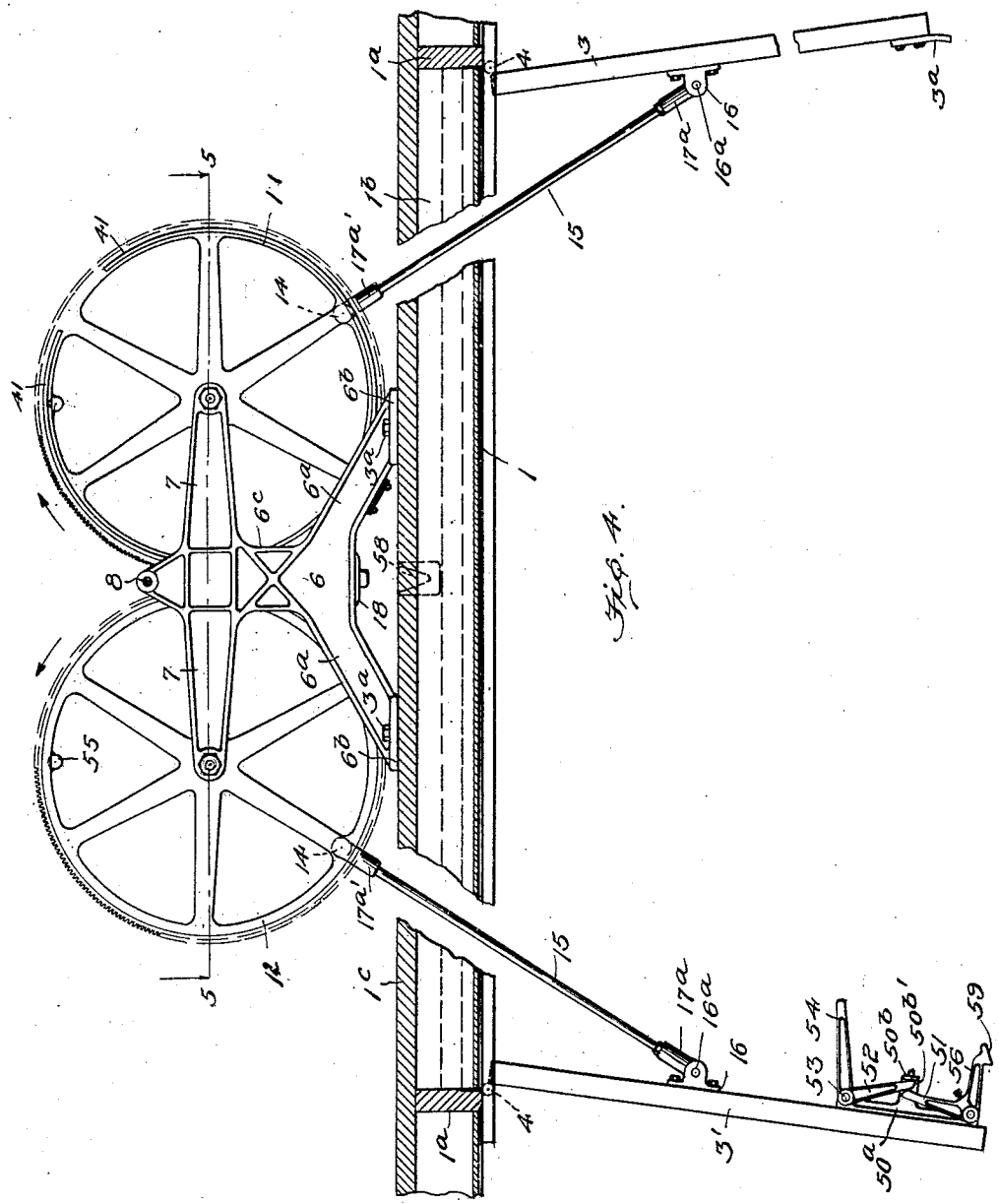


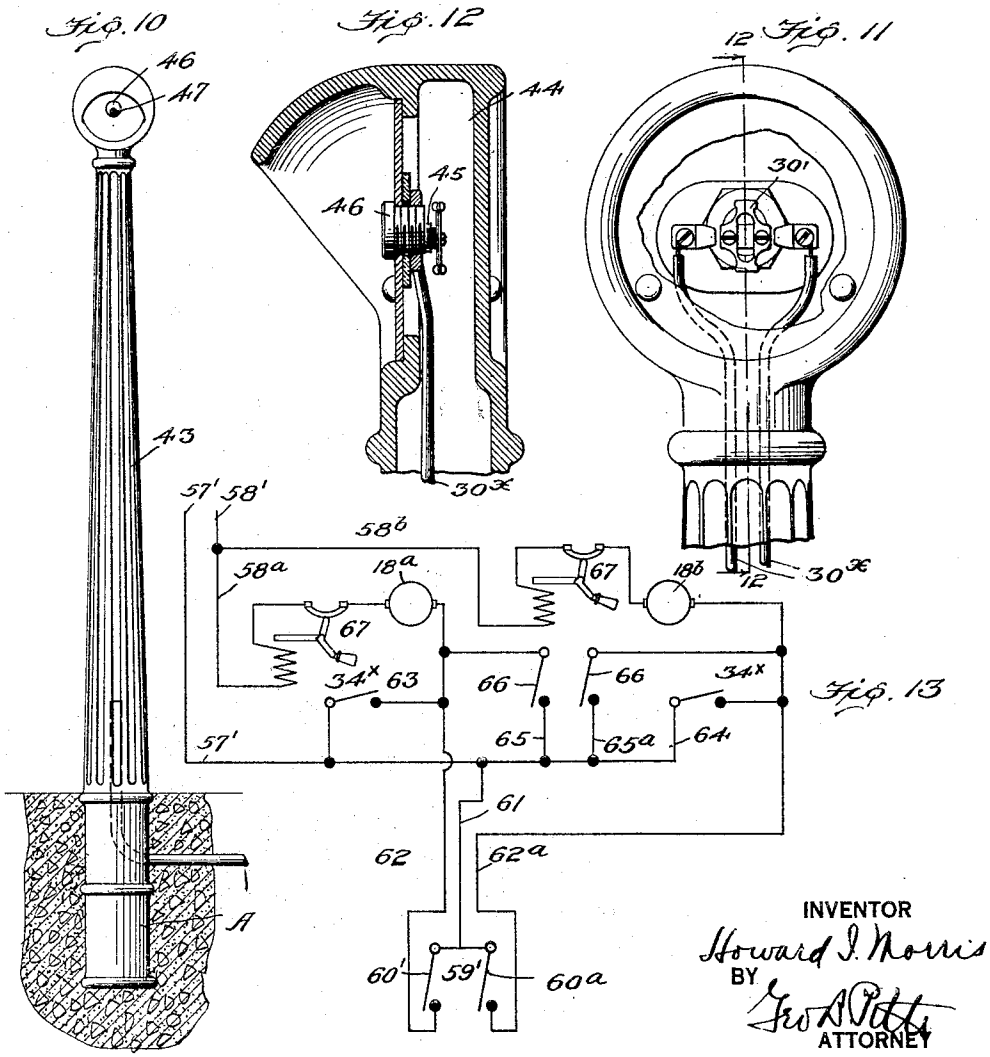
Fig. 4.

