Dec. 27, 1949 W. H. LINDAE 2,492,490

ELECTRICAL SAFETY SWITCH

Filed Aug. 22, 1946 4 Sheets-Sheet 1

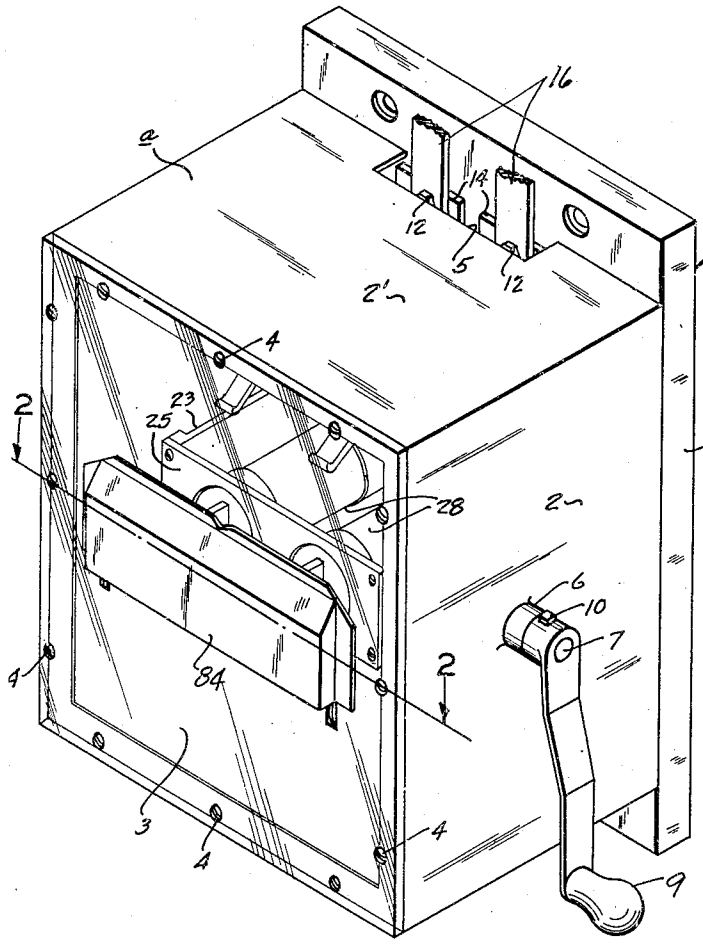

FIG.1.

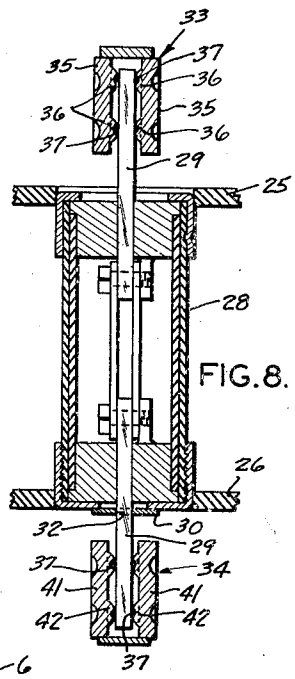

FIG.8.

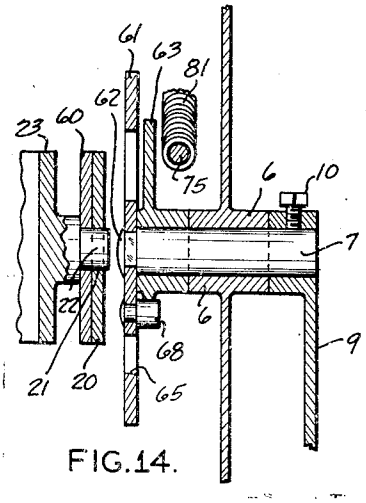

FIG.14.

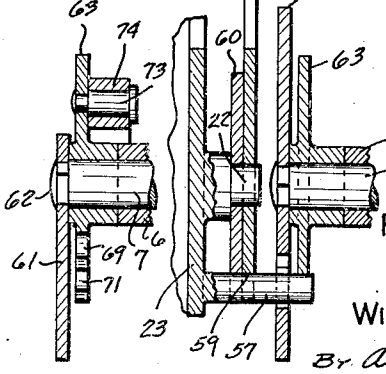

FIG.15.

FIG.16.

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ELECTRICAL SAFETY SWITCH

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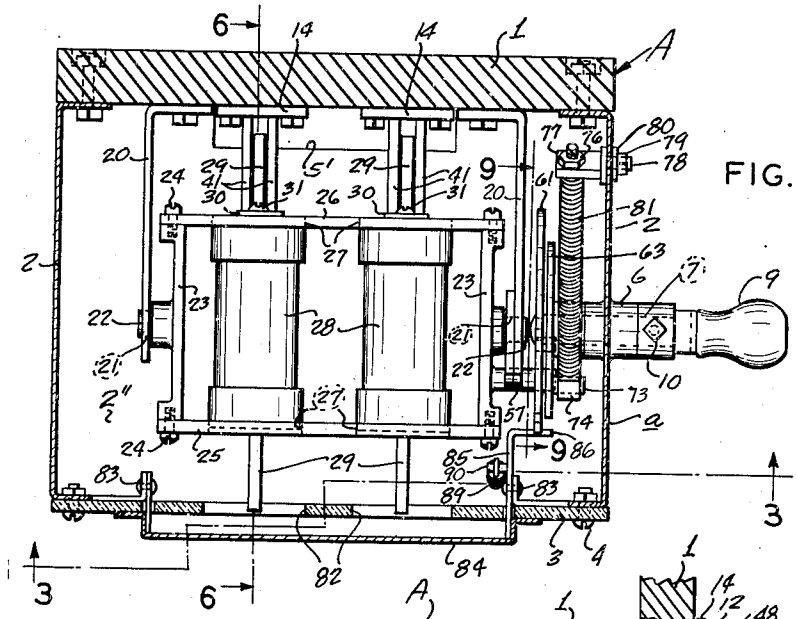

FIG. 2.

