

Dec. 17, 1935.

H. C. MILLER

2,024,300

COMBINED DOOR OPENER AND DOORCHECK

Filed Sept. 2, 1933

3 Sheets-Sheet 1

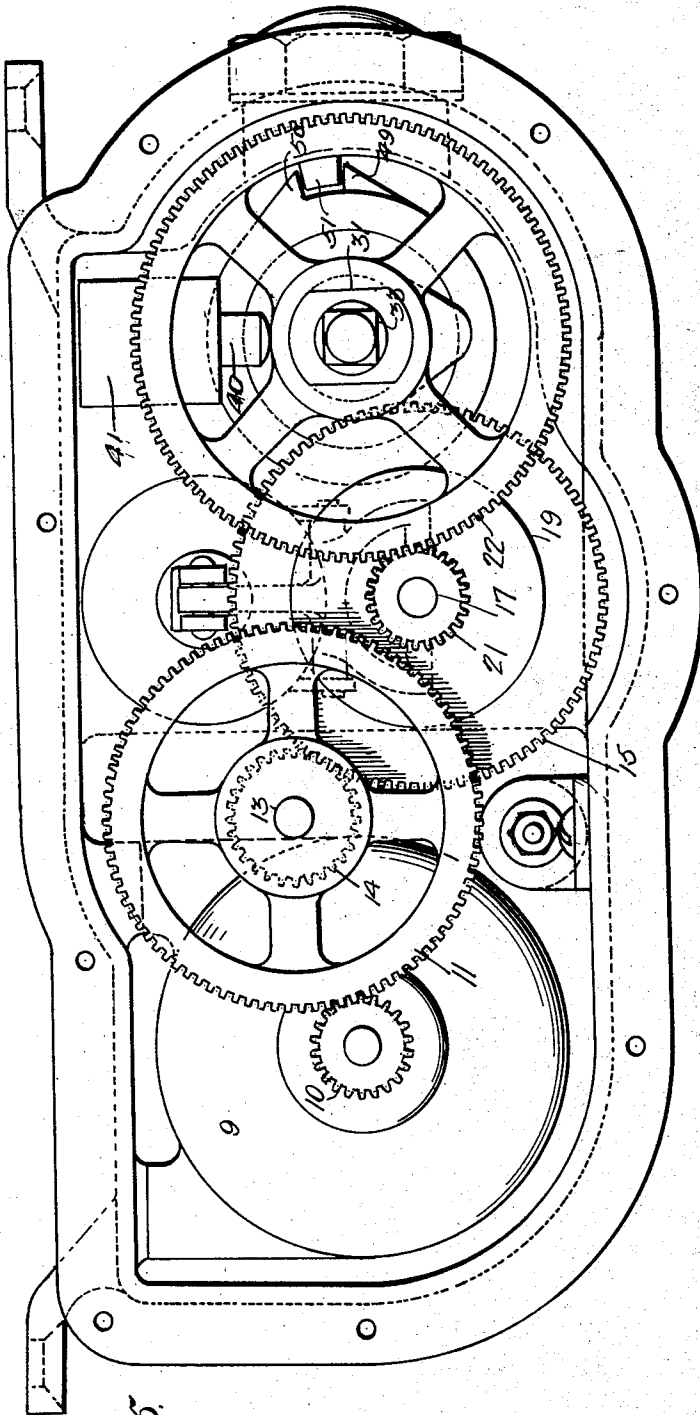
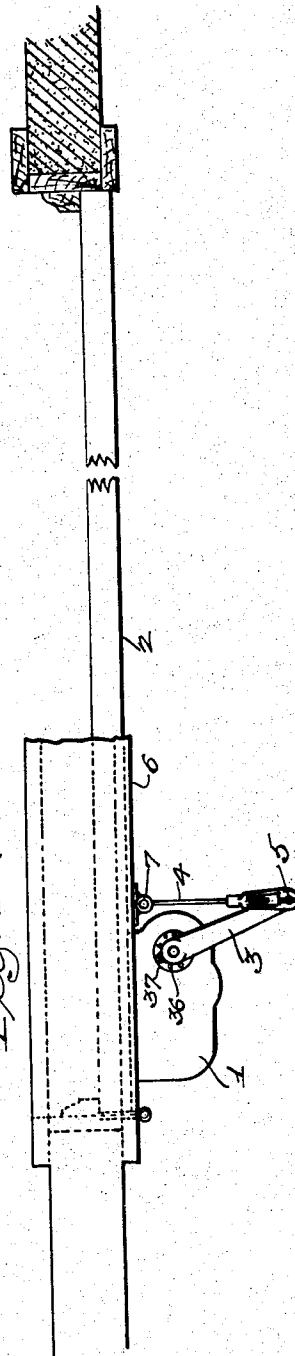


Fig. 5.

