July 22, 1947. J. F. COOK 2,424,385

CLOSURE OPERATOR CONTROL SYSTEM

Filed June 27, 1945

Fig. 1.

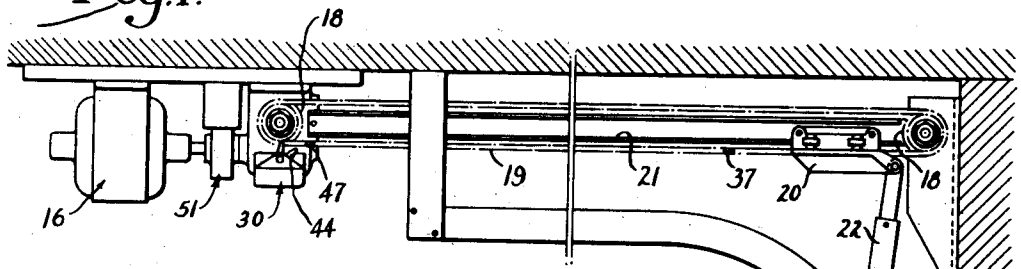
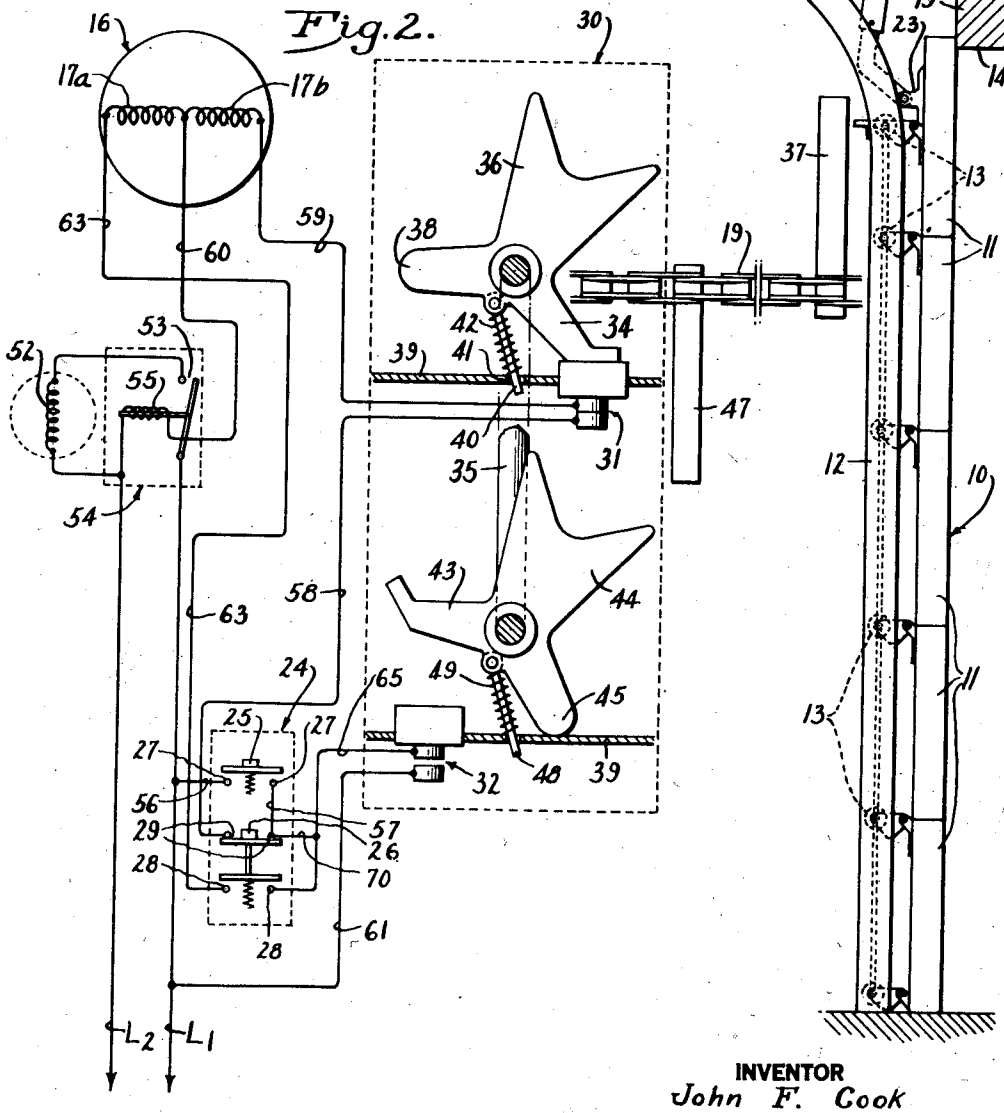


