Sept. 24, 1946. J. K. HUBER 2,408,213

ELECTRIC CIRCUIT CONTROLLER

Filed March 4, 1942

Fig. 1.

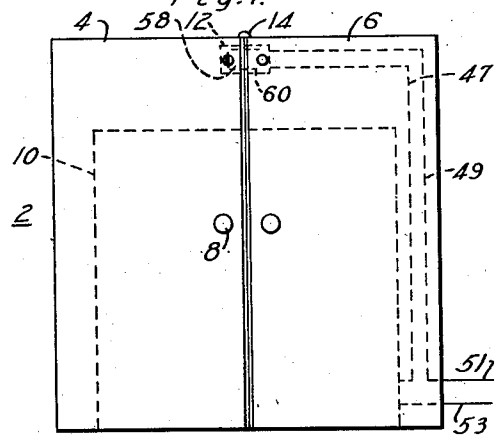


Fig. 2.

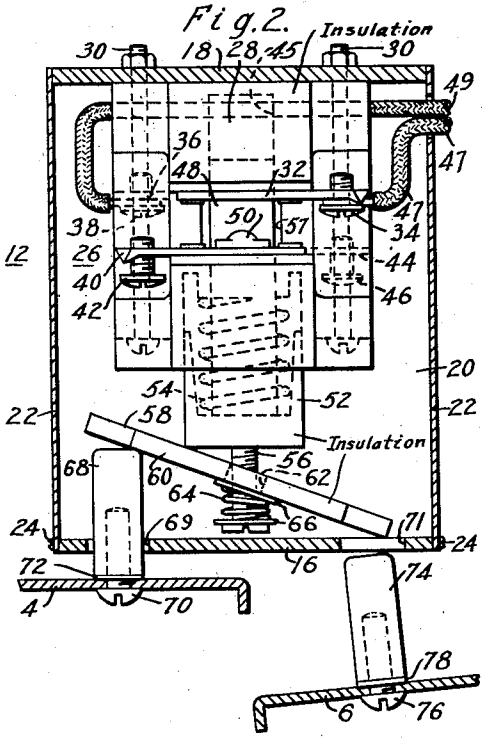
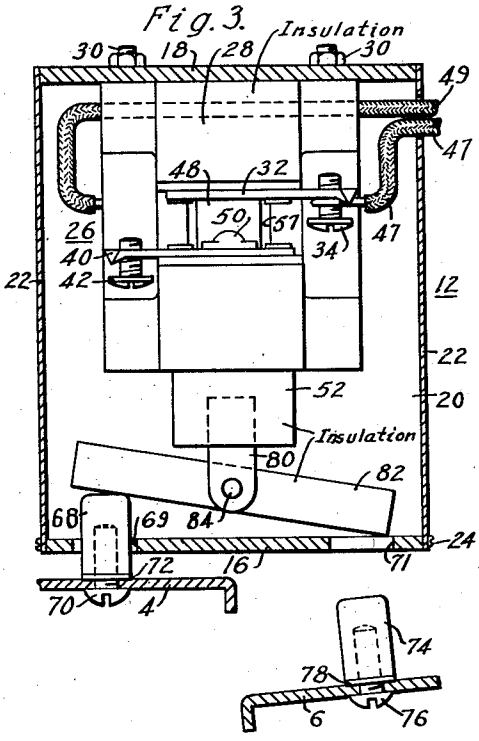


Fig. 3.



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ELECTRIC CIRCUIT CONTROLLER

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11 Claims. (Cl. 200—54)

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This invention relates generally to electric circuit controlling devices and more specifically to door-operated switches.

In certain applications it is desired that a circuit be controlled by the positions of a pair of movable members such as doors, one possibility is to provide a pair of serially connected switches in the circuit, with one switch for each member. Thus, in housings for electrical apparatus having double doors or like closures, it is highly desirable for safety purposes that the apparatus be electrically energized only when such closures or doors are in closed position, and that it be entirely deenergized when the doors or closures are opened, in order to prevent anyone from coming in contact with any live parts of the circuit. One such application is in electrical precipitating equipment where high voltages are employed; however, this invention may be employed with any other type of electrical equipment.

This invention is embodied in an electrical equipment housing having double doors, and to obtain the desired safety features it is necessary that the circuit controller for the apparatus be closed only when both doors are closed, and that it be open at all other positions of either door.

Accordingly, one object of this invention is to provide a novel arrangement wherein a single switch is responsive only to predetermined positions of two housing closure members, to effect energization of electrical apparatus within the housing.