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OPERATING MECHANISM

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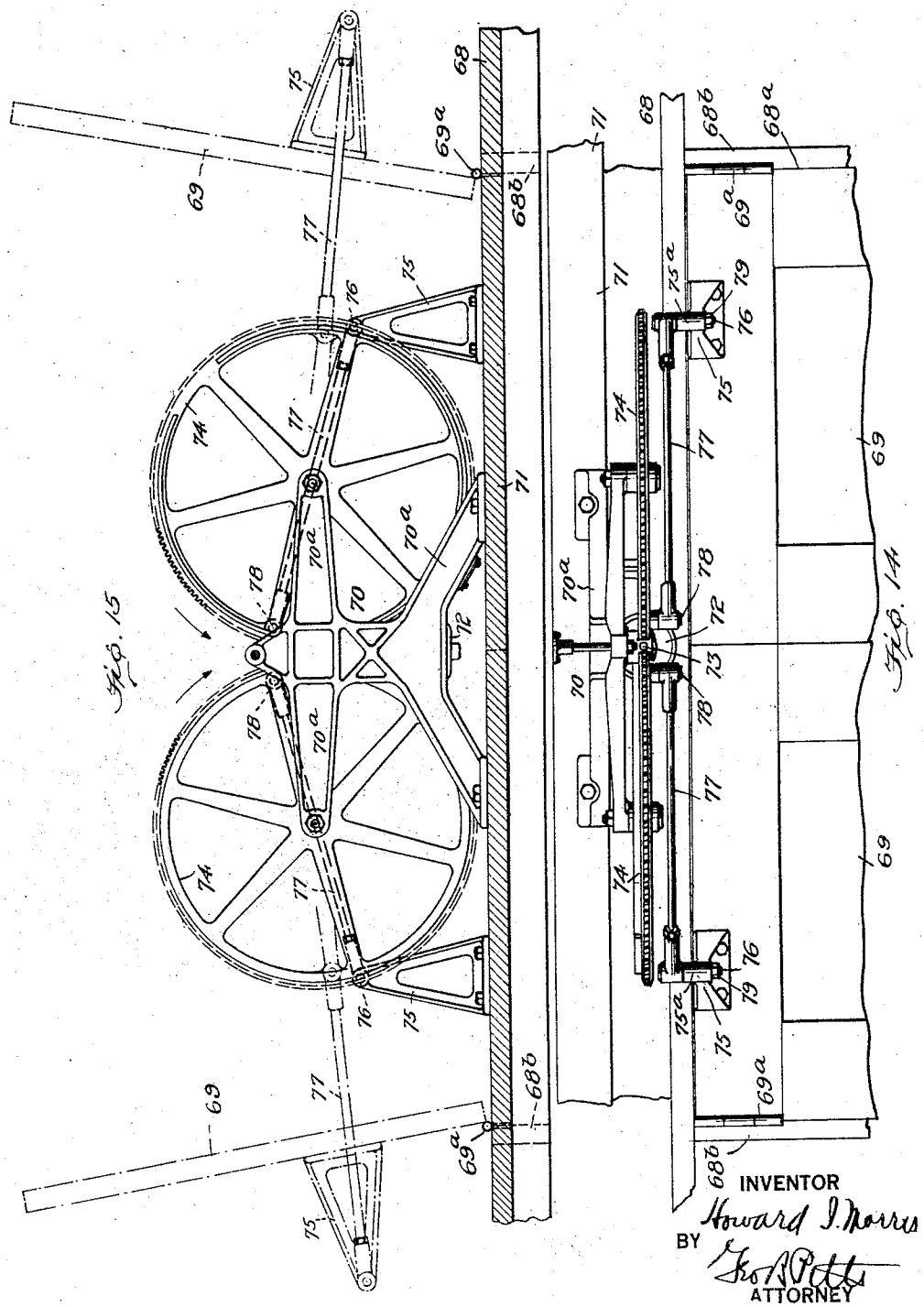


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OPERATING MECHANISM

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Aug. 30, 1932. H. I. MORRIS 1,874,576

