Oct. 29, 1935. E. G. JOHANSSON 2,019,416

ELECTRIC SWITCH

Filed Aug. 19, 1931 2 Sheets-Sheet 1

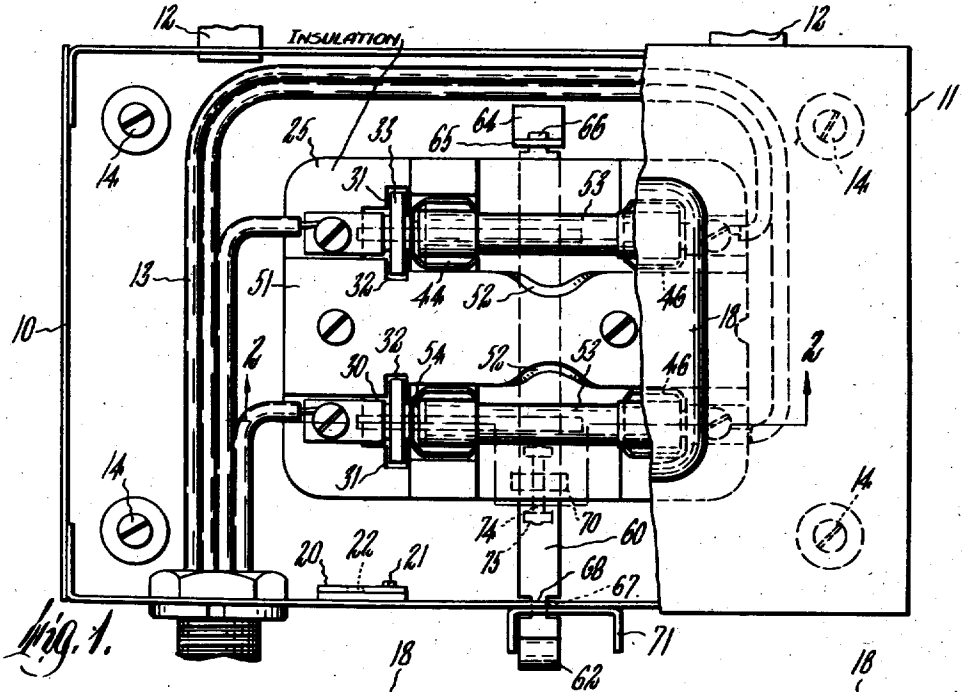


Fig. 1.

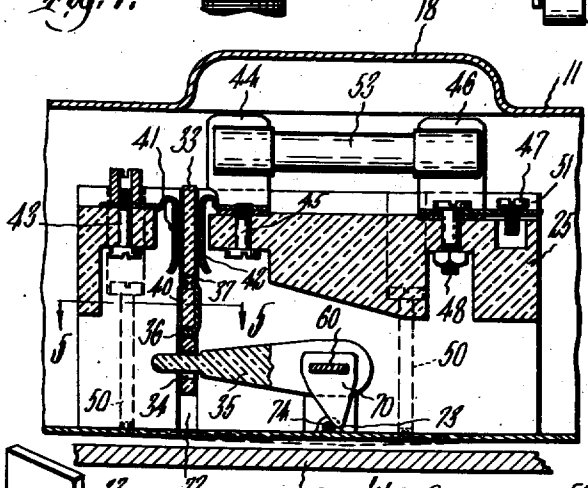


Fig. 2.

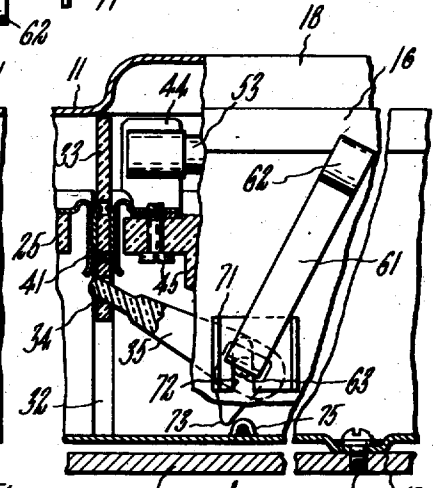


Fig. 3.