Fig. 1.



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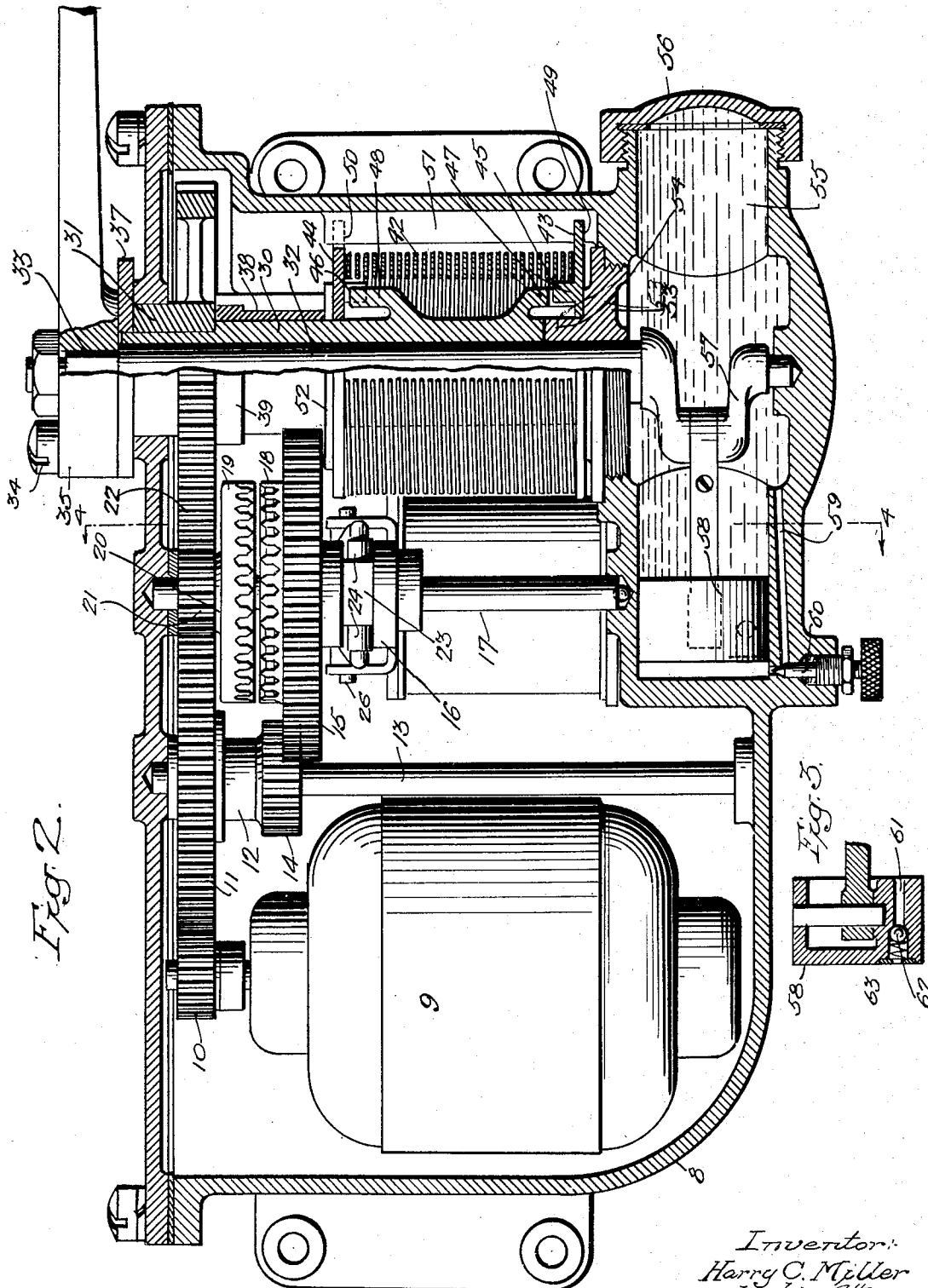
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3 Sheets-Sheet 2