Another object of this invention is to provide novel operating means for a switch for operation by a pair of movable members only at predetermined respective positions thereof.

Another object of this invention is to provide a single door operated switch having separable contacts, with novel actuating mechanism for actuation by double doors of an enclosure in a manner such that the switch contacts are engaged only when both doors are closed.

These and other objects of this invention will become more apparent upon consideration of the following detailed description of preferred embodiments thereof, when taken in connection with the attached drawing, in which

Figure 1 is a front view of a housing for electrical apparatus embodying this invention;

Fig. 2 is an enlarged section taken through the switch casing mounted in the housing shown in Fig. 1, with the switch and switch operating parts shown in elevation; and

Fig. 3 is a view similar to Fig. 2 but showing a modified form of switch operating means.

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In Fig. 1 of the drawing, there is illustrated a housing 2 for electrical apparatus diagrammatically illustrated at 10. The invention is not limited to any specific type of apparatus, but is intended for use with any type of apparatus which may be electrically energized at high voltages, or having high enough capacity to render the same dangerous. An example of high voltage equipment could be electrical precipitating apparatus which uses high voltages for the purpose of charging the particles to be precipitated. It is often desirable to locate a plurality of units of such high voltage or high capacity electrical apparatus in a single housing, or the apparatus itself may be so large as to require a relatively large housing. With such large housings, relatively large openings are required for moving apparatus into and out of the housing, and also for the purpose of entering the housing to work on the apparatus, and these openings may be of such a size as to require a double door construction, such as shown in Fig. 1, wherein two doors 4 and 6 are provided. The doors 4 and 6 are preferably hinged or otherwise movably mounted adjacent the outer edges thereof, so as to swing outwardly away from each other relative to the housing. Each door may be provided with an operating handle or knob 8 for opening and closing the door, and, if desired, suitable securing means may be provided for maintaining the doors in their closed position.

In order to insure deenergization of the apparatus 10 when one or both doors are opened, there is provided a switch unit contained in a casing 12 secured within housing 2, for example, to the top wall thereof by a bolt 14. This switch unit is more particularly illustrated in Fig. 2, and as viewed therein, it is apparent that casing 12 completely encloses the switch unit. Casing 12 includes a front wall 16, rear wall 18, end walls 22, and side walls 20. These walls may be all of integral construction with the exception of front wall 16, or they may be made in separate parts and secured together, for example, as by welding or the like. Front wall 16, however, is preferably formed of a separate piece of material from the other walls of the casing, and as shown in Fig. 2, may be removably secured in position, as by screws 24.

The switch unit itself is adapted to be mounted within casing 12, and this switch unit may be of any desired type having contacts normally biased apart. The specific switch unit 26 illustrated comprises a standard push-button switch unit like that illustrated in the copending application of

Clarence E. Gary, Serial No. 225,357, filed August 17, 1938, now Patent No. 2,284,813, issued June 2, 1942, and assigned to the same assignee as this application. Since this switch unit is more particularly disclosed in the aforesaid application of Gary, it will not be herein described in detail. In general, however, the switch unit comprises a supporting block 28 of insulating material preferably a molded insulating material, having bores at opposite ends thereof for receiving mounting bolts 30 to secure the supporting block to rear wall 18 of switch casing 12. Opposite sides of supporting block 28 are provided with cavities intermediate the ends of the block for supporting spaced pairs of spaced contacts fixed with respect to the block. Thus in Fig. 2, the contact strip 32 of one pair of contacts is seen to be positioned at one side of the block, with a terminal screw 34 for securing a conductor thereto located at one end of the block. The other contact 36, which is paired with contact strip 32, is located at the opposite side of supporting block 28 and is provided with a terminal screw 38 located at the opposite end of the block from terminal screw 34. The pair of contact strips 32—36 extend in spaced, parallel, overlapping relation. Although, as will be hereinafter pointed out, the pair of contacts 32—36 are the only ones used in this particular application of this invention, the standard switch construction disclosed in the above-mentioned patent of Clarence E. Gary also includes another pair of contacts including a contact strip 40 on the same side of the block 28 as contact strip 32 but spaced forwardly thereof and with its terminal screw 42 positioned at the opposite end of the supporting block from terminal screw 34. Contact strip 44, on the opposite side of the supporting block, is paired with strip 40 and includes a terminal screw 46 at the opposite end of the block from terminal screw 42.