OPERATING MECHANISM

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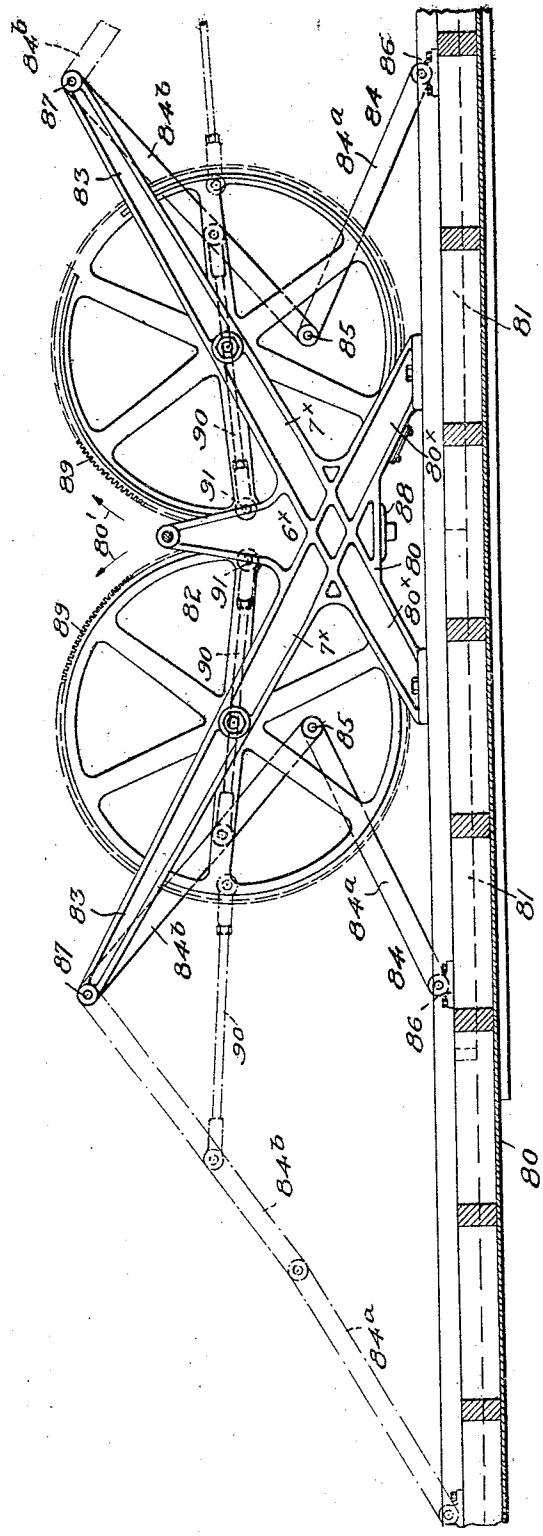


Fig. 16

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UNITED STATES PATENT OFFICE

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OPERATING MECHANISM

Application filed February 5, 1925. Serial No. 7,087.

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, as herein illustrated, I have applied it for use in opening and closing a pair of swinging doors.

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

Another object of the invention is to provide a mechanism for swinging 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 an improved opening and closing mechanism having an electric motor driven in one direction and adapted to be controlled from one or more remote control points.

A further object of the invention is to construct an improved door opening and closing mechanism having automatic means for stopping it when the door or doors reach either position.

Another object of the invention is to provide an improved door operating mechanism so constructed that it may be readily and economically installed.

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 an elevational view looking at a pair of swingable doors from the inside of the building or structure, and a mechanism for opening and closing the doors and latching them, embodying my invention.

Fig. 2 is a section on the line 2—2 of Fig. 1, looking in the direction of the arrows.

Fig. 3 is a side view, partly in section, looking toward the left of Fig. 1.

Fig. 4 is a section on the line 4—4 of Fig. 3, with portions of the structure broken away and the doors shown in open position.

Fig. 5 is a section on the line 5—5 of Fig. 4.

Fig. 6 is a fragmentary view of parts shown in Fig. 2, enlarged.

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

Fig. 8 is a view, partly diagrammatic and partly in plan, showing the circuits and switches for controlling the operation of the driving motor.

Fig. 9 is a fragmentary view of the supplemental switch in closed position.

Fig. 10 is an elevational view, with parts broken away, showing a support for one of the switches at a remote point or position.

Fig. 11 is a fragmentary view with parts broken away.

Fig. 12 is a section on the line 12—12 of Fig. 11.

Fig. 13 is a diagrammatic view showing the circuits and controlling switches for a plurality of motors, where the doors or pairs of doors for two separate openings are to be operated from a single source of supply.

Fig. 14 is a fragmentary view similar to Fig. 1, but showing a slightly modified form of construction in which the invention is adapted to doors that swing inwardly.

Fig. 15 is a top plan view of the parts shown in Fig. 14.

Fig. 16 is a fragmentary top plan view of a further modified form of construction embodying my invention wherein it is applied to and operates doors that slide horizontally.

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 build-

ing structure. The member or members may be supported to swing in either direction or to slide in suitable guides. For illustrative purposes, 1 indicates a building structure such as a garage 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 and is correlated with the walls 1*a* 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 above the doors 3, 3′. As shown in Fig. 4, the support 6 preferably comprises a pair of converging arms 6*a* having feet 6*b* each preferably secured by bolts 3*a* to a horizontal member 1*c* disposed above the doors 3, 3′, a body member 6*c* extending outwardly at substantially right angles to the horizontal 1*c* and brackets 7 extending laterally relative to the body member 6*c* in opposite directions, preferably in a plane parallel to the horizontal 1*c*.

8 indicates a supplemental supporting device secured to the ceiling 1*d* of the building structure 1 by a flange 9 and depending therefrom, its lower end fitting and secured in an opening formed in the free end of the body member 6*c*.