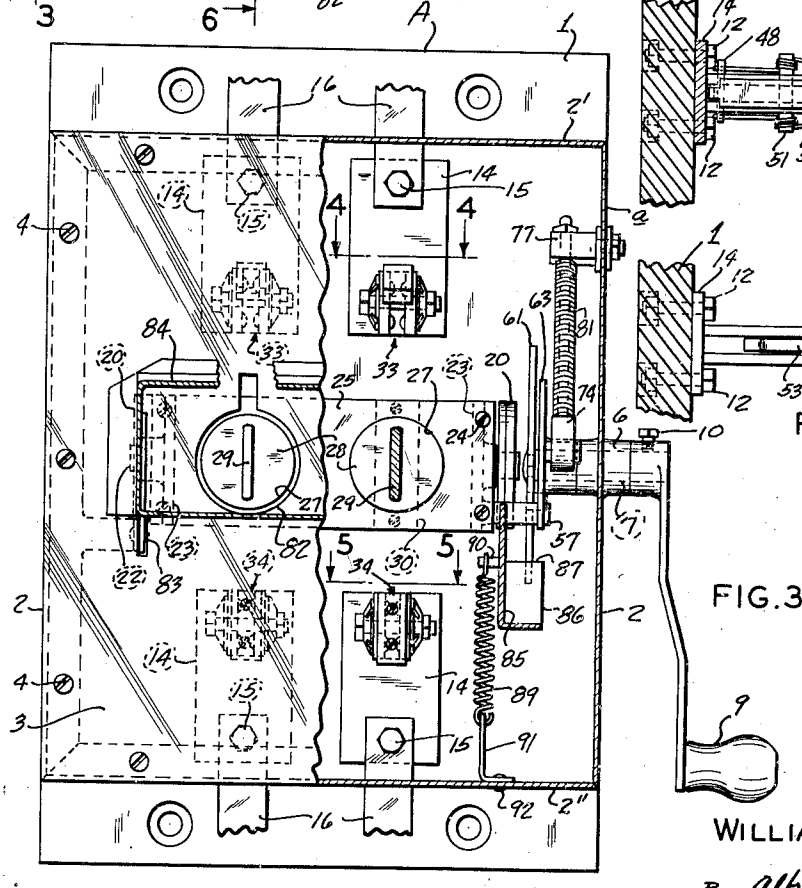

FIG. 3.

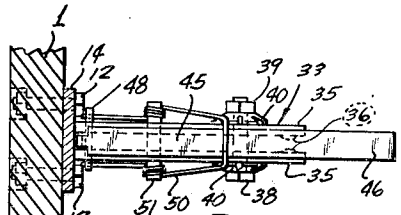

FIG. 4.

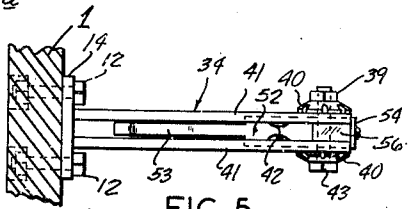

FIG. 5.

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ELECTRICAL SAFETY SWITCH

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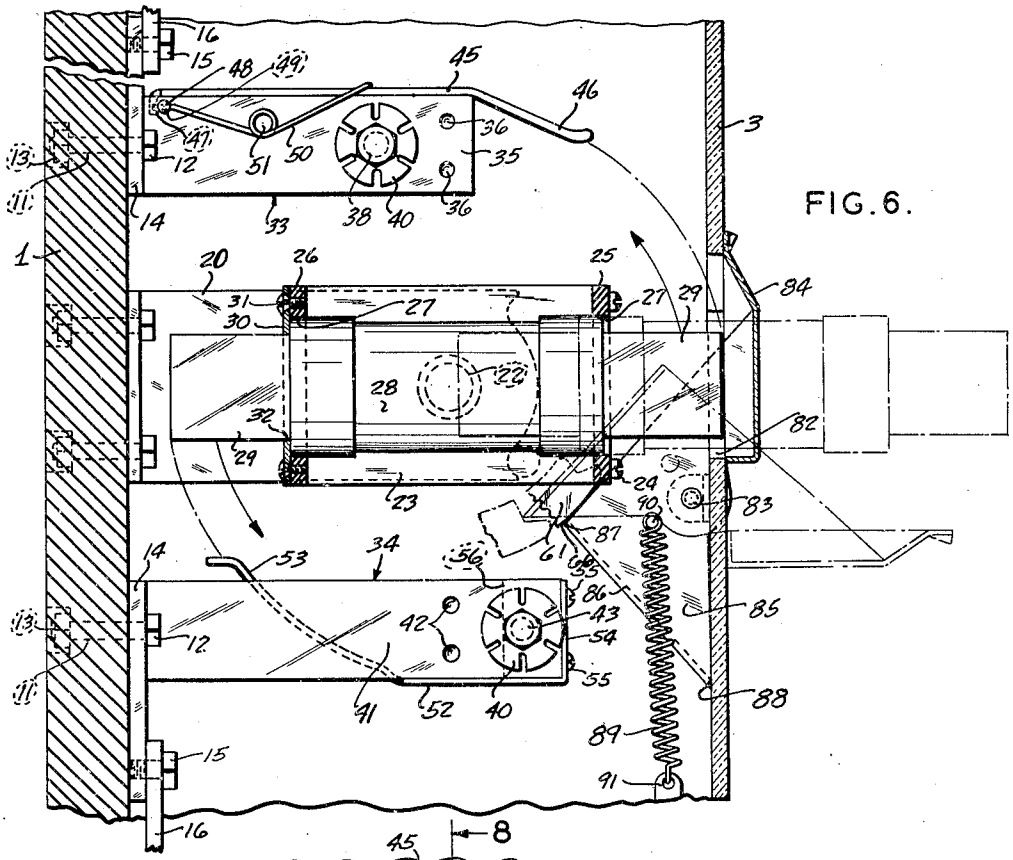