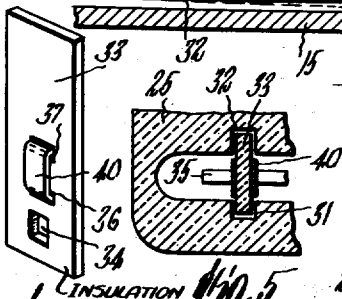


Fig. 4.

Fig. 5.

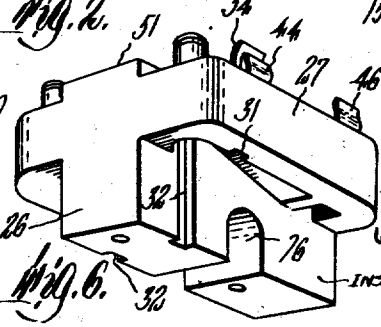


Fig. 6.

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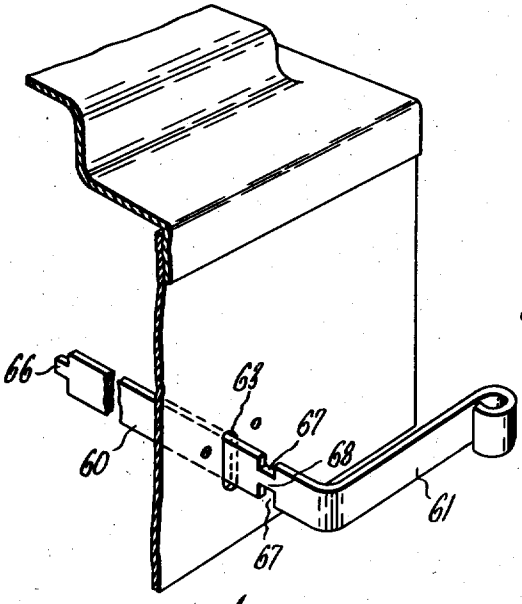


Fig. 7.

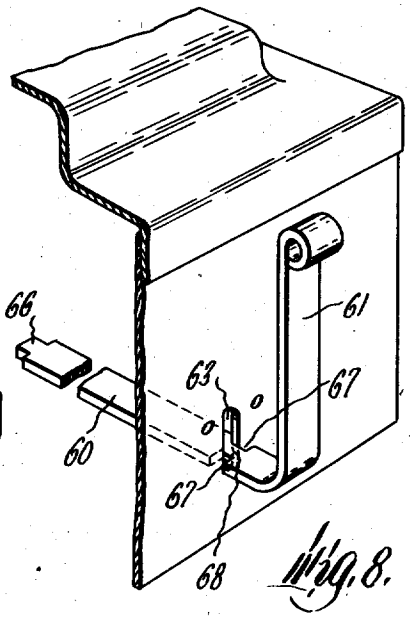


Fig. 8.

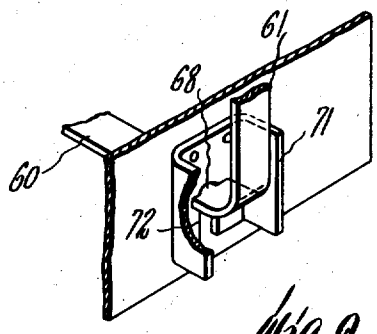


Fig. 9.

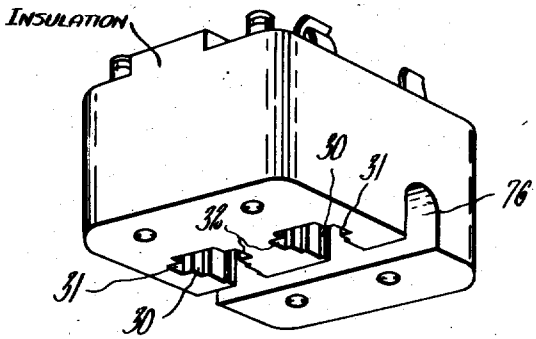


Fig. 10.