At their outer ends, the arms 7 are formed with openings 7*a* to receive the shanks of stud shafts 10 which depend downwardly and rotatively support gears 11, 12, the teeth of which are preferably of the worm type. The lower ends of the stud shafts 10 are provided with heads 10*a*, which engage the hubs on the gears 11, 12, and hold them in rotative engagement with the underside of the arms 7 (see Fig. 5). The upper ends of the stud shafts 10 are provided with screw threads to receive nuts 13, which clamp the shoulders of the stud shafts against the walls of the opening 7*a* and thus rigidly secure the stud shafts in position.

14 indicates pins depending downwardly from the gears 11, 12, and forming crank pins or a pivot connection for the inner ends of rods 15. The rods 15 are pivotally connected at their opposite ends to the doors 3, 3′, and thus operate as thrust and pull rods to swing the doors open when the gears 11, 12, are rotated approximately a half revolution (compare Fig. 2 with Fig. 4) and to close the doors when the gears are rotated approximately a half revolution. The pivot connections between the rods 15 and the doors 3, 3′, may be of any desired form, but in the illustrated form of construction I provide a dolly-box or bearing support 16 on each door and mount in the opening therein a depending stud shaft 16*a* on which is rotatably mounted the hub 17 of a T-member 17*a* having an axially threaded opening to receive the outer threaded end of the rod 15. The pivot connection for the inner end of each rod 15 is preferably made in a similar manner, that is, by a T-member 17*a*′ rotatively mounted on the adjacent pin 14. This arrangement permits the rods to have screw threaded connection at their opposite ends with the pivot elements, so that by the provision of right and left hand threads, the rods 15 may be rotated to lengthen or shorten the thrust and pull members, as it may be found necessary to close the doors completely when the gears 11, 12, are rotated for this purpose and to open them to the full open position when the gears are rotated a half revolution.

18 indicates a motor, which may be of the electric type, supported by the support 6, preferably from the under side thereof and adjacent to the intersections of the converging members 6*a*, with its armature shaft extending in a direction at right angles to a plane cutting the axes of the gears 11, 12. The armature shaft is connected in any desired manner to a shaft 19 supported at its opposite ends in bearings formed in standards 20, which are secured to and depend from the body member 6*c* of the support 6. As shown in Fig. 7, the base portion of each standard 20 is formed with screw threaded openings 20*a* which register with openings 21 formed in the body member 6*c*. The openings 20*a*, 21, receive cap screws 21*a* to rigidly secure the standards in position. As will be understood from Figs. 2 and 6, the standards 20 are disposed between the gears 11, 12, at opposite sides of a plane passing through their axes to support the shaft 19 between the gears, and in the plane thereof, so that by the provision of a worm 22 on the shaft 19 and in the plane just referred to, the worm 22 will mesh simultaneously with both gears 11, 12, and thus drive them in opposite directions relative to each other. The worm 22 may be secured to the shaft 19 in any desired manner.

23 indicates a thrust bearing interposed between a shoulder 24 provided on the shaft 19 and the innermost standard 20 and constructed so as to take end thrust resulting from the driving of the gears 11, 12.

As above described, each gear is connected directly to the adjacent door; accordingly

each gear is of such size that the travel of the crank pin the distance of one half revolution of the gear will swing the door from its closed position to a position preferably greater than a right angle relationship to the door opening, as shown in Fig. 4. In the preferred arrangement, the rod 15 for each door is connected to the remote side of the adjacent gear; that is, when the doors are closed, the rods extend diametrically of the gears, respectively, to their remote sides; and when the gears are rotated a half revolution the doors are opened to the desired extent, namely, to a point beyond a plane extending at right angles to the opening 2. Accordingly, if the gears are rotated a half revolution again, the doors 3, 3′, will be completely closed. This construction and operation has many advantages, of which the following may be mentioned: it permits the provision of a motor which is always driven in the same direction and therefore simplifies the circuits and switch mechanism; the bearings for the worm shaft may be of a simple form—one thrust bearing only being required; and the rods and their pivot connections are positioned in line with the axes of the gears and thus lock the doors open or shut so that they cannot be operated by subjecting them to pressure.

25 indicates guides preferably carried by each of the standards 20 disposed upon opposite sides of and bearing against the rims of the gears 11, 12, as shown in Figs. 6 and 7, to prevent distortion or side thrust of the gears incident to the driving thereof by the worm 22, thus insuring their accurate meshing with the latter and minimum wearing of the teeth of the worm and gears. The guides 25 are preferably provided by extending the walls of each standard 20 laterally as indicated at 25*a*, 25*b*, and providing each wall with a bearing face 25*c* to engage the gear rims.