FIG. 6.

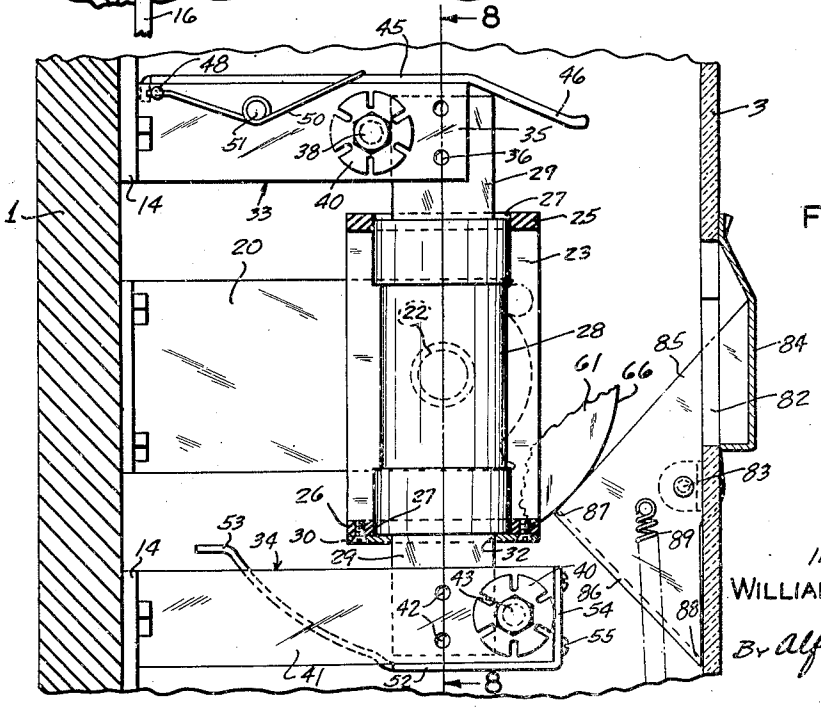

FIG. 7.

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ELECTRICAL SAFETY SWITCH

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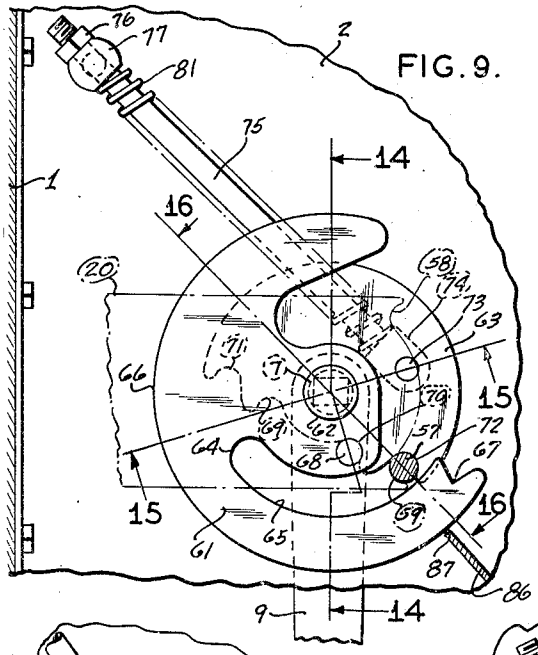

FIG. 9.

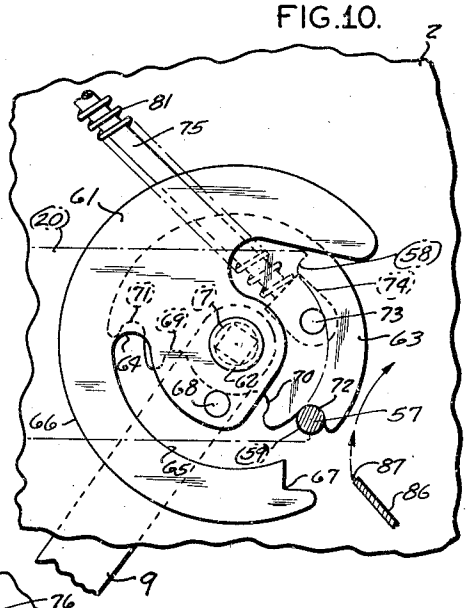

FIG. 10.