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UNITED STATES PATENT OFFICE

2,019,416

ELECTRIC SWITCH

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Application August 19, 1931, Serial No. 558 038

6 Claims. (Cl. 200—114)

This invention relates to an electric switch which is characterized chiefly by compact, simple, rugged, durable and economical construction, which is easily assembled, in which the various current-carrying parts of opposite polarity are suitably spaced from each other, and in which arcing when the current is ruptured is reduced to a minimum.

Generally accepted standard practice requires a definite cross-section for electrical switch current-carrying parts based on their ampere rating and on the conductivity of the copper and also a definite dimension spacing between such parts that are of opposite polarity when mounted on the same surface. The rupture capacity of such devices is determined by their performance under test.

The invention, as embodied in the form illustrated on the drawings and hereinafter described, may include a suitable box or housing and fuse terminals. Within the box is mounted a unitary block of insulating material on which are mounted the switch elements, fuse terminals, and wiring terminals, the block being cut away to form cavities or pockets in which the switch elements make and break contact with each other. This helps to quench any arc which may occur between separating switch elements when the circuit through them is ruptured. Further provision is made for quenching arcs by structure which causes rapid separating movement between the switch elements at the instant of separation, and by the interposition of an insulating barrier between the switch elements immediately after the circuit through the switch elements is broken. According to the invention, the switch elements are preferably made of rolled or drawn copper bar stock bent to shape in such a way that the surfaces which rub on each other rub along the "grain" of the metal. Various additional advantageous features of structure will be apparent to one skilled in the art from the disclosure of the invention in the following description of an embodiment thereof, and from the drawings, of which:

Figure 1 is a plan view of an embodiment of the invention.

Figure 2 is a section on the line 2—2 of Figure 1.

Figure 3 is a fragmentary side elevation of the same with portions broken away to show in section.

Figure 4 is a perspective view of one of the barrier members with a bridging element.

Figure 5 is a fragmentary section on the line 5—5 of Figure 2.

Figure 6 is a perspective view of an insulating block which carries the terminal members.

Figures 7, 8 and 9 are perspective views of the operating shaft and handle, showing successive steps of assembling with the box, a fragment of which is shown.

Figure 10 is a perspective view of an insulating block such as is shown in Figure 6, but differing slightly in form.

The switch and fuse-holding members may be housed in a suitable box 10 having a cover 11 hinged thereto as by suitable hinges 12 of any desired construction. The box and cover may be made of stamped sheet metal as is customary in the art. For convenience in describing and claiming the apparatus illustrated, the box will be considered as lying with its back on a horizontal surface, the hinged cover thus forming the top of the box. It is understood, however, that the box in actual use may be mounted in any desired position and is ordinarily fixed to a vertical wall. The box is adapted to receive a suitable number of conductors such as insulated wires 13 through any one of the side walls thereof. To this end each side wall may be provided with suitable knock-out sections which can be readily removed to receive a bushing or clamp for armored cable or conduit. These knock-out portions are customarily circular, and are partially fractured so as to facilitate removal from the wall. As the size of the bushing to be inserted will depend on the size of the conduit or the size and number of conductors which are to enter the box, knock-out sections may be provided in two or more different sizes which may be arranged one within another at convenient points in the side walls, the knock-out portions being arranged so that bushings which are set in the holes which are left will be clear of the cover flange. The depth of the box must be sufficient to accommodate against a side or end of the box the largest size bushing or fitting therefor to be used with the box. The switch structure within the box is arranged so as to permit a box of such minimum depth to carry the switch and fuse-holding elements therein with the prescribed spacing between all current-carrying parts of opposite polarity. The bottom of the box is suitably pierced to receive screws 14 by which the box may be secured to a supporting wall 15, and is preferably offset from the supporting wall 15 by small bulges projecting outwardly as at 17 from the bottom of the box, preferably around