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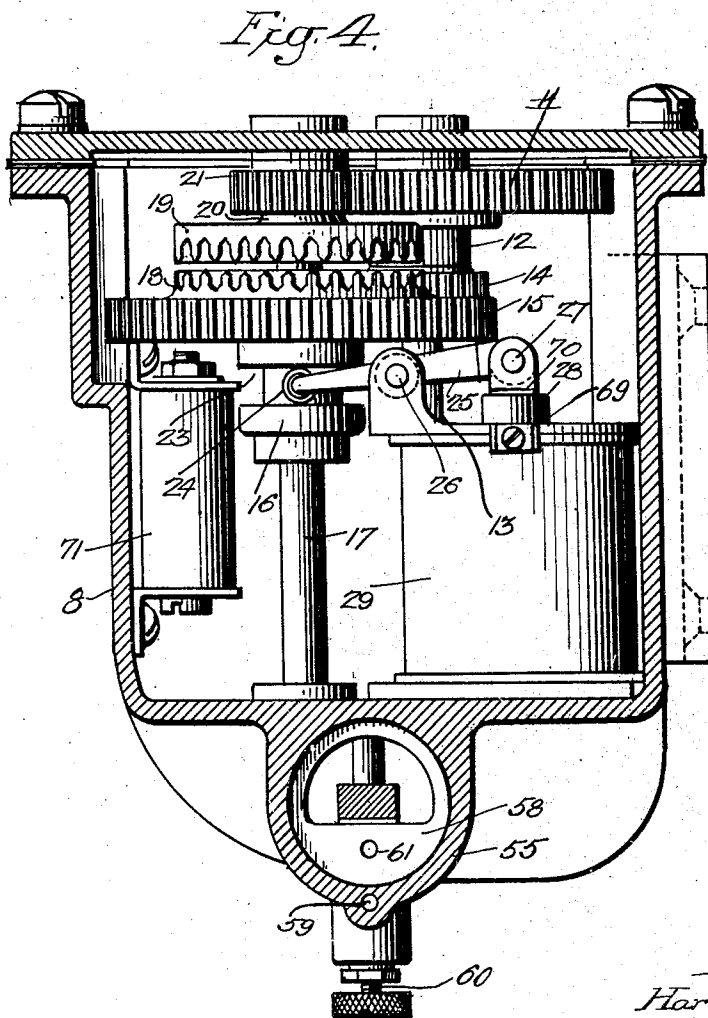
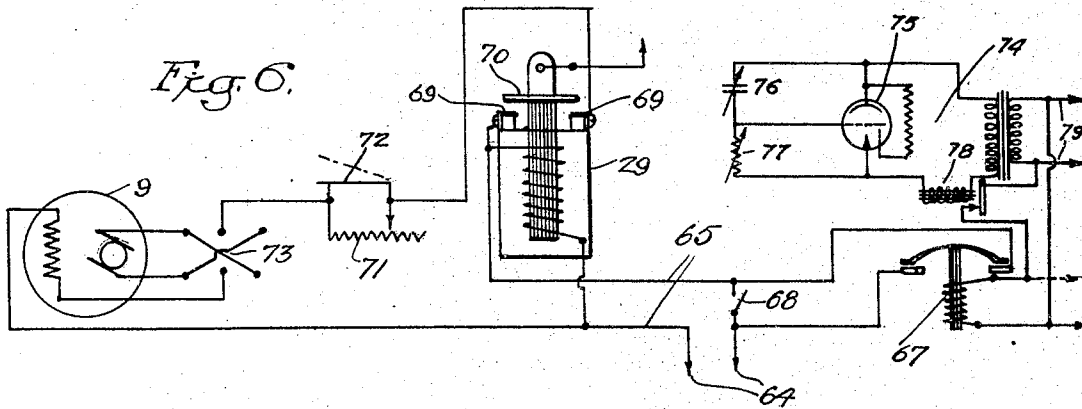
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COMBINED DOOR OPENER AND DOORCHECK

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,024,300

COMBINED DOOR-OPENER AND
DOORCHECK

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Application September 2, 1933, Serial No. 688,025

6 Claims. (Cl. 268—65)

This invention relates to door-operating mechanisms and, more particularly, to such mechanisms as comprise a motor for opening a door against the action of a spring, the spring being wound under the influence of the motor and functioning later to close the door. Such mechanisms normally and preferably comprise also braking means which may take the form of a dash-pot to retard movement of the door in at least one direction of its movement to cause it to move gradually rather than abruptly.