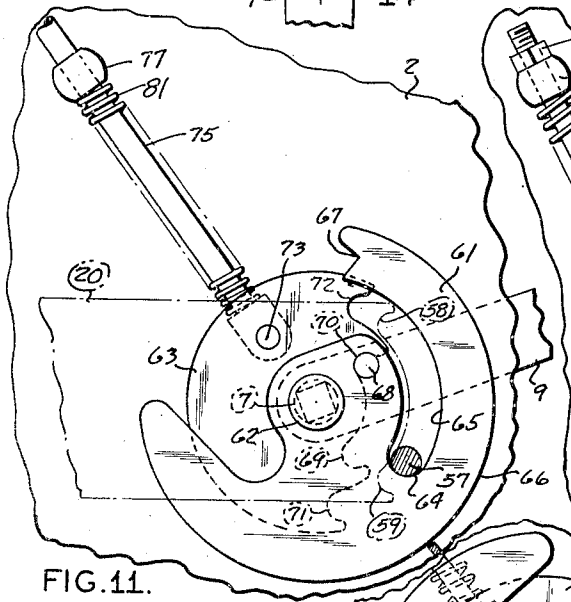

FIG. 11.

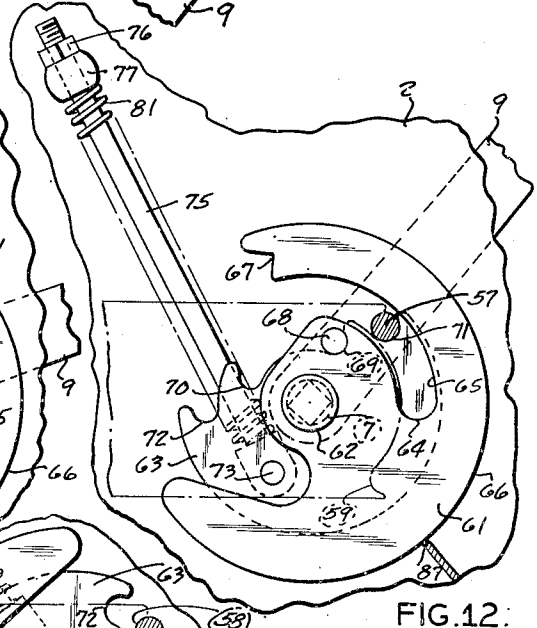

FIG. 12.

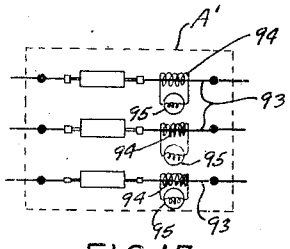

FIG. 17.

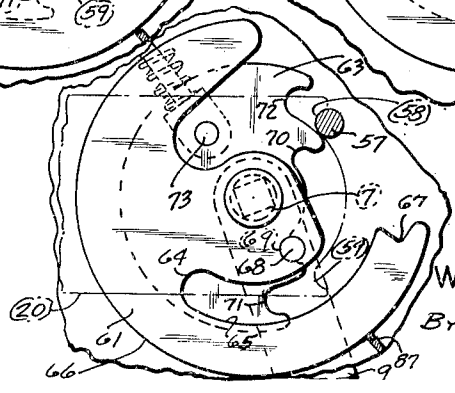

FIG. 13.

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ELECTRICAL SAFETY SWITCH

William H. Lindae, St. Louis, Mo., assignor of one-half to Eola Lindae and one-half to Joseph P. Pohrer

Application August 22, 1946, Serial No. 692,342

11 Claims. (Cl. 200—50)

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This invention relates in general to certain new and useful improvements in electrical safety switches. Electrical safety switches are widely used in industrial applications. The usual type is in its essence a double-pole, single-throw knife switch, with a cartridge-type fuse incorporated in each leg of the circuit, a protective case, and an operating handle outside the case. It is necessary to open the protective case of such a switch in order to remove and replace fuses. When so opened, the switch is no longer safe. Short circuits are readily caused by the insertion of metallic tools, and workmen servicing such switches are frequently injured as a result of accidental contact with the current-conducting portions inside.

The primary object of this invention is to provide a switch containing fuses which may be readily changed with complete safety.

A further object of this invention is to eliminate the conventional switch blades and to utilize the ordinary knife-blade, cartridge-type fuses as the movable elements of the switch.

A further object of this invention is to provide a safety switch box with an access door which can be opened only when the fuses are in disconnected position, and then sufficiently for access to the fuses only.

A further object of this invention is to provide a switch-operating device having positive action with a spring-boost, quick "make-and-break" mechanism.

The above and other objects will become more fully apparent from the following specification which, by way of illustration rather than limitation, shows preferred processes and preferred forms of apparatus constituting embodiments of the present invention, the scope of which is defined in the appended claims.