Fig. 2.



INVENTOR
John F. Cook
BY Carlson, Pilgrim, Hubbard & Wolfe
ATTORNEYS

Patented July 22, 1947

2,424,385

UNITED STATES PATENT OFFICE

2,424,385

CLOSURE OPERATOR CONTROL SYSTEM

John F. Cook, Rockford, Ill., assignor to Barber-Colman Company, Rockford, Ill., a corporation of Illinois

Application June 27, 1945, Serial No. 601,896

3 Claims. (Cl. 172—239)

1

The invention relates to closure operator control systems such as may be used for operating doors, gates and the like. It finds particular, although not exclusive, utility as applied to entrance doors for public garages and similar buildings.

The general aim is to improve and simplify prior control systems of this general type such as, for example, that shown in H. F. Collins Patent No. 2,262,719, issued November 11, 1941. More particularly, my objective has been to simplify and lessen the cost of such a system through elimination of a substantial number of parts, while still retaining performance of their functions. As will be evident from a comparison with the system disclosed in said Collins patent, I have succeeded in eliminating one of the three limit switches which are there used, together with its actuator, while still retaining the same overall functions for the circuit. This not only reduces the cost of the parts but also very considerably simplifies the initial adjustments required in installing the apparatus.

Further objects and advantages of the invention will become apparent as the following description proceeds, taken in connection with the accompanying drawings, in which:

Figure 1 is a side elevation of a door and operating mechanism therefor, as well as for a control mechanism embodying the present invention, the associating building structure being shown in vertical section.

Fig. 2 is a schematic wiring diagram of the apparatus of Fig. 1.

For purposes of illustration and explanation of its novel features, the invention has been exemplified herein as embodied in an operating system for a door or closure member 10 such as may be used, for example, in a public garage. The door itself may, of course, take various forms and since door structures of the general style shown are well known, a brief description will suffice as a preliminary to detailing of the actuating arrangement for it.

The particular door shown (Fig. 1) is of the so-called overhead type. It is made up of a plurality of horizontal sections 11 hingedly connected so that the door may be slid upwardly and inwardly along a curved trackway 12 on which it is supported by rollers 13. When in the closed position shown the door 10 is vertical and closes a doorway 14 in a wall 15. When moved upwardly along the trackway 12 the door finally reaches an open position in which it rests upon the horizontal upper arms of the trackway.

The power drive mechanism for the door 10 is illustrated herein as including a reversible

2

electric drive motor 16 provided with alternatively energizable field windings 17a and 17b, which are selectively energized to accomplish rotation of the motor in a corresponding direction. Through appropriate speed reducing mechanism, the motor drives one of the sprockets 18 over which an endless roller chain 19 is trained. In the present instance, the winding 17a is energized for closing the door and the winding 17b for opening.