An object of the present invention is to provide a compact and unitary device which incorporates certain novel features that render the device a marked improvement over prior devices of the same class.

The improved device of the invention embodies an electrically operable clutch interposed in the driving connection or gear train between the driving motor and the door-actuating means. The clutch is preferably operated by a solenoid device connected to the supply circuit of the driving motor, the said device also preferably having the characteristics of a relay and controlling the energization of the motor.

Another feature of the invention is the provision of a spring arranged to wind in either direction under the influence of a reversible motor so that the device may be used in connection with either right or left hand doors.

A further feature of the invention is the provision of means for rendering the driving motor ineffective to overcome the resistance of the spring while maintaining the motor energized so that the torque of the motor substantially balances the torque of the wound spring, the said means being controlled in accordance with movement of the door. This feature preferably comprises an impedance of predetermined value in circuit with the motor and a switch normally shunted about the impedance.

A still further feature of the invention is the control by presence of a person's body which may be affected by capacity sensitive devices, light sensitive devices, etc.

Other objects and features of the invention will appear hereinafter. The invention may be clearly understood from a consideration of the preferred form illustrated in the drawings and described in detail hereinafter.

In the drawings:

Fig. 1 is a plan view showing the device in co-operative relation with a door;

Fig. 2 is a sectional view of the device;

Fig. 3 is a detail view of the dash-pot piston or plunger;

Fig. 4 is a sectional view taken along line 4—4 of Fig. 2;

Fig. 5 is a plan view of the device with the top cover thereof removed; and

Fig. 6 is a schematic illustration of the electric circuit of the device.

Referring to Fig. 1 of the drawings, the device comprises generally a unit 1 which is adapted for ready attachment to the door 2, an arm 3 which is adapted to be driven by unit 1, and a second arm 4 which is pivotally attached to arm 3 at 5 and which may be readily attached to a door frame 6 by means of the attaching bracket 7 carried at the free end of the arm. It will be understood that in operation arm 3 is rotated and it, in turn, actuates the door to open the same through the medium of arm 4. During closure of the door, the arms return to the positions shown.

Referring particularly to Figs. 2 to 5, unit 1 comprises a casing or housing 8 which is especially designed to house the various elements of the device in compact arrangement so that the device is unitary in structure and occupies as small a space as possible. The driving motor is shown at 9 and this motor carries upon its armature shaft a driving pinion 10 which meshes with gear 11. Gear 11 is carried by collar 12 which is mounted upon the rotatable shaft 13. Collar 12 carries a second smaller gear 14 which meshes with gear 15, the latter forming a part of the clutch mechanism above mentioned. Gear 15 is carried upon collar 16 which is loosely mounted upon the rotatable shaft 17. While gear 15 meshes at all times with gear 14, it is slidable with respect thereto to effect engagement and disengagement of the clutch members 18 and 19. These members preferably take the form of toothed elements as shown, member 18 preferably being formed integral with or attached directly to gear 15. It will be noted that the teeth of the clutch members are so formed that they may readily engage each other regardless of their respective rotary positions. Clutch member 19 is carried upon the collar 20 which is mounted upon shaft 17 and carries pinion 21, the latter meshing with gear 22.

Collar 16 is provided with an annular recess 23 within which a pair of rollers 24 carried at the bifurcated end of arm 25 (see Fig. 4) are disposed. Arm 25 is pivotally mounted at 26 and its other end is pivotally attached at 27 to the armature 28 of the solenoid device 29.

The solenoid device functions through arm 25 to reciprocate the movable collar 16 and the clutch member 18 carried thereby so as to effect engagement and disengagement of the clutch. Rollers 24 are snugly disposed and ride within the annular recess 23 and engage the shoulder portions of collar 16 to actuate the same, while maintaining friction at a minimum.

The hub of gear 22 is secured to sleeve 30 by the provision of opposed flats 31 at an end of the sleeve and the provision of a central opening in the gear hub which is adapted to snugly receive such end. Sleeve 30 is rotatable with respect to shaft 32 which carries arm 3 at an end thereof. The end of shaft 32 is squared as at 33 and arm 3 is provided with a corresponding opening which snugly receives the squared end. A bolt 34 passes through the projecting end 35 of arm 3 and into one of a series of apertures 36 (see Fig. 1) formed in disk 37. This disk is also secured to sleeve 30 in the manner of gear 22 as above explained. It will be seen that sleeve 30 is locked to shaft 32 through disk 37, bolt 34, and arm 3.