The supporting block 28 is provided with a substantially centrally located bore 45 opening to the outer end of the supporting block, for slidably receiving an elongated supporting strip 48. The supporting strip 48 carries a bridging contact 50 which extends transversely thereof, and transversely with respect to the supporting block through a transverse passage 57 therethrough, intersecting bore 45. In the position of the parts shown in Fig. 2, it is apparent that bridging contact 50 is in engagement with spaced contact strips 40 and 44. By movement of supporting strip 48 upwardly, as viewed in Fig. 2, it is obvious that bridging contact 50 may be moved from bridging relation with respect to contact strips 40 and 44, into bridging engagement with contact strips 32 and 36. Secured to the outer end of supporting strip 48 is a conventional push-button operating member 52, also preferably of a molded insulating material. A coiled compression spring 54 engages between push button 52 and a shoulder provided on supporting block 28, to normally maintain bridging contact 50 in engagement with contact strips 40 and 44, as shown in Fig. 2.

To adapt the standard push-button switch unit described above for actuation by doors 4 and 6 of housing 2, the outer end of the push-button is tapped, and a screw 56 threadedly engaged in the tapped opening. This screw is adapted to support an operating disk 58, which, as is apparent from Figs. 1 and 2, may be made in circular form with opposite sides cut off as at 60, to fit in elongated casing 12. Operating disk 58 is also preferably of insulating material, such, for example, as fiber or a molded insulating material. As shown in Fig. 2, operating disk 58 is provided with a substantially centrally located aperture 62, preerably larger in diameter than screw 56, to permit tilting movement of the disk from a position wherein it lies flat against the outer end of push button 52 to the position shown, for example, in Fig. 2. In order to normally maintain operating disk 58 seated on the outer end of push-button 52, a coiled compression spring 64 is provided between washers 66, bearing against operating disk 58 and the head of screw 56, respectively.

It will be observed that the front wall 16 of switch casing 12 is provided with spaced apertures 69 and 71 positioned to be located adjacent opposite ends of operating disk 58. The door 4 of housing 2 is provided adjacent the outer edge thereof with an actuating pin 68 secured thereto, for example, as by a screw 70 passing through an aperture in the door and into a tapped bore in pin 68. The pin 68 is made to be of a size to enter aperture 69 in the front wall 16 of the switch casing, to engage one end of operating disk 58 and move it inwardly in the movement of the door to its closed position. Housing door 6 is provided with an actuating pin 74 similar to the pin 68, and mounted on door 6 in a like manner, for example as by a screw 76. In order that the actuating pins 68 and 74 may be adjusted to the proper length, washers 72 and 78 may be provided to take care of such adjustment.

As stated above, in the position of the parts shown in Fig. 2 of the drawing, bridging contact 50 is biased into bridging engagement with contact strips 40 and 44 and away from contact strips 32 and 36. Contact strips 32 and 36 are connected in the supply circuit to electrical apparatus 10, thus as shown, contact strip 32 is connected by conductor 47 to the electrical apparatus 10, and contact strip 36 is connected by conductor 49 with one wire 51 of the supply circuit. The other wire 53 of the supply circuit may be connected directly with electrical apparatus 10. Accordingly, it will be apparent that in the position of the switch shown in Fig. 2, the circuit to apparatus 10 will be interrupted because bridging contact 50 is out of engagement with contact strips 32 and 36. Door 6, as shown in Fig. 2, is in an open position such that actuating pin 74 thereon has not yet moved into aperture 71 or into engagement with operating disk 58. However, door 4 is at its closed position, and its actuating pin 68 projects through aperture 69 in the front wall 16 of the switch casing and has engaged operating disk 58 and tilted the same to the position shown. However, it should be noted that this tilting of operating disk 58 has had no effect upon bridging contact 50 and that spring 54 still maintains bridging contact 50 out of engagement with respect to contact strips 32 and 36. In order to move bridge contact 50 into engagement with contact strips 32 and 36, and thereby complete the energizing circuit to apparatus 10, it is necessary that both doors 4 and 6 be closed. Now if door 6 be moved to the closed position from the position shown in Fig. 2, that is until door 6 is in alignment with door 4, it is obvious that actuating pin 74 will engage the opposite end of operating disk 58 from that engaged by actuating pin 68, to cause relative pivotal movement of the disk about pin 68 thereby moving the central portion of the disk upwardly as viewed in Fig. 2 and causing movement of bridging contact 50 upwardly and into bridging

engagement with respect to contact strips 32 and 36.