To connect the chain 19 with the door 10, a carriage 20 is mounted for traversing movement along a horizontal trackway 21 located between the upper and lower reaches of the chain 19. A curved arm 22 is pivotally connected at its opposite ends to the carriage 20 and to a bracket 23 bolted to the upper portion of the inner face of the door 10. The carriage 20 is fixed to the chain 19 and, accordingly, when the lower reach of the chain is moved to the left (as viewed in Fig. 1) the door 10 is pulled upwardly and to the rear into its open position. Similarly, when the lower reach of the chain 19 is moved to the right or in the opposite direction, the door 10 is slid downwardly to its closed position. The configuration of the arm 22 and the location of its pivots is such that, when in the position of Fig. 1, it prevents the door 10 from being pushed up, thus locking it closed. The motor brake also aids in holding the door closed.

The control system for the door operator motor 16 includes a control station designated generally as 24 (Fig. 2) and which may be located at any suitable point either near to or comparatively remote from the door 10, as may be desired in a particular installation. The control station 24 in the particular construction here shown includes a pair of normally open switch contacts 27 arranged to be bridged by depression of the "opening" push button 25. Similarly, a "closing" push button 26 is arranged, when depressed, to bridge a pair of normally open switch contacts 28 and to open a pair of normally closed back contacts 29. In addition to the manually operated push button switches noted above, there are included in the illustrated control system two limit switches 31 and 32 as part of a limit switch assembly designated generally as 30. It will be observed that a third limit switch, designated as 33 in the Collins Patent No. 2,262,719 referred to above, has been eliminated in its entirety, together with its actuator which is designated as 50 in said patent, but, as will appear below, the circuits have been reorganized in a novel manner herein so that there is no sacrifice in function.

The limit switch assembly 30 illustrated herein is, of course, but one of a variety of forms that may be employed, so far as mechanical construction is concerned. As here shown, it is mounted adjacent chain 19 (see Fig. 1). Both of the switches 31 and 32 are normally urged to open position by suitable spring arrangement (not shown). The switch 31 is arranged to be closed by an actuator finger 34 loosely journaled on a horizontal rockshaft 35. Integral with the actuator finger 34 is a two-horned cam lug 36 disposed in the horizontal path of movement of a lug or projection 37 fixed on the chain 19. When the parts are in the position shown in Fig. 2, movement of the lower reach of the chain 19 to the left will cause the lug 37 to strike the left-hand horn of the cam 36 and swing it in a counterclockwise direction so that the finger 34 releases the contacts 31, thereby permitting the latter to open. Such movement of the finger 34 in a counterclockwise direction is limited by an integral stop finger 38 which contacts a fixed plate 39. Furthermore, an over-center spring-biased toggle mechanism serves to snap the actuator finger 34 to one or the other of its extremities of movement toward which it is shifted. This toggle mechanism includes a pin 40 pivoted to its upper end to the actuator structure and having its lower end projecting loosely through a hole 41 in the plate 39, a helical compression spring 42 being arranged to encircle the pin.

Also mounted on the shaft 35 is an actuator for the other limit switch 32 and which is substantially similar to that heretofore described for the switch 31. This actuator includes a finger 43 fastened as an integral projection on a plate carried on the shaft 35. On this plate is formed a two-horned cam 44 as well as a stop finger 45 cooperating with the fixed plate 39. The cam 44 is arranged to be engaged by a second projection 47 carried by the chain 19. As in the case of the first actuator described, a toggle mechanism is provided including a pin 48 and spring 49.

In general, the actuating arrangements for the limit switches 31 and 32 are such that both of these switches remain closed throughout substantially the full path of travel of the door 10 and are opened only at respective extremities of its path of travel. Thus the switch 31 is open only when the door is open, while the other switch 32 is open only when the door is closed. With but two limit switches, so related as to time of operation, there is no problem involved of initially timing a plurality of switches to open and close precisely in unison.

Current for the electric drive motor 16 may be supplied from any suitable source such, for example, as alternating current supply lines L_1 and L_2. The system may, for example, be designed for operation from a conventional 110 volt alternating current supply line.