In the accompanying drawings—

Figure 1 is a perspective view of a safety switch constructed in accordance with and embodying my present invention;

Figure 2 is a horizontal sectional view taken along line 2—2 of Figure 1, and showing the switch mechanism in disconnected position;

Figure 3 is a vertical sectional view taken along line 3—3 of Figure 2;

Figure 4 is a fragmentary top view, partly in section, taken along line 4—4 of Figure 3;

Figure 5 is a fragmentary top view, partly in section, taken along line 5—5 of Figure 3;

Figure 6 is a transverse view, partly in section, taken along line 6—6 of Figure 2, with the switch in disconnected position, showing in dotted lines

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the open position of the access door and a fuse being removed through it;

Figure 7 is a view along the same line as Figure 6, with the switch connected;

Figure 8 is a fragmentary sectional view along line 8—8 of Figure 7;

Figure 9 is a fragmentary view along line 9—9 of Figure 2, showing the switch mechanism in disconnected position, but with the access door locked;

Figure 10 is a view similar to Figure 9 showing the switch mechanism in disconnected position and the operating lever thrown into position for opening the access door;

Figure 11 is a view similar to Figure 9 showing the switch mechanism in so-called "dead center" position;

Figure 12 is a view similar to Figure 9 showing the switch mechanism in fully closed position;

Figure 13 is a view similar to Figure 9 showing the switch mechanism in "dead center" position preparatory to breaking the circuit;

Figure 14 is a fragmentary sectional view along line 14—14 of Figure 9;

Figure 15 is a fragmentary sectional view along the line 15—15 of Figure 9;

Figure 16 is a fragmentary sectional view along line 16—16 of Figure 9; and

Figure 17 is a schematic view of a modified form of safety switch constructed in accordance with and embodying the present invention.

Referring now in more detail and by reference characters to the drawings which illustrate a preferred form of the present invention, A designates a safety switch comprising an outer shell or box *a* including a rear-wall forming dielectric base 1, side walls 2, a top wall 2', a bottom wall 2'', and a transparent plastic front panel 3 removably secured in place by screws 4. The top and bottom walls 2', 2'' are respectively provided adjacent base 1 with upper and lower connection apertures 5, 5' and one side wall 2 is provided upon its opposite face with axially aligned side bearing collars 6 for rotatably supporting shaft 7 which extends horizontally therethrough and at one extended end is provided with an operating handle 9 secured thereto by a set-screw 10.

Formed in the base 1 are apertures 11 for receiving bolts 12 attached thereto by nuts 13 and adapted to hold in place upper and lower contact blocks 14 which are suitably tapped to receive binding posts 15 whereby buss-bars 16 may be connected to the switch. Similarly attached to the insulating base 1 at mid-height are journal brackets 20, which extend forwardly into the box

a and have bearing apertures 21 aligned with the horizontal axis of shaft 7. Rotatably mounted in the apertures 21 are journals 22 extending from rotary side frames 23, which are tapped to receive screws 24 mounting thereto front insulating fuse plate 25 and rear insulating fuse plate 26, provided with relatively large apertures 27 serving as supports and guides for cartridge-type fuses 28 having knife-blade ends 29. Fuse stop-plates 30, attached by screws 31 to rear insulating fuse plate 26, prevent fuses 28 from being inserted too far, and contain slots 32 which vertically align the knife-blade fuse ends 29.

Affixed to the upper and lower contact blocks 14 are, respectively, upper contact clips 33 and lower contact clips 34, each of which has a pair of vertical parallel blades 35 provided with inwardly-embossed spherically-rounded contacts 36 containing at their contact surfaces silver inserts 37, aft of which is lateral bolt 38 and nut 39 under the heads of which are radially-split spring washers 40. Lower contact clips 34 have similar vertically parallel blades 41 with inwardly-embossed spherically-rounded contacts 42 containing similar silver contact inserts 37, forward of which are lateral bolts 43, nuts 39, and radially split spring washers 40. Contacts 36 and 42 are vertically above and below, respectively, the axis of journals 22, and at the same radial distance therefrom. The shanks of bolts 38 and 43 serve as stops for the knife-blade fuse ends 29 when fuses 28 are in vertical or connected position. Thus, fuses 28 center upon the axis of rotation of journals 22 and may be rotatively engaged with said contact clips by turning in the direction indicated by arrows in Figure 6 and may be disengaged therefrom upon rotation in the opposite direction.

To prevent arcing of the contacts 36 and 42 and to hold the fuses 28 in proper position within the fuse-plate apertures 27 during the operation of the switch, each upper contact clip 33 is provided with a guide plate 45 having a contact end 46 bent into the arc of rotation of the upper knife blade terminal 29, and at its other end is provided with a tongue 47 which projects between blades 35 and rests upon a pin 48, the latter being mounted in and projecting through the blades 35 and being provided in its projecting ends with diametral apertures 49 for receiving the ends of wire spring 50 which, at its outer end extends across and bears upon the upper surface of guide plate 45 and intermediate its ends is coiled on each side of blades 35, around the ends of pin 51 projecting through blades 35. For the same purpose each lower contact clip 34 is provided with leaf spring 52 having a rear portion 53 extending upwardly between blades 39 in the formation of a blade guide and initial contact, the forward end 54 of the spring 52 being bent upwardly and secured by screws 55 to block 56 mounted between blades 39 on bolt 42.