26 indicates as an entirety a circuit for the motor 18 and a switch mechanism preferably so arranged that the current for the motor is automatically opened at predetermined positions to stop the mechanism when the doors 3, 3′, reach their closed position or open position. 27, 28, indicate the incoming wires from mains (not shown) or other suitable source of supply, the wire 28 being connected to one side of the motor 18 by a lead 28′ and the wire 27 being connected to one contact 29 of a main switch 30. I have shown two main switches 30, 30′, in the circuit 26 for a purpose to be later set forth. 31 indicates a lead extending from the other contact 32 of the switch 30 to the other side of the motor 18, through which lead the circuit to the motor is completed when the switch 30 is closed. The circuit and switch mechanism 26 are preferably so constructed that the motor 18, when its circuit is closed, will continue operating until the doors are moved from one position to their other position without the necessity of holding the main switch closed. Accordingly, I prefer to make the main switch of the push button type capable of closing the circuit and then substantially immediately opening it, and I provide in or associate with the circuit and switch mechanism 26, an auxiliary circuit 33 and an auxiliary switch 34. The auxiliary circuit 33 comprises leads 33*a*, 33*b*, the former being connected to the wire 27 and one terminal 34*a* of the auxiliary switch 34 and the latter being connected to the other terminal 34*b* of the auxiliary switch 34 and the lead 31, so that upon the closing of the latter switch which is effected by the operation of the motor or movement of some element (such as a gear 11 or 12) driven thereby, incident to the closing of the circuit by the switch 30, the current for the motor 18 will flow through the lead 27, lead 33*a*, switch 34 and lead 33*b* to one side of the motor and return through the leads 28′ and 28. By providing for the breaking of the circuit through the switch 30 and the establishing of a circuit for the motor through an auxiliary circuit, no one is required to manually maintain the main switch closed and the operation of the door operating mechanism (once it is set in motion) and the stopping thereof becomes automatic. This arrangement and construction also simplifies the control and stopping of the mechanism at the predetermined position when moving in either direction.

The auxiliary switch 34 preferably comprises a base 35 of insulating material fixed to a plate 35*a* by screws 36. 33*a*, 33*b*, indicates leads connected in a well known manner to the switch contacts 34*a*, 34*b*, and the latter being connected by a knife blade 34′, to complete the auxiliary circuit. 37 indicates a spring (preferably comprising a flat strip of resilient metal) connected at one end of the plate 35*a* and at its opposite end connected to the knife blade 34′ by a link 38 and normally tending to hold the switch blade 34′ in open position, as shown in Figs. 2 and 8. The free or outer end of the spring 37 preferably extends through an opening formed in the outer end of the link 38 and the inner end of the latter is pivotally connected to the switch blade or an arm 39 (to which reference will later be made) carried thereby.

40 indicates as an entirety the devices for controlling the closing and opening of the switch. The devices 40 comprises the arm 39 already referred to and a cam 41 carried by the adjacent gear 11. The cam 41 may comprise a wall carried by the gear rim and disposed in the plane of movement of the arm 39. The wall 41 preferably extends upwardly from the gear rim and is formed integrally therewith (see Fig. 7). As already set forth, the spring 37 tends to throw the switch blade 34′ to open position, whereas the function of the rim or cam 41 is to close the switch and

maintain it closed for a predetermined period or through a predetermined angular movement of the gear, which movement will correspond to the travel or swing of the door from closed position to full open position or vice versa. Accordingly, by making the wall 41 equal in length to the predetermined angular movement required, the arm 39 will first be operated by the end 41*a* of the wall 41 engaging therewith as the gear is driven (see arrow in Fig. 8) and will then ride the wall 41 (see Fig. 9) until the opposite end 41*b* of the wall passes the arm 39, due to the rotation of the gear, at which time the spring 37 (which has been put under tension by the closing movement of the switch blade) will throw the arm 39 outwardly to its normal position and thus open the auxiliary switch 34, the effect of which is to break the auxiliary circuit and automatically stop the motor 18. Since the motor 18 drives the gears 11, 12, in one direction to open the doors and close them and each operation is effected by a half revolution of the gears, I provide the gear with two walls 41. The walls 41 are arranged so that one terminates and the other begins at points opposite the auxiliary switch 34 so as to effect the automatic stopping of the motor 18 when the doors reach either position and immediate closing of the auxiliary switch 34 following the starting of the motor by the operation of a push-button switch, such as shown at 30.

The operation of the doors 3, 3′, is as follows: Figs. 1 and 2 show the doors closed and the auxiliary switch open, which corresponds to the position of the parts shown in Fig. 8. If now the switch 30 is operated, the motor circuit is closed and motor 18 set in operation to rotate the gears 11, 12, and through them swing the doors to the position shown in Fig. 4. As the gear 11 rotates, the end 41*a* of the wall 41 will engage the arm 39 and close the auxiliary switch 34, so that in the event the circuit is opened through the main switch 30 (as is intended it should be for reason already stated), the circuit for the motor is completed through the auxiliary circuit 33, and this circuit remains closed by reason of the arm 39 riding the wall 41 until the latter terminates (see end 41*b* of wall 41—Fig. 9) and allows arm 39 (under the influence of the spring 37) to swing outwardly, which will break the motor circuit and stop the motor, the end 41*b* of wall 41 being arranged so that the breaking of the circuit will take place as the doors approach or approximately reach their open position (Fig. 4).

To close the doors, the switch 30 is operated in the manner already set forth, which operation sets the motor 18 in operation and thus drives the gears 11, 12, the operation of the former gear serving to again close the auxiliary switch 34 and hold it closed until the doors approach or approximately reach their closed position (see Figs. 1 and 2), at which time the auxiliary switch plate 34′ is released and the auxiliary circuit 33 opened, thereby stopping the motor with the doors in closed position.

42 indicates a circuit breaker disposed in the auxiliary circuit 33 and operated by an electromagnet 43 due to an overload in the auxiliary circuit 33. As the circuit breaker 42 may be of any usual or preferred form of construction it will not be necessary to describe the same.

The main switch 30 may be located at any convenient point for operation either within or outside the structure 1, and one or more main switches may be provided, for example, one such additional switch being indicated at 30′. The main switches may be located at convenient points of operation. Where the door operating mechanism is applied to a garage, it will be advantageous to provide a main switch within the garage and another main switch either within the adjoining house or in the driveway and associated with a lock and key mechanism. In the latter arrangement, the switch and lock and key mechanism is mounted within reach of the driver as the car is driven in or driven out, this latter arrangement being shown in Figs. 10, 11, 12 wherein a column 43 is shown supported in the ground A adjacent to driveway and constructed to form at its upper end a casing or chamber 44 into which leads 30*x*, 30*x*, extend for connection with the terminals of the switch 30′. The movable member of the switch 30′ is connected to the tumbler 45 of a lock mechanism 46 which is provided with a suitable key slot for the reception of a key, whereby the switch may be operated to close the circuit 26. The connection between the movable element of the switch and the lock is such that the switch would be operated and released in a manner similar to a push button type of switch.