As a further safety measure, a brake 51 (Fig. 1) is applied to the motor 16, this brake being normally urged into braking condition by suitable spring mechanism (not shown). An electric solenoid 52 (Fig. 2) serves, when energized, to release the brake 51. Energization of the solenoid is controlled by normally open contacts 53 of a relay 54 having an actuating winding 55 interposed in the common supply lead of the motor field windings 17a, 17b. In this way the solenoid 52 is energized when, but only when, the motor 16 is in operation. Accordingly, inadvertent gravity descent of the door 10 is effectively prevented at all times.

Attention may now be given to the connections employed in the illustrated control system. With the supply line L_2 connected to the common terminal of the motor windings 17a and 17b, the motor is energized for closing and opening movements by connecting the other terminals of the corresponding windings 17a and 17b to the supply line L_1. To initiate opening movement of the door 10 the opening switch 25, 27 is closed. Thereupon a circuit to the motor winding 17b is completed through such switch in series with the normally closed back contacts 29 of the "closing" switch and through the limit switch 31 (through L_1—56—27—57—29—58—31—59—17b—60—55—L_2).

As soon as the opening movement of the door 10 starts, the second limit switch 32 is closed automatically thereby completing a holding or maintaining circuit in shunt with the manually operated "opening" switch 25, 27. Thus it will be noted that the switch 32 has one terminal connected to the line L_1 through the conductor 61 while the other terminal of switch 32 is connected to conductor 58, and then to motor winding 17b, through 65—70—29. Consequently, the push button 25 may be released after a momentary closure and the door 10 will continue to rise until it reaches the fully opened position. At the latter point the limit switch 31 is automatically opened thereby interrupting the previously identified circuit to the motor winding 17b to stop the motor.

To close the door 10 the push button 26 is depressed thereby opening the back contacts 29 and closing the main contacts 28. The closing of contacts 28 completes an energizing circuit for the motor winding 17a with the limit switch 32 again functioning in the circuit, this time in series with the "closing" switch 28. Thus supply line L is connected to the motor winding 17a through 61—32—65—28—63. As soon as the door starts to descend, the switch 31 is closed.

As the door 10 descends, if the operator releases the push button 26 at any time the contacts 28 reopen, thereby interrupting the energizing circuit to the motor closing winding 17a. Moreover, the back contacts 29 are reclosed, resulting in the establishment of a circuit for the motor opening winding 17b, again through coaction of the limit switch 32. Thus, when contacts 29 are reclosed there is a circuit from L_1 to the winding 17b through 61—32—65—70—29—58—31—59. Consequently the descent of the door 10 is not only stopped upon releasing the push button 26, but in addition, the motor 16 is automatically reenergized to restore the door to its fully opened position. The advantages of such an action, from the standpoint of safety, will be clear. Should a car or person attempt to enter the doorway while the door is closing the operator has only to release the button 26. The door will go back up to its safe open position without even requiring the attendant to have presence of mind enough to press the button 25.

In the event that the operator holds the closing push button 26 depressed throughout the closing movement of the door 10, the door finally reaches the fully closed position shown in Fig. 1. Upon reaching such position the limit switch 32 is automatically opened, thereby interrupting the previously identified energizing circuit to the motor winding 17a so that the motor stops and the door remains closed.

From the foregoing it will be perceived that the limit switch 32 performs three rather distinct functions in the system, and it is by using this single switch to accomplish such a variety of purposes that I have achieved an important overall simplification in the system. First, the switch 32 serves to interrupt the energizing circuit to the motor winding 17*a* at completion of the normal closing movement of the door. Second, the switch 32 functions to establish a holding circuit in shunt with the opening switch contacts 27 so that only a momentary closure of the latter is required to effect full opening of the door. Third, the switch 32 partially completes an energizing circuit for the opening winding 17*b* of the motor, so that such circuit may be automatically completed by reclosure of the contacts 29 to effect emergency reopening of the door after partial closure of the latter.