the holes for the screws 14. The cover 11 is provided with a suitable flange 16, this cover having a central bulge or dome 18 projecting outwardly to provide sufficient spacing between portions of the box top and the current-carrying fuse terminals. Mounted on a side wall of the box near the bottom is a latch member 20 which is adapted to project up through a corresponding slot (not shown) in the box cover 11 when the box is closed. A small tab 21 is struck out laterally from the latch 20 to engage an edge of the slot in the cover so as to hold the cover releasably shut. The latch 20 may also be provided with a suitable hole 22 through which a padlock or other securing means may be passed in order to lock the box shut.

The fixed current-carrying elements within the box are all mounted on a suitable unit block 25 which is preferably of molded porcelain or other suitable insulating material. This block, as illustrated in Figures 6 and 10, has the general shape of a rectangular parallelepiped. The block is pierced vertically by a pair of holes 30 into which project portions of the switch elements, these holes serving as cavities or pockets in which the current-rupturing separation of switch elements takes place so that the arcs are partially enclosed by the adjacent portions of the block 25. The holes 30 each include a pair of vertical grooves 31 and 32 which guide a sliding barrier 33 carrying a make-and-break or movable switch element 40 thereon. The barrier 33 is preferably made of insulating material such as vulcanized fiber, and is pierced as at 36 and 37 to receive the movable switch element 40. This switch element is preferably a strip of flat rolled or drawn copper bar stock. This strip passes through the lower hole 36, extends upwardly on both sides of the barrier, and has its ends bent into the upper hole 37. The portions of the strip between the two holes lie against the opposite faces of the barrier 33 and present contact faces for rubbing engagement with a pair of fixed switch elements 41 and 42. The "grain" of the metal in the contact faces of the movable element 40 extends vertically, that is, in the direction of motion of the barrier 33 and the element 40.

The stationary switch elements 41 and 42 are preferably made of rolled or drawn copper bar stock bent to shape. As shown in Figure 2, each of these elements has a horizontal portion fixed to the upper face of the block 25, and a vertical portion projecting downwardly into the hole 30. The downwardly projecting portions of the elements 41 and 42 present to each other within the hole 30 spaced parallel contact faces between which the barrier 33 is adapted to slide loosely to move the switch element 40 into and out of contact with the fixed elements 41 and 42. The grain of the metal in the vertical portions extends vertically. Hence the contacting faces of the elements 40, 41 and 42 rub each other along the grain and thus greatly increase the wearing qualities of the elements. The switch element 40 is located well below the upper edge of the barrier 33 so that when the element 40 is below and out of contact with the elements 41 and 42, the upper portion of the barrier lies between and confronts the vertical portions of the elements 41 and 42 throughout their entire length.

As shown in Figure 1, the fixed current-carrying elements are arranged in straight lines on the top of the block, each aligned set of elements comprising a line terminal 43, a pair of switch elements 41 and 42, a pair of fuse terminals 44 and 46, and a second line terminal 47. This straight-line arrangement economizes space as it permits the use of a block 25 of minimum width consistent with the required spacing between current-carrying members of opposite polarity. Assuming that the clearance between the sides of the block 25 and the side walls of the box 10 is the minimum requisite for housing the wires which enter the box, the resulting box is as narrow as can be made in conformity with standard requirements of spacing.