48 indicates a mechanism associated with the operating mechanism 5 and controlled thereby to mechanically lock the doors when in their closed position, such mechanism preferably being supplemental to the locking thereof by the gears 11, 12 and connecting rods 15 and being preferably arranged to lock the lower ends of the doors so that the doors will be locked at both their upper and lower ends, thereby preventing the springing of the doors by pressure on their lower ends and otherwise distorting their shape and hinge connection with the jambs 1*a*. The mechanism 48 comprises a rocker or shaft 49 mounted in bearings 50 disposed adjacent to the upper and lower ends of one of the doors, for example, the door 3′. At its upper end, the shaft 49 carries an arm 51 which extends laterally so that its free end may be engaged by an arm 52 fixed to a shaft 53 suitably mounted on the door 3′. 54 indicates a lever

fixed to the shaft 53 and extending laterally into the path of movement of a lug 55 depending from the adjacent gear 12 so as to be operated thereby to swing the arm 51 and through it rock the shaft 49. At its lower end the shaft 49 carries a locking member 56 having an offset end or hook 57 engaging a stationary abutment 58 fixed in the floor of the structure to lock or hold the doors in closed position, as shown in Figs. 1, 2 and 3. I prefer to connect a spring 51′ to one of the elements of the supplemental locking mechanism so as to maintain the locking arm 56 in the position shown in Figs. 1, 2 and 3 and to provide its outer end with an inclined wall 59 and the stationary abutment 58 with an inclined wall 60 so that when the door closes the inclined walls will ride each other, but will thereafter, under the influence of the spring 51′, swing or move back into normal position and thus effect the automatic engagement between the hooked or off-set end 57 and the stationary abutment 58. It will be noted from Fig. 2, that when the doors 3, 3′, are in closed position the lug 55 is in position to engage with the arm 54. Accordingly when the motor is operated to drive the gears 11, 12, to open the doors, the lug 55 will engage and operate the arm 54 and the latter in turn will swing the arm 52. As a result of this movement, the arm 52 will engage the arm 51 and through it rock the shaft 49 and effect the release of the member 57 from the stationary abutment 58, thus immediately releasing the door for movement to its open position. As the door swings open, the lug 55 will free the lever 54 and thus allow the member to assume its normal position ready to engage the abutment 58 when the doors are again closed.

The arm 51 may have connected to it a locking member 51*a* adapted to engage an abutment 51*b* secured to the cross member 1*b* and horizontal 1*c* (see Fig. 3). In this latter arrangement and construction it will be seen that the supplemental devices 48 lock the doors 3, 3′, at both their upper and lower ends. To maintain the rock shaft 49 against endwise movement upwardly or downwardly, I connect the hubs of the arm 51 and locking member 56 to the shaft above and below the bearings 50, preferably by set screws 51^x, 56^x, respectively. The bearing 50 for the lower end of the shaft 49 may comprise a plate having a lug 49*a* formed with an opening through which the shaft 49 extends; but to maintain the arm 51 and arm 52 in co-operative relation, I prefer to provide the bearing 50 for the upper end of the shaft 49 and bearing for the fulcrum for the arm 52 upon a base 50*a*, whereby both bearings may be secured to the door as a unit (see Figs. 2 and 4). 50*b* indicates a stop for limiting the outward movement of the arms 51, 52. The stop 50*b* preferably comprises an arm extending upwardly from a bracket 50*b*′ which may be formed integrally with the base 50*a*.

I prefer to mount the supplemental locking devices 48 upon one door and to provide the other door with an overlapping plate or strip 3*a*, so that when the door carrying these devices is closed and locked it will act through the plate 3*a* to lock the other door; but if desired, supplemental locking devices 48 may be mounted upon each door, as will be clearly understood from the dotted lines in Fig. 2.

Where it is desired to provide one or more signals to give warning of the swinging of the doors, I may provide a supplemental circuit 26′ having one or more lamps 26*a* preferably connected in parallel with the motor 18. If an audible signal is desired, I may provide an electric bell 26*b* connected by leads 26*c* to the secondary winding of a transformer 26*d* interposed in the circuit 26′. The modification just referred to is illustrated in connection with the diagram shown in Fig. 8.

In Fig. 13 I have illustrated diagrammatically circuits and switch mechanisms for controlling independently the swinging of two doors or two pairs of doors for two openings in a building structure, such as a garage, where the current for both operating motors is supplied from two incoming mains indicated at 57′, 58′. In these views, 18*a*, 18*b*, indicate the motors each operatively connected with an operating mechanism 5 for operating the door or doors for one of the openings.

58*a* indicates a lead extending from the main 58′ to one side of the motor 18*a* and 58*b* indicates a lead extending from the main 58′ to one side of the motor 18*b*.

59′ indicates a switch mechanism comprising a pair of main switches 60′, 60*a*, for closing the main circuits to the motors 18*a*, 18*b*, respectively. These last referred to circuits comprise a lead 61 common to the corresponding terminals of the switches 60′, 60*a*, and leads 62, 62*a*, leading from the other terminals for the switches 60′, 60*a*, to the opposite sides of the motor 18*a*, 18*b*, respectively.