There is also secured to sleeve 30 a collar 38 having a cam portion 39 which is adapted to actuate a switch whose operation will be explained hereinafter. This switch (see Fig. 5) comprises a spring-biased push button 40 which is adapted to actuate the switch contacts disposed within casing 41.

The spring assembly comprises a helical or coiled spring 42 which is preferably formed of flat metal, as shown, and a pair of disks 43 and 44 attached to the ends of the spring. These disks are provided with projecting lugs 45 and 46 respectively which are adapted to cooperate with the extending fingers 47 and 48 formed on sleeve 30. Disks 43 and 44 are also provided respectively with extending noses 49 and 50 (see Fig. 5) which are adapted to cooperate with a rib 51 formed on the inner surface of casing 8. As shown clearly in Fig. 5, nose 50 of disk 44 engages rib 51 on one side thereof, while nose 49 of disk 43 engages the rib on the other side thereof. As shown in Fig. 2, finger 47 of sleeve 30 is disposed on one side of lug 45 of disk 43, while finger 48 is disposed on the opposite side of lug 46 of disk 44.

The purpose of this arrangement is to adapt spring 42 for winding operation in either direction so that the device may be used on either right or left hand doors, the motor 9 being reversible. It will be seen from Fig. 2 that if sleeve 30 is rotated in a clockwise direction, finger 47 will engage lug 45 to wind the spring in a certain direction, the other end of the spring being held stationary by engagement of the nose 50 with rib 51. On the other hand, if sleeve 30 is rotated in a counter-clockwise direction, finger 48 engages lug 46 to wind the spring in the opposite direction, the other end of the spring being held stationary by engagement of nose 49 with rib 51.

The spring assembly is disposed between washer 52 and the screw plug 53, being seated upon the axially-extending portion 54 of the plug. Plug 53 forms a closure for the dash-pot cylinder 55 formed within housing 8. The cylinder is adapted to contain oil or other fluid resistant means. An end of the cylinder is closed by the cap or cover 56 which enables access to the interior of the cylinder to replenish fluid therein or for other purposes.

Spring 42 may be placed under any desired

tension by means of the adjusting disk 37. When the device is mounted in cooperative relation with a particular door whose direction of movement is ascertained, the spring tension may be adjusted by removing bolt 34 so as to unlock arm 3 with respect to disk 37 and then rotating arm 3 relative to the disk until the desired tension of the spring is obtained, after which bolt 34 may be placed in the proper opening 36 of disk 37 to lock the parts together. Since disk 37 is secured to the spring-actuating sleeve 30, the desired tensioning adjustment of the spring may thus be obtained.

Coming back to the dash-pot, shaft 32 is attached at one end thereof to crank 57 to which is attached the movable piston or plunger 58. The cylinder wall is provided with a duct or passage 59 which is controlled by means of the needle valve 60. As shown clearly in Fig. 3, the piston is provided with a passage 61 which is enlarged at one end and carries a spring-biased ball 62, the ball and its seat constituting a one-way valve, as will be more clearly apparent hereinafter. An apertured disk 63 serves to retain the ball and its spring in place.

In operation, when shaft 32 is rotated during opening movement of the door, the piston is moved from left to right, as viewed in Fig. 2. The oil, or other fluid, within the cylinder forces its way through the piston valve by forcing ball 62 from its seat against the force of its actuating spring so that there is substantially no resistance imposed by the dash-pot on the door movement. During the opposite or closing movement of the door, however, the oil or other fluid is unable to pass through the piston in the opposite direction so that it is compressed by the piston and is forced to flow through the duct or passage 59 in the cylinder wall. By manipulation of the needle valve 60, the flow of fluid through the cylinder wall passage may be accurately controlled to adjust the braking action of the dash-pot during closing movement of the door.