The fixed current-carrying elements lie substantially in a common plane. The path of motion of each movable switch element 40 is substantially perpendicular to this plane and is between the corresponding line terminals, the points of separation between switch elements being well below this plane. This results in economy in the required length of the block 25 since the range of motion of the movable elements 40 must be substantial to ensure the quenching of arcs when a heavy current is ruptured. Suitable means for moving the barrier members 33 up and down are provided. As shown on the drawings, each barrier member is pierced near its lower end as at 34 to receive the reduced end of an arm 35. These arms are preferably made of insulating material such as vulcanized fiber and are mounted on a rock shaft 60. The rock shaft 60 as shown in the drawings is preferably made of flat bar stock of steel or other suitable material, and preferably has a bent portion 61 at one end acting as a crank arm with handle element 62. The arms 35 which operate the barrier members 33, are preferably slotted so as to fit loosely on the rock shaft. Since this slot is non-circular, the arms 35 rock with the shaft 60. This shaft is mounted in a box in a simple and economical manner. The side wall of the box 10 is pierced with a slot 63 of sufficient height to receive the shaft 60 when the latter is on edge with the crank arm 61 parallel to the bottom of the box as shown in Figure 7. The shaft 60 can thus be inserted through the side wall of the box when turned to the position shown in Figure 7. A bearing member 64 is provided near the other side of the box, this member being preferably attached as by riveting or welding to the bottom or side wall of the box opposite the slot 63. As shown in Figure 1 the bearing member 64 consists of an angle bracket having an upstanding ear 65 perforated to receive the reduced end portion 66 of the shaft 60 remote from the crank arm 61. Near the crank arm 61, the shaft 60 is laterally notched as at 67 to form a neck 68 sufficiently narrow to turn in the slot 63. The notches 67 are suitably spaced from the reduced end 66 so that when the latter is in the aperture of the bearing member 64, the slots 67 register with the sides of the slot 63 so that the crank arm 61 may be swung upwardly to the position shown in Figure 8. In this position axial movement of the shaft 60 is prevented. In assembling the switch mechanism, the shaft is inserted through the side wall of the box 10 in the position shown in Figure 7, the various elements including the arms 35 which are to be mounted on the shaft are slipped over the end 66 for this end is inserted through the aperture in the bearing member 64. The arm 61 is thereupon rocked to its upright position shown in Figure 8. To maintain the rock shaft in place, I provide a U-shaped element 71 having a pair of arms projecting outwardly from the wall of the box. These arms permit the operation of the shaft

through its operative angle but prevent the rocking of the shaft to a position which permits its removal through the slot 63. The member 71 may be slotted as at 72, this notch registering with a portion of the slot 63 and acting to maintain the neck 68 in the lower portion of the slot. This prevents excessive play or looseness of the shaft 60.

For the more effective quenching of arcs between the bridging conductors 40 and the contact members 41 and 42, it is desirable that the slides 33 be snapped or jerked downwardly when the conductors 40 are about to leave contact with the contact members in their circuit-breaking movement. A snap action device may be provided to produce automatically a short, quick downward jerk on the plates 33 at the proper moment when the switch handle is swung to break the circuit. The snap action device illustrated on the drawings comprises a heart-shaped arm 70 of refractory material, this arm having a downwardly tapering portion below the shaft 60 terminating in a rounded lower end 73. The arm 70 is of such a length that in the lower portion of its swing with the rocking of the shaft 60 it engages the bottom of the box or an abutment element thereon. If that portion of the bottom of the box is spaced from the supporting wall 15, it is free to give slightly. The shaft 60 may also be slightly resilient. As the end portion 73 of the arm 70 reaches the bottom of its swing, the shaft 60 and a portion of the bottom of the box are sprung away from each other by engagement of the arm 70 with the bottom of the box or an abutment thereon. As the end portion 73 passes the lowermost point of its swing, the powerful restoring force arising from the stiffness of the shaft 60 and the bottom of the box presses strongly against one side edge or the other of the arm 70 and causes an exceedingly quick rotational movement of the shaft through a small angle. This jerks the plates 33 up or down as the case may be. In the circuit breaking movement, the parts are so arranged that the jerk on the plates 33 comes just as the conductors 40 are leaving contact with the members 41 and 42.