From the foregoing description it will be seen that either or both switches 60′, 60*a*, may be operated to close the adjacent circuit or circuits and the motors 18*a*, 18*b*, will be set in operation in accordance with such operation. The auxiliary circuit for the motor 18*a* comprises a lead 63 connected to the main 57′ and lead 62 and controlled by auxiliary switch 34^x which is operated by the operating mechanism 5. The auxiliary circuit for the motor 18*b* comprises a lead 64 connected to the main 57′ and lead 62*a* and controlled by an auxiliary switch $34^{x'}$, which is operated and controlled in the same manner as the switch 34.

Where separate main switches are desired to operate the motors 18*a*, 18*b*, I may provide leads 65, 65*a*, from the main 57′ and connect

them to the leads 62, 62*a*, and interpose in each a switch 66 of the type already referred to, so that the motors 18*a*, 18*b*, may be set in operation from any one or more desired locations, such as described in connection with Figs. 8, 10, 11 and 12. Each of the leads 58*a*, 58*b*, may have interposed in it a circuit breaker 67 of any desired construction.

Referring to Figs. 14 and 15, I have shown my invention as applied to doors that swing inwardly, that is, within the building structure, instead of outwardly. In these views 68 indicates the walls of the building structure, such as a garage constructed to form an opening 68*a* closed by doors 69, hinged at 69*a* along the inner edges of the jambs 68*b*, so that the doors swing to positions within the building structure 68, as shown in dotted lines in Fig. 15. 70 indicates the operating mechanism which is similar in construction to the mechanism 5 already shown and described in connection with Figs. 1 to 13, inclusive, the support 70*a* being secured to a cross member 71 extending above the doors 69, as shown. The support 70*a* mounts a motor 72 which drives a shaft 73 having a worm meshing with the worm gears 74 and drives the latter in opposite directions, preferably in the directions of the arrows shown in Fig. 15. 75 indicates brackets or arms extending in a lateral direction inwardly from the doors and provided at their free ends with hollow bosses 75*a* which form bearings for shafts 76. The shafts 76 form pivot connections for connecting rods 77, each extending from the adjacent shaft to a crank pin 78 depending from the adjacent gear. The connecting rods 77 are constructed and are pivotally connected at their opposite ends to the shafts 76 and pins 78 similar to the corresponding connections for the rods 15 shown in Fig. 1, except that the shafts 76 are inverted and extend through the T-member at the outer ends of the rods and the bosses, being held in operating position by nuts 79. As shown in Fig. 15, the brackets 75 form crank arms so that when the gears 74 are rotated to move the connecting rods 77 outwardly, a lever action on the doors, in which the hinges 69*a* for the doors constitute the fulcrums is effected and accordingly the thrust on the rods due to the rotation of the gears 74 will swing the doors from the position shown in Figs. 14 and 15 to the position shown in dotted lines in the latter figure. The operation of the mechanism 70 shown in Figs. 14 and 15 is similar to the operation of the mechanism shown in Fig. 1, in that the gears 74 rotate in the same direction, respectively, to open the doors and to close them and each movement is carried out by a half-revolution of the gears; furthermore the construction is preferably arranged so that the pivots between each connecting rod and the adjacent door and adjacent gear wheel will be in a plane substantially cutting the axis of the adjacent gear wheel when the door is closed and when it is opened, so that the mechanism itself will serve as a lock to hold the doors in either position and prevent them from being moved by some one pressing against them. It will also be understood that the mechanism may be associated with suitable electric circuits preferably similar to those disclosed in Fig. 8 so that the doors may be suitably actuated and automatically controlled. Furthermore the doors may be provided with supplemental locking means shown in Figs. 1, 2, 3 and 4, as desired. It is not thought necessary to further illustrate these details of construction.

Referring to Fig. 16, 80 indicates the building structure having an opening which is closed by a pair of doors 81 mounted in the wall of the structure so as to slide away from and toward each other. 82 indicates a mechanism for opening and closing the doors 81, this mechanism being similar to that shown in Figs. 1 to 15, inclusive, except that the supporting arms or brackets 7*x* extend from the body member to provide extensions 83 which support the outer ends of linkage 84. In this form of construction, the body portion 6*x* and arms 7*x* are slightly modified to dispose the latter and the extensions 83 at angles to each other, being preferably disposed in line with the arms 80*x*. Each linkage 84 may comprise a pair of links 84*a*, 84*b*, pivotally connected together at their inner ends by pivot pins 85. The outer end of the link 84*a* is pivotally connected to a dolly-box or bearing support 86 secured to the adjacent sliding door 81, whereas the outer end of the link 84*b* is pivotally connected to a shaft or pin 87 depending from the outer end of the adjacent extension 83. The support or body portion 6*x* mounts on its under side an electric motor 88, which drives relatively large worm gears 89 in the manner similar to that already described in connection with the construction shown in Fig. 1, preferably in the direction of the arrows 80′. 90 indicates connecting rods, each connected to a crank pin 91 depending from the adjacent worm wheel 89 and pivotally connected at its outer end to the adjacent linkage 84, preferably to the link 84*b* thereof. The connection between each connecting rod and the adjacent link 84*b* may be such as to insure the maximum sliding movement of the doors 81. Such connection may be adjustable, either by changing the length of the connecting rod, as already described in connection with the Fig. 1 form of construction, or by adjusting the connection along the link 84*b* so as to secure the operation of the door the desired distance to open it to the desired extent; or, if desired, the relative lengths of the links may be changed. The construction is preferably so arranged that the pivots between each connecting rod 90 and the adjacent worm wheel and the ad-

jacent linkage will be in a plane substantially cutting the axis of the adjacent worm wheel when the adjacent door is closed and when it is opened, for the purpose of preventing sliding of the door or doors by pressure thereon.