When both doors are closed, the energizing circuit to electrical apparatus 10 will be closed; however if either door is opened, it is obvious that removal of its actuating pin from engagement with actuating disk 58 will permit compression spring 54 of the switch unit to move bridging contact 50 outwardly, because the operating disk 58 will then be free to pivot or tilt about its aperture 62 either to the position shown in Fig. 2 of the drawing if door 6 is opened, or it will tilt in the opposite direction if door 4 is opened. Tilting movement of operating disk 58 is, of course, accompanied by compression of spring 64, so that when both doors are opened, spring 64 will automatically return the operating disk 58 to its normal position transverse with respect to screw 56 wherein it is in engagement with the outer end of push button 52.

The embodiment of the invention illustrated in Fig. 3 of the drawing is identical with that shown in Fig. 2 in most respects, and, therefore, like reference numerals will be used to designate like parts, and these common parts will not be described again in detail in order to avoid undue repetition.

This embodiment of the invention differs from that previously described in that there is secured to push button 52 a supporting post 80 in any desired manner, for example, it may be molded therein, and this supporting post is provided with a split outer end for receiving an intermediate portion of an operating bar 82. The operating bar 82 is pivotally supported intermediate the ends thereof in the split end of supporting pin 86, for example, as by pivot pin 84.

The operation of the modified construction shown in Fig. 3 is similar to that previously described in connection with Fig. 2, in that bridging contact 50 will be moved into engagement with contact strips 32 and 36 to close the energizing circuit to apparatus 10 only when both doors 4 and 6 are in closed position. When either door is opened, operating bar 82 may tilt similar to operating disk 58 as shown in Fig. 2, to permit movement of bridging contact 50 under the influence of coil spring 54 out of engagement with contact strips 32 and 36 to open the energizing circuit of apparatus 10.

From the foregoing, it is apparent that this invention provides a switch construction for controlling the energizing circuit of electrical apparatus in accordance with the position of the closure means for the apparatus housing, wherein such closure means comprises double doors, and the control is effective to close the energizing circuit for the apparatus only when both doors are closed so that the circuit will be open even though only one of the doors are open. It can be seen, therefore, that whenever either or both of the housing doors are open, the energizing circuit for the apparatus is also open to thereby eliminate any danger in handling or working on the apparatus. Another safety feature of the specific switch constructions herein disclosed resides in the fact that the operating disk 58 and bar 82 are spaced from front wall 16 of the switch casing and are accessible only through apertures 69 and 71 through front wall 16, and can be operated to close the circuit only when opposite ends of the operating members are simultaneously depressed. This renders it impossible to operate the switch with the finger while the door is open, and this may be positively prevented by making apertures 69 and 71 of small enough size to prohibit the entrance of a human finger therein. In addition to the safety features above enumerated, applicant's switch construction is particularly desirable because of its relatively simple construction whereby the desired safety features are obtained, and because but a single switch is used to control the circuit in response to the position of two housing doors. It is obvious that considerable savings are obtained over constructions utilizing two switches, not only in cost, but in the space required for the switches.

Having described preferred embodiments of the invention in accordance with the patent statutes, it is desired that the invention be not limited to the specific embodiments herein disclosed, because it will be obvious, particularly to persons skilled in the art, that many modifications and changes in these particular embodiments may be made without departing from the broad spirit and scope of this invention. Accordingly, it is desired that the invention be interpreted as broadly as possible, and that it be limited only by the prior art.

I claim as my invention:

1. A housing for electrical apparatus having double doors for said housing, switch actuating means on said doors, switch means supported by said housing in proximity to said doors to be actuated thereby in the closed positions of said doors, said switch means including separable contacts normally biased apart and adapted to be connected in the supply circuit to said apparatus to control energization thereof, means for moving at least one of said contacts into engagement with another of said contacts only when both of said doors are closed, including an actuating member tiltably mounted at an intermediate portion thereof and positioned so that portions thereof at opposite sides of said intermediate portion will be engaged by said switch actuating means on said doors, respectively, when said doors are closed.

2. A housing for electrical apparatus, double doors for said housing, switch means supported by said housing in proximity to said doors to be actuated thereby in the closed positions of said doors, said switch means including separable contacts normally biased apart and adapted to be connected in the supply circuit to said apparatus to control energization thereof, reciprocable means associated with said contacts to move at least one of said contacts into engagement with another contact against said bias, an actuating member tiltably mounted intermediate the ends thereof on said reciprocable means, and means carried by each door adapted to engage said actuating member at points on opposite sides of said tiltable mounting, respectively, when said doors are in closed positions to actuate said reciprocable means and cause engagement of said contacts only when both doors are closed.