In analyzing the foregoing circuit it will be seen that there is a lead from the motor closing winding 17*a* to the supply line L_1 in which the manually operated closing and opening switches are interposed in series (17*a*—63—28—65—70—57—27—56—L_1), whereas there is a second lead from the other motor winding 17*b* to the supply line L_1 in which the switches 31, 29 and 32 are all interposed in series (17*b*—59—31—58—29—70—65—32—61—L_1). Moreover, there is what amounts to a cross connection between these two leads constituted by the conductor 70 which is common to the two. Such point of cross connection is located in the first lead at a point intermediate the "opening" switch 27 and the "closing" switch 28, and in the other lead at a point intermediate the limit switch 32 and back contacts 29 of the "closing" switch. By such interconnection I am able to accomplish the operation described with but two limit switches acting in conjunction with the "opening" and "closing" switches and back contacts on the latter.

I claim as my invention:

1. In a power operator for a closure member movable between open and closed positions, the combination of a reversible electric drive motor having two alternatively available energizing circuits for effecting rotation of the motor in corresponding opposite directions for respectively opening and closing the closure member, means including a first manually operable switch normally biased to open position for energizing said opening circuit, said means also including a second manually operable switch which is normally closed and a first limit switch, both connected in series with said first manual switch, means for retaining said first limit switch in closed position throughout the travel of the closure member and for opening the same only when such member is substantially in fully open position, a third manually operable switch normally biased to open position and mechanically connected to said second manual switch to open and close in alternation therewith, and means including a second limit switch operable in timed relation with the closure member to remain closed throughout the travel of such member and open only when the latter is substantially fully closed for (*a*) deenergizing the motor closing circuit upon completion of a closing movement of the closure member instituted by closing of said third switch, (*b*) completing a holding circuit in shunt with said first manual switch to retain said motor opening circuit energized after momentary closure of said first manual switch, and (*c*) partially completing an energizing connection for said motor opening circuit preparatory to completion of the same by reclosure of said second manual switch to effect restoration of the closure member to open position whenever the third switch is manually released during closing of the closure member.

2. In a power operator for a closure member, the combination of a reversible electric motor having a pair of terminals adapted to be alternatively connected to a supply line for effecting, respectively, opening and closing movements of the closure member, a pair of leads for connecting respective ones of said terminals to a supply line, a normally open manually operable "closing" switch interposed in the lead to the closing terminal, a normally open manually operable "opening" switch also interposed in the last-mentioned lead between said "closing" switch and the supply line, a first limit switch and an additional manually operable switch interposed in series in the lead to the opening terminal, said additional switch being mechanically interconnected with said "closing" switch to open and close in alternation therewith, means for retaining said first limit switch closed throughout the path of travel of the closure member and for opening such switch only when such closure member is substantially fully open, a second limit switch also interposed in said lead to said opening terminal between the supply line and said additional switch, means for retaining said second limit switch closed throughout the path of travel of the closure member and for opening such switch only when such closure member is substantially fully closed, and a cross connection between said leads from a point in the lead to the closing terminal intermediate said "opening" switch and said "closing" switch to a point in the other lead intermediate said second limit switch and said additional switch.

3. In a power operator for a closure member movable between open and closed positions, the combination of a reversible electric drive motor having "opening" and "closing" windings, said windings being adapted for common connection to one terminal of a power source, an intermediate terminal supplied from the remaining terminal of said power source via a parallel circuit including (*a*) a first manually operable normally open switch means and (*b*) a normally closed limit switch arranged to be open only when the closure member is fully closed, second manually operable switch means connected to said intermediate terminal and effective normally to connect the same to said "opening" winding but depressible to alternatively connect said intermediate terminal to said "closing" winding, and a normally closed limit switch in series with said "opening" winding and arranged to be open only when the closure member is fully open, so that said first and second manually operable switch means are effective respectively to cause opening and closing of the closure member and so that the closure member will be automatically driven to the open position upon release of said second switch means with the closure in an intermediate position.

JOHN F. COOK.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,262,719	Collins	Nov. 11, 1941