It will be understood that all portions of the switch which are intended to conduct the current are fabricated of copper or other metal having good electrical conductivity as in case of contact block 14, contact clips 33 and 34, guide plates 45, and leaf springs 52.

From rotary side frame 23 on the side adjacent to operating handle 9, operating pin 57 projects laterally, its axis being parallel to, but not coincident with, the axis of journals 22. Its rotary travel about said axis is limited by upper arcuate stop lobe 58 and lower arcuate stop lobe 59 formed in both reinforcing plate 60 and in the forward-projecting end of the adjacent journal bracket 20, to which plate 60 is spot-welded.

Operating pin 57 projects also through, and is in the several stages of operation engaged from time to time by, the driving cam 61 keyed to the inner end of shaft 7 and held by retaining screw 62 and is also engaged by floating cam 63 which is, in turn, rotatably mounted on shaft 7. Functional portions of the driving cam 61 include its arcuate lobe 64 at the head of groove 65, outer or door-control, face 66, and door engagement 67. The driving cam 61 is also provided with a laterally projecting pin 68, which moves between the inner arcuate lobes 69 and 70 of floating cam 63. The floating cam 63 is finally provided with outer arcuate lobes 71 and 72 adapted to engage operating pin 57 in the operation of the switch as hereinafter described. Fixed upon floating cam 63 is a lateral pin 73 on which pivots the lower end 74 of the rod 75, the upper end of which is threaded to receive nut 76. Beneath said nut 76 rod 75 passes through sleeve 77 swivel-mounted by its stud 78 to the side adjacent wall 2 of box a by means of nut 79 and washer 80. Fitted over rod 75 between its lower end 74 and sleeve 77 is a spiral spring 81.

The front panel 3 of safety box a is provided with circular openings 82 so located that when the switch is in disconnected position, front insulating fuse plate 25 will be presented toward said openings, with the fuse plate apertures 27 in registration therewith, permitting the removal and replacement of fuses 28. It will be noted access to the interior of the boxes is prevented beyond that sufficient for fuse removal. Mounted on the face panel 3 adjacent to the lower edge of the opening 82 are hinges 83 for operatively supporting the outwardly opening access door 84, provided with an inwardly-extending lever 85 with flange 86 whose upper edge 87 bears against the door-control face 66 of driving cam 61 except when the mechanism is in extreme disconnected position as in Figure 10. In such position the door 84 can be opened, and the lower edge 88 of flange 86 will be engaged by notch 67 in cam 61, as shown in Figure 6, and so held by force of gravity on the handle 9. When flange 86 is released from the notch 67, the door 84 is retained closed by tension spring 89 connecting stud 90 on door lever 85 with lug 91 affixed to the base of box a by rivet 92.

When connected, the respective parts of the operating mechanism are in positions shown in Figure 12, except that the operating handle 9 may be moved upward and aft to a point slightly beyond center so that driving cam lobe 64 rests against operating pin 57. In order to break the circuit, the handle 9 is brought forward and down about a half turn to approximately vertical position so that pin 68 engages lobe 69 of the floating cam, bringing the spring driven rod 75 past the dead-center position shown in Figure 13. The resulting compression in spring 81 drives the floating cam 63 so that its outer lobe 72 engages operating pin 57 and forces it against the lower stop lobe 59. The 90° travel of the operating pin 57 effects a corresponding rotation of the fuses 28, bringing their upper knife-blade terminals 29 forward and down out of engagement with upper contact clips 33 and guide plate 46, and their lower terminals 29 aft and upward out of

engagement with lower contact clips 34 and their contact springs 52, so fuses 28 assume the horizontal position shown in Figure 6. However, with the operating handle vertically down, access door 84 cannot be opened because cam face 66 bears against upper edge 87 of the door lever flange 86. When the lever is swung farther forward as shown in Figure 10, the door may be opened as shown in Figure 6, and the fuses removed and replaced. It is to be noted that the opening 82 in the front face 3 of safety box 2 is relatively small, and whenever the door can be opened front insulating fuse plate 25 is presented closely in front of it, making it almost impossible for the person removing the switch to touch any part inside the box other than this plate and the disconnected fuses. In this manner the job of changing fuses is rendered non-hazardous.

It is apparent that until the access door is closed, the switch cannot be connected. Upon closing the door the handle returns by gravity to the position shown in Figure 9, pin 68 engaging inner lobe 70 of the floating cam. The handle is brought outward and upward past the dead-center position shown in Figure 11. Before reaching this position, lobe 64 of the driving cam has already raised the operating pin 57 from lower stop lobe 59. After the dead-center has been passed, however, the compression in spring 81 drives outer lobe 71 of the floating cam against operating pin 57, carrying it up and against the upper stop lobe 58, rotating the fuses into vertically upward position and thus making the circuit.

The mechanism shown makes and breaks the circuit positively and with extreme rapidity. The use of guide plate 45 on the upper contact, and leaf spring 52 on the lower assures that arcing cannot wear away the spherically-rounded upper and lower contacts 36 and 42, or their long-wearing silver inserts 37.