Referring now to the circuit diagram of Fig. 6, supply lines 64 are connected to a suitable source of electrical energy (not shown) and they supply energy to the motor supply circuit 65. This circuit may be controlled automatically by means of a relay 67 or it may be controlled manually by a manually operable switch 68. If automatic operation is desired, relay 67 may be energized in any desired manner. For example, the energizing circuit of the relay may be controlled by a light sensitive cell to effect closure of the motor supply circuit whenever a person approaches the door and intercepts a beam of light. The relay might also be controlled by mechanism which is sensitive to variation in electrical capacity so that the capacity of an approaching person's body effects energization of the relay, of which more will be said later. Other methods of control will suggest themselves. If manual control is desired, the manually operable switch 68 may take any desired form. For example, it may take the form of a knob control switch which may be actuated by movement of the door knob by anyone desiring to open the door.

The solenoid device 29 above mentioned, which functions to operate the clutch is also preferably adapted to act as a relay to control the motor circuit. To this end, stationary contacts 69 are provided and the solenoid core or armature carries a movable contact 70 which is adapted to bridge the stationary contacts. The switch which is constituted by these contacts is serially in-

cluded in the supply line, as will be apparent. The energizing winding of the solenoid device is connected directly across the supply line so as to receive energy under control of relay 67 or switch 68.

There is also included serially in the motor supply circuit a variable resistance 71 which may be adjusted to any desired predetermined value. The cam-operated switch above described is designated 72 and is shunted about the effective portion of resistance 71. Normally, switch 72 is closed so that it short circuits the resistance and renders it ineffective. The switch is adapted, however, to open when the door reaches a predetermined position in its opening movement so as to include resistance 71 in the motor circuit. The resistance acts as a holding resistance, reducing the current flow to the motor and, consequently, reducing its torque to a value substantially equal to the torque of the wound spring. The motor is adapted to be energized at standstill by the reduced current without deleterious effects. A reversing switch 73 is provided to enable reversal of motor 9 so that the device may be used for either right or left hand doors.

Considering the operation of the device as a whole, normally with the door in closed position, as shown in Fig. 1, the parts of the device will be in the positions shown, reference being made particularly to Fig. 2. The supply circuit for the motor will be open. Assuming now that the motor supply circuit is closed, either automatically or manually, as described above. The winding of the solenoid device 29 will be energized, thereby actuating the armature or core to close switch contacts 69 and 70 and move clutch member 18 into engagement with clutch member 19. The motor being energized, it functions to open the door by rotating sleeve 30 through the gear train and interposed clutch. Rotation of sleeve 30 causes movement of arm 3 through the medium of disk 37 and consequent opening movement of the door. Rotation of sleeve 30 also causes winding of the spring. At this time also shaft 32 is rotated and the piston moves freely in the dash-pot cylinder, as above described.

When the door reaches a predetermined opened position, cam 39 engages push button 40 to open the switch 72 and include resistance 71 in the motor circuit. This causes stopping of the motor, but the motor is maintained energized and exerts sufficient torque to substantially balance the torque of the wound spring, as above described, to maintain the door in open position until the motor supply circuit is opened. At such time, the motor is deenergized, as is also the solenoid device, which allows separation of the clutch members, clutch member 18 returning to inoperative position under the influence of gravity. If desired, a spring may be provided to positively return the clutch member. Also, the teeth of the clutch members might be formed so as to act as cam members during reverse movement of the door, it thus being insured that these members will separate even if there were a tendency for them to stick.

When the torque exerted by the motor is thus removed, the torque of the wound spring causes movement of the door in the opposite direction to close the same. At such time, the dash-pot piston moves in a direction to compress the fluid, the dash-pot thus acting as a braking means to retard closing of the door by the spring. The parts return to their normal positions and the device is ready for repeated operation.

A refinement of the device might be made by having switch 72 controllable by the presence of a person approaching the door from the opposite side so that the switch would function to cause stopping of the door to thereby prevent the door from striking the approaching person. This could be accomplished by having the switch controlled additionally by capacity sensitive mechanism so that the capacity of the body of the approaching person would cause actuation of the switch to open the same. The same general result might be accomplished by controlling the switch with a light sensitive cell and a source of light properly positioned for control by the approaching person's body.

Of the various possibilities of automatic operation of the device, the capacity control method seems most feasible and practical. Accordingly, there is shown a control circuit 74 connected to relay 67, which circuit comprises a capacity sensitive device 75 in the form of a vacuum tube. An example of such a device is the grid glow tube type K. U. 618 manufactured by Westinghouse Electric and Mfg. Co. In circuit with this device is a variable condenser 76 and a variable resistance 77, the connections to the electrodes of the tube being as clearly illustrated. A relay has its energizing winding included in the plate circuit of the tube, this relay being sensitive to the minute currents of the tube circuit and controlling the energizing circuit of relay 67. Supply lines 78 may be connected to a suitable electrical energy source, preferably the same source as supplies lines 64. Relay 67 may be connected to other control devices, as indicated by the broken arrow head lines.