3. A housing for electrical apparatus, double doors for said housing, switch means supported by said housing in proximity to said doors to be actuated thereby in the closed positions of said doors, said switch means including separable contacts normally biased apart and adapted to be connected in the supply circuit to said apparatus to control energization thereof, means positioned to be engaged and actuated by said doors when said doors are closed to move at least one of said contacts into engagement with another contact only when both of said doors are closed, but ineffective to cause engagement of said con-

tacts if one or both of said doors are on open position.

4. A housing for electrical apparatus, double doors for said housing, switch means supported by said housing in proximity to said doors to be actuated thereby in the closed positions of said doors, said switch means including separable contacts normally biased apart and adapted to be connected in the supply circuit to said apparatus to control energization thereof, a casing for said switch, actuating means for said switch within said casing and spaced from the adjacent wall of said casing, spaced apertures in said casing wall aligned with spaced portions of said actuating means, and projections on said doors for entering said apertures, respectively, and engaging said actuating member to move at least one of said contacts into engagement with another contact only when both of said doors are closed, but ineffective to cause engagement of said contact if one or both of said doors are on open position.

5. In a switch, a base, separable contacts on said base normally biased apart, actuating means for at least one of said contacts mounted for reciprocating movement on said base and operative when moved in one direction to cause engagement of said contacts against said bias, an operating member for said actuating means tiltably mounted thereon intermediate its ends, and a pair of actuating members movable into and out of engagement with said operating member at points adjacent opposite ends of said operating member, respectively, so that said contacts will be closed only when both of said actuating members engage said operating member.

6. In a switch, a base, separable contacts on said base normally biased apart, actuating means for said contacts mounted for reciprocating movement on said base and operative when moved in one direction to cause engagement of said contacts against said bias, an operating member for said actuating means pivotally mounted thereon intermediate its ends, and a pair of actuating members movable into and out of engagement with said operating member at points adjacent opposite ends of said operating member, respectively, so that said contacts will be closed only when both of said actuating members engage said operating member.

7. In a switch, a base, separable contacts on said base normally biased apart, actuating means for at least one of said contacts mounted for reciprocating movement on said base and operative when moved in one direction to cause engagement of said contacts against said bias, an operating member having an intermediate portion thereof seated on said actuating means, resilient means biasing said operating member into engagement with said actuating means but permitting tilting movement thereof, and means cooperating with said actuating means and operating member for limiting said tilting movement.

8. In a switch, a base, separable contacts on said base normally biased apart, actuating means for at least one of said contacts mounted for reciprocating movement on said base and operative when moved in one direction to cause engagement of said contacts against said bias, an operating member for said actuating means tiltably mounted thereon intermediate its ends, and resilient means reacting between said actuating means and operating member for restoring said operating member to a normal position after it has been tilted from such position.

9. In a switch, a base, separable contacts on said base normally biased apart, actuating means for said contacts mounted for reciprocating movement on said base and operative when moved in one direction to cause engagement of said contacts against said bias, an operating member for said actuating means tiltably mounted thereon intermediate its ends, a casing for enclosing said switch, said casing having spaced apertures through the wall thereof opposite said operating member and positioned on opposite sides of the tiltable mounting point of said operating member, and a pair of actuating members movable into and out of said casing through said apertures, respectively, to engage and disengage said operating member on opposite sides of said tiltable mounting point so that said contacts will be closed only when both actuating members are in engagement with said operating member.

10. In a switch, a base, separable contacts on said base normally biased apart, actuating means for at least one of said contacts mounted for reciprocating movement on said base and operative when moved in one direction to cause engagement of said contacts against said bias, and an operating member of insulating material for said actuating means tiltably mounted thereon intermediate its ends.

11. A housing for electrical apparatus, double doors for said housing, switch means supported by said housing in proximity to said doors to be actuated thereby in the closed positions of said doors, said switch means including separable contacts normally biased apart and adapted to be connected in the supply circuit to said apparatus to control energization thereof, a casing for said switch, actuating means for said switch means within said casing and spaced from the adjacent wall of said casing, spaced apertures in said casing wall aligned with spaced portions of said actuating means, projections on said doors for entering said apertures, respectively, and engaging said actuating member to move at least one of said contacts into engagement with another contact only when both of said doors are closed, but ineffective to cause engagement of said contact if one or both of said doors are on open position, and means whereby the effective length of said projections may be adjusted.

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