A modified form of safety switch A' may also be provided, as shown in Figure 17, and is substantially identical in all its mechanical parts with the previously described safety switch A except that the outgoing leads 93, which are normally dead when the switch is disconnected, are provided with a small many-turned induction coil 94, the ends of which are connected directly across the terminals of a small ruby lamp 95 which may be either of the incandescent or fluorescent type, as desired. Thus, when current is flowing through the outgoing leads 93 the lamps will glow, providing an indication of such fact. When the switch A' is disconnected and current ceases to flow in the leads 93, the lamp 95 will go out. If, for any reason, the mechanical parts of the switch A' should malfunction and fail to disconnect properly even though the handle and relating mechanism have been moved into disconnecting position, this failure to disconnect will be clearly signaled by the fact that the lamp 95 remains lighted.

It should be understood that changes and modifications both in the methods as well as in the form, construction, arrangement and combination of the several parts of the safety switch may be made and substituted for those herein shown and described without departing from the nature and principle of the present invention.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. Operating mechanism for a safety switch including a switch box having an access door, a bearing penetrating the side of the switch box, and a shaft rotatably mounted therein on an axis concentric with that of said rotating switch element, said operating mechanism comprising an operating lever fixed to the outer extremity of said shaft, a cam keyed to the inner end of the operating lever and having an outer face, an access door control mechanism abutting said face whereby to permit opening of an access door only when said operating lever is in position for disconnection of the circuit, a second cam mounted on said shaft adjacent to said first named cam, spring means carried by the switch box and acting eccentrically on said second cam in a plane substantially parallel to its plane of rotation thereby permitting travel on each side of a dead-center position of said spring means equal to not less than the arc of rotation, a pin eccentric and parallel to the axis of rotation of said rotating switch element interconnecting it with lobes of said second cam during travel through the arc of rotation in either direction after passing said dead-center position, so that the spring force released as said position is passed will drive said rotating switch element through said arc of rotation, stop means limiting rotary travel of the switch element to the arc of rotation, and a pin operating between cam lobes, interconnecting said first named cam with said second cam during travel of said second cam in either direction approaching and passing the dead-center position.

2. In a safety switch, spaced fixed contact elements, a rectangular fuse carrying frame including forward and rear insulating plates having aligned apertures, said frame being journaled for rotation about an axis lying between said contact elements, cartridge fuses supported in said apertures and having end terminals extending therethrough, fuse stop plates secured to said rear insulating fuse plate to limit movement therethrough of the fuses, said stop plates having slots through which extend the one end terminal of the fuses, and means for rotating said rectangular frame so as to optionally engage and disengage the end terminals with the fixed contact elements.

3. In a safety switch, spaced fixed contact elements, a rectangular fuse carrying frame including forward and rear insulating plates having aligned apertures, said frame being journaled for rotation about an axis lying between said contact elements, cartridge fuses supported in said apertures and having end terminals extending therethrough, fuse stop plates secured to said insulating fuse plates to limit movement of the fuses through said apertures, said stop plates having slots disposed in a plane at right angles to the axis of rotation of the fuse carrying frame through which extend one end terminal of the fuses, and means for rotating said rectangular frame so as to optionally engage or disengage the end terminals with the fixed contact elements.

4. In a safety switch, vertically spaced fixed contact elements, a rectangular fuse carrying frame including forward and rear insulating plates having aligned apertures, said frame being journaled for rotation about an axis lying between said contact elements and in such a manner that said forward plate will be positioned horizontally and above said axis and the rear plate will be positioned horizontally and below said axis when the switch is in closed position,

cartridge fuses loosely held in said apertures and having end terminals extending therethrough, fuse stop plates secured to said rear insulating fuse plate adjacent the apertures in said rear plate to prevent movement therethrough of the fuses when said fuse carrying frame is rotated to closed position, said stop plates having slots disposed at right angles to the axis of rotation of the frame through which extend one end terminal of the fuses, and means for rotating said rectangular frame so as to optionally engage and disengage the end terminals with the fixed contact elements.

5. In a safety switch, vertically spaced contact elements, a finger element extending outwardly from the upper one of said fixed contact elements, a rectangular fuse carrying frame including forward and rear insulating plates having aligned apertures, said frame being journaled for rotation about an axis lying between said contact elements and in such a manner that the forward plate will be positioned horizontally above said axis and the rear plate will be positioned horizontally below said axis when the switch is in closed position, cartridge fuses loosely held in said apertures and having end terminals extending therethrough, fuse stop plates secured to said rear plate adjacent the apertures in said rear plate to prevent the fuses from falling therethrough when the frame is rotated to closed position, said stop plates having slots disposed in a plane at right angles to the axis of rotation of said frame through which slots extend one end terminal of the fuses, the other end terminal of said fuse engaging said finger element on the upper fixed contact element when the frame is rotated into circuit closing position whereby said fuse is firmly seated upon said fuse stop plate insuring complete contact between said end terminals and said fixed contact elements, and means for rotating said rectangular frame so as to optionally engage and disengage the end terminals with the fixed contact elements.

6. A safety switch comprising pairs of substantially vertically spaced stationary contacts, a frame journaled for rotation about a substantially horizontal axis located intermediate the contacts, and being adapted to move from a horizontal to a vertical position, said frame having aligned apertures, a cartridge fuse loosely disposed within said apertures and being freely removable from the frame when the latter is in horizontal position, said cartridge having blade-like terminal members adapted for contactive engagement with said contacts when the frame is in vertical position, and resilient guide plates mounted upon the stationary contacts for slidably engaging the transverse end faces of said terminal members as the frame is rotated into vertical position for restraining the cartridge fuse against endwise movement in relation to the frame.