In operation, tube 75 responds to the capacity of a person's body in the immediate vicinity to effect such current flow through relay 78 as to cause energization thereof, which in turn causes energization of relay 67.

An important feature of the device of the invention is that normally the clutch members are disengaged and the door may be operated easily by hand in the ordinary manner. This meets the requirements of the fire underwriters, providing for such emergencies as fire. Of course, if automatic control is provided, there may be some simple provision for disabling it when desired, such as a circuit-opening switch.

Although a preferred form of the device has been illustrated and described herein and certain suggested arrangements have been specified, the invention is not limited to the present disclosure but is capable of such modifications as fall within the scope of the appended claims.

I claim:

1. A unitary device adapted to be mounted in cooperative relation to a door for operating the same, comprising an electric motor, door-actuating mechanism, driving means between said motor and said mechanism including normally inoperative clutch members permitting manual operation of the door independently of said motor, electrically operable means for simultaneously rendering said clutch members operative and energizing said motor to effect operation of said mechanism by the motor, a door-closing spring associated with said mechanism and arranged to wind when the door is opened either manually or under the influence of said motor, and braking means adapted to retard the closing movement of said door caused by said spring.

2. A unitary device adapted to be mounted in cooperative relation to a door for operating the

same, comprising an electric motor, door-actuating mechanism, driving means between said motor and said mechanism including interlockable members normally free of each other and permitting manual operation of the door independently of said motor, electrically operable means for simultaneously interlocking said members and energizing said motor to effect operation of said mechanism by the motor, a door-closing spring associated with said mechanism and arranged to wind when the door is opened either manually or under the influence of said motor, and braking means adapted to retard the closing movement of said door caused by said spring.

3. A unitary device adapted to be mounted in cooperative relation to a door for operating the same, comprising an electric motor, door-actuating mechanism, driving means between said motor and said mechanism including a pair of interlockable members normally free of each other and one of which is movable into engagement with the other, said members normally permitting manual operation of the door independently of said motor, electrically operable means for simultaneously moving said one member into engagement with said other member and energizing said motor to effect operation of said mechanism by the motor, a door-closing spring associated with said mechanism and arranged to wind when the door is opened either manually or under the influence of said motor, and braking means adapted to retard the closing movement of said door caused by said spring.

4. A unitary device adapted to be mounted in cooperative relation to a door, for operating the same, comprising an electric motor, door-actuating mechanism, driving means between said motor and said mechanism including normally inoperative clutch members permitting manual operation of the door independently of said motor, electrically operable means for simultaneously rendering said clutch members operative and energizing said motor to effect operation of said mechanism by the motor, a door-closing spring associated with said mechanism and arranged to wind when the door is opened either manually or under the influence of said motor,

braking means adapted to retard the closing movement of the door caused by said spring, means for reducing the torque of the motor to substantially balance the torque of the wound spring, and means for controlling said last means in accordance with movement of said door.

5. A unitary device adapted to be mounted in cooperative relation to a door for operating the same, comprising an electric motor, door-actuating mechanism, driving means between said motor and said mechanism including normally inoperative clutch members permitting manual operation of the door independently of said motor, electrically operable means for simultaneously rendering said clutch members operative and energizing said motor to effect operation of said mechanism by the motor, a door-closing spring associated with said mechanism and arranged to wind when the door is opened either manually or under the influence of said motor, braking means adapted to retard the closing movement of the door caused by said spring, means for reducing the torque of the motor to substantially balance the torque of the wound spring, said last means including an impedance in circuit with said motor and a switch normally shunted about said impedance, and means adapted to open said switch when said door is in open position to effectively include said impedance in the motor circuit.

6. A unitary device adapted to be mounted in cooperative relation to a door, for operating the same, comprising an electric motor, door-actuating mechanism, driving means between said motor and said mechanism, means for energizing said motor to effect operation of said mechanism by the motor, a door-closing spring associated with said mechanism and arranged to wind when the door is opened under the influence of said motor, braking means adapted to retard the closing movement of the door caused by said spring, means for reducing the torque of the motor to substantially balance the torque of the wound spring, and means for controlling said last means in accordance with movement of said door.

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