If desired, there may be provided a relay so arranged that it may be automatically operated by the driver of the vehicle to be stored in the garage by the operation of suitable means, such as a magnetic wave, sound wave or light wave; or a main switch may be arranged in the path of the vehicle and actuated by contact therewith or by its weight as the vehicle is driven toward the garage door opening.

From the foregoing description, it will be noted that the motor is driven in one direction to both open the doors and close them, that a worm and worm gear is used between the motor and the element which is connected to the door, so that suitable speed reduction is attained, and that relatively large wheels are used as cranks to effect movement of the doors. As a result of this construction, it will be seen that the mechanism is relatively simple and the power means may be readily started and stopped; furthermore, I am enabled to effect the complete operation of the doors in either direction by the operation of a switch, such as a push button or other form in which the contacts are normally held open.

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 description 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 of a pair of movable doors movable from a closed position to an open position and back to closed position, a pair of operating gears each disposed in juxtaposition to one of said doors, a linkage between each gear and the adjacent door, a gear common to and meshing with said first mentioned gears and arranged to rotate in one direction, a motor for driving said last mentioned gear, and means for controlling the starting and stopping of said motor.

2. An apparatus as claimed in claim 1 in which one of said operating gears is provided with devices for effecting stopping of the motor at a plurality of positions of said gears in each complete revolution thereof.

3. In apparatus of the class described, the combination of a pair of movable doors movable from a closed position to an open position and back to closed position, a pair of operating gears each disposed in juxtaposition to one of said doors, a linkage between each gear and the adjacent door, a gear common to and meshing with said first mentioned gears and arranged to rotate in one direction, a motor for driving said last mentioned gear, and means for starting and stopping said motor, the elements of said means which stop said motor being disposed to effect stoppage when the doors are full open and closed.

4. In an apparatus of the class described, the combination of a pair of doors hinged along their outer edges, a pair of operating gears disposed adjacent the inner edges of said doors, but at opposite sides of a plane cutting said inner edges, a driving gear common to and meshing with said operating gears, a motor for driving said driving gear, and a pitman between and pivotally connected at its opposite ends to each of said operating gears and the adjacent door.

5. An apparatus as claimed in claim 6 in which the motor drives said driving gear in one direction to open and close the doors and one of said gears controls the stopping of the motor when the doors are in open position and when the doors are in closed position.

6. In an apparatus of the class described, the combination of a pair of doors hinged along their outer edges, a pair of operating gears disposed adjacent the inner edges of said doors, but at opposite sides of a plane cutting said inner edges, a driving gear common to and meshing with said operating gears and arranged to rotate in one direction, a pitman between and pivotally connected at its opposite ends of each of said operating gears and the adjacent door, a motor for driving said driving gear in one direction, and means for starting and stopping said motor, the starting being effected manually and stopping being effected automatically.

7. In apparatus of the class described, the combination with a movable member, of power means, driven means including a pair of meshing elements, a connecting rod pivotally and operatively connected to said member at one end and at its opposite end to one of said elements, means for stopping said member at a plurality of positions, means for locking said member in one position of rest, and means under the control of said driven means for releasing said locking means.

8. In apparatus of the class described, the combination with a member supported to move in opposite directions to predetermined positions, of a motor arranged to rotate in one direction, a gear driven by said motor, a connecting rod between and pivotally connected with said gear and said member, means for starting and stopping said motor, supplemental means for locking said member in one position, and devices carried by said gear and said supplemental means and co-acting to release said means when said gear moves to operate said member to its other position.

9. In apparatus of the class described, the

combination with a pair of members movably mounted to close an opening and operable to an open position, a pair of gears, an element common to said gears and in mesh therewith, means for driving said element, a connecting rod between each said gear and the adjacent member, means for starting and stopping said driving means, and means carried by one of said gears for controlling the operation of the stopping elements of the last mentioned means.

10. In apparatus of the class described, the combination with a pair of members movably mounted to close an opening and operable to an open position, a pair of gears, an element common to said gears and in mesh therewith, means for driving said element, a connecting rod between each said gear and the adjacent member, means for starting and stopping said driving means, and means adjacent said driving element for preventing lateral distortion of said gears.

11. In apparatus of the class described, the combination with a pair of members movably mounted to close an opening and operable to an open position, a pair of gears, an element common to said gears and in mesh therewith, means for driving said element in one direction, operating connections between each said gear and the adjacent member, each said connection including a connecting rod, and means for starting and stopping said driving means.

12. In apparatus of the class described, the combination with a pair of members movably mounted to close an opening and operable to an open position, a pair of gears, an element common to said gears and in mesh therewith and operable in one direction, power means for driving said element, a connecting rod between each said gear and the adjacent member, and means for starting and stopping said power means.

13. In apparatus of the class described, the combination with a pair of members movably mounted to close an opening and operable to an open position, a pair of gears, an element common to said gears and in mesh therewith and operable in one direction, power means for driving said element, a connecting rod between each said gear and the adjacent member, means for starting and stopping said power means, and means carried by one of said gears for controlling the operation of the stopping elements of the last mentioned means.

14. In apparatus of the class described, the combination with a pair of members movably mounted to close an opening and operable to an open position, a pair of gears, an element in mesh with said gears and operable in one direction to drive them, power means for driving said element, a connecting rod between each said gear and the adjacent member, means for starting and stopping said power means, and means adjacent said driving element for preventing lateral distortion of said gears.

15. In apparatus of the class described, the combination with a pair of doors, of a motor, a gear fixed to the shaft of said motor, a pair of gears meshing with said first mentioned gear, whereby the power of said motor is transmitted directly to each of the last mentioned gears, and connecting rods each pivotally connected at its opposite ends to one of said doors and the adjacent gear.

In testimony whereof, I have hereunto subscribed my name.

HOWARD I. MORRIS.