7. A safety switch comprising vertically spaced contact elements, a finger element extending outwardly and downwardly from the upper one of said contact elements, a finger element extending upwardly and outwardly from the lower one of said contact elements, a rectangular fuse carrying frame including forward and rear insulating plates having aligned apertures, said frame being journaled for rotation about an axis lying between said contact elements and in such a manner that the forward plate will be positioned horizontally and above said axis and the rear plate will be positioned horizontally and below said axis when the switch is in closed position, cartridge fuses loosely held in said apertures and having end terminals extending therethrough, fuse stop plates secured to said rear plate adjacent the apertures in said rear plate to prevent the fuse from falling therethrough when the frame is rotated to closed position, said stop plates having slots disposed in a plane at right angles to the axis of rotation of said frame through which slots extend one end terminal of the fuses, the end terminals of said fuses engaging said finger elements on said fixed contact elements when the frame is rotated into circuit closing position, whereby said fuses are firmly seated upon said fuse stop plate and insure complete surface contact between said end terminals and the fixed contact elements, and means for rotating said rectangular frame so as to optionally engage and disengage the end terminals with the fixed contact elements.

8. An electric switch comprising a rectangular fuse carrying frame, cartridge fuses with end terminals supported in said frame, the end terminals of said fuses protruding through apertures in said frame, spaced fixed contact elements, said frame being journaled for rotation about an axis lying between said contact elements, means for rotating said rectangular frame so as to optionally engage and disengage the end terminals with the fixed contact elements, said contact elements comprising a pair of parallel blades, said blades provided with inwardly embossed spherically rounded contact points, resilient guide plates mounted on said blades and extending outwardly from said blades into the arc of rotation of the end terminals, a tongue provided at the extreme outer end of said resilient guide plates to make initial contact with said end terminals when said switch is rotated into circuit closing position, and spring members provided on said contact elements to maintain said guide plates to said blades.

9. An electric safety switch comprising a rectangular fuse carrying frame, cartridge fuses with end terminals loosely held in said frame, said frame having apertures through which said end terminals protrude, vertically spaced fixed contact elements, said frame being journaled for rotation about an axis lying between said contact elements, said contact elements comprising a pair of parallel blades, said upper contact elements having a first resilient guide plate member extending outwardly and downwardly therefrom, said lower contact elements having a second resilient guide plate extending upwardly and inwardly therefrom whereby said fuses are seated securely within the apertures of the frame by a downward action of the first resilient guide plate on one end terminal of the fuse and an upward movement of the other end terminal by the second resilient guide plate when said fuse is rotated into circuit closing position thus insuring complete contact between said end terminals and said contact elements.

10. In an electric safety switch of the type wherein the circuit is made by rotating a fuse carrying frame through which the end terminals of the fuses protrude through a fixed arc of rotation less than 180° into contact with electrical contacts opposed at a distance corresponding to the fuse length between terminals and breaking said circuit by rotating said fuse carrying frame through said arc in the opposite direction, a protective case, an access door in said case adjacent

to one end of said fuse terminals when in disengaged position, a bearing extending through the side of said case, a shaft rotatably mounted therein on an axis concentric with that of said fuse carrying frame, an operating handle fixed to the outer extremity of said shaft, a cam keyed to the inner end of said lever and having an outer face, access door control mechanism abutting said face whereby to permit opening of said access door only when said operating handle is in position for disconnection of the circuit, a second cam mounted on said shaft adjacent to said first mentioned cam, spring means attached to said fixed insulated portion and acting eccentrically on said second cam in a plane substantially parallel to its plane of rotation, permitting its travel on each side of a dead center position of said spring means equal to not less than the arc of rotation, a pin eccentric and parallel to the axis of rotation of said fuse carrying frame interconnecting such frame with lobes of said second cam during travel through the arc of rotation in either direction after passing said dead center position so that the spring force released as said position is passed will drive said frame through said arc of rotation, stop means limiting its rotary travel to the arc of rotation, and mechanism, as a pin operating between cam lobes, interconnecting said first cam with said second cam during the latter's travel in either direction approaching and passing said dead center position.

11. In an electric safety switch of the type wherein the circuit is made by rotating a fuse carrying frame through which the end terminals of the fuse protrude through a fixed arc of rotation less than 180° into contact with electrical contacts opposed at a distance corresponding to the fuse length between terminals and breaking said circuit by rotating said fuse carrying frame through said arc in the opposite direction, a protective case, an access door in said case adjacent

to one end of said fuse terminals when in disengaged position, said access door being hingedly mounted on an axis parallel with the axis of rotation of the fuse carrying frame, a lever attached to said door and extending within the protective case, a flange provided on said door lever, a bearing extending through the side of said case, a shaft rotatably mounted therein on an axis parallel to the hinge axis of the access door, an operating handle fixed to the outer extremity of said shaft, a driving cam keyed to the inner end of said shaft and provided with a cut-away portion along its periphery, said driving cam co-operating with means for operatively rotating said fuse carrying frame, the flange of said door lever abutting against the periphery of said driving cam when the rotatable fuse carrying frame is in circuit closing position whereby opening of the door is prevented, the flange of said door lever being opposite the cut-away portion of said driving cam for opening of said door when the driving cam is so moved as to rotate the fuse carrying frame into circuit breaking position.

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

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