The snap action may be produced by causing the end portion 73 of the arm 70 to engage directly against the inner face of the bottom of the box. As shown, however, an abutment member is mounted on the bottom of the box in the path of the end portion 73. The abutment member may be made of hardened steel to prevent rapid wear. While the abutment member may be made in various forms, it is shown on the drawings in the form of a hardened steel pin 74 which may be held loosely against the bottom of the box by a pair of loops 75 struck up from the bottom This structure promotes a quick jerk which can be closely timed to occur at any desired point of the stroke of the operating handle. The loose mounting of the pin 74 permits the pin to turn on its axis to present different portions of its periphery for engagement with the arm 70. This greatly prolongs the life of the abutment member.

The block 25 on which are mounted the various current-carrying elements of the switch is illustrated in slightly differing forms in Figures 6 and 10. The block is preferably in the general shape of a rectangular parallelepiped, but portions thereof may, if desired, but cut away to save weight and material, such portions being unnecessary for the correct design and operation of the switch. As shown, the top of the block may be cut away along either side leaving a central rib 51 on either side of which are mounted the fixed current-carrying elements. The rib 51 permits close spacing between the two sets of elements while retaining the required surface distance between members of opposite polarity. In each set of elements on the top of the block 25, the line terminal 43 may be used to anchor the switch element 41 to the upper surface of the block 25. The fuse-terminal 44 may be anchored to the upper surface of the block 25 and held in contact with the switch element 42 as by a screw or bolt 45. The cooperating fuse terminal 46 may be mounted as by a bolt 48 on the upper face of the plug and suitably spaced from the terminal 44 to support therewith a cartridge fuse 53, the fuse terminals each having a bent-in portion 54 to hold the fuse against longitudinal displacement. The bolt 48 also holds the line terminal 47 in contact with the fuse terminal 46. The sides of the rib 51 may be recessed as at 52 between the fuse terminals 44 and 46 so as to facilitate the grasping of the fuse 53 with the finger for removal thereof.

In addition to cutting away portions from the top of the block, I may also cut away portions from the sides of the block near the bottom thereof so as to leave a structure comprising an elevated platform 27 upon a supporting member 26 beneath its longitudinal median line, thus leaving spaces under the platform on either side of the support member for the switch-operating lever arms 35. The block is also notched upwardly from its bottom surface as at 76, this notch extending from one side to the other to receive operating shaft 60 for rocking motion. Various holes may also be provided through the block for the line terminals 43, the bolts 45 and 48, and a pair of bolts 50 by which the block itself is anchored to the bottom of the box 10. It should be noted that in both forms of block illustrated in Figures 6 and 10, the points of separation between the movable switch elements 40 and the fixed switch elements 41 and 42 are substantially enclosed by the interior walls of the block which define the holes or cavities 30. This partially enclosed space about the points of separation limits the supply of oxygen immediately available for the maintenance of the burning arc between the switch elements after the circuit has been ruptured and this tends to quench any arc which may be formed by the separation of the element 40 from the contact elements 41 and 42.

The arc quenching features, including the barrier 33 which moves into position between the fixed switch elements 41 and 42 when the circuit is ruptured, the snap action device which causes quick separating movement of the movable switch element 40 away from the fixed elements at the instant of circuit rupture, and the location of the points of separation of the switch elements in a confined space substantially enclosed by walls of insulating material, all coact to augment the efficiency of the switch whereby it successfully ruptures circuits carrying currents of high amperage.

The unitary block with fixed switch elements and terminals arranged in straight lines on its top face, the arrangement of the barriers to move with the bridging conductors through holes in the block and at right angles to the plane of the top of the block, and the actuation of the barriers from below, make possible a switch structure which is exceedingly compact but which conforms to the customary requirements of spacing between current-carrying parts.

It is evident that various modifications and

changes may be made in the structure described herein without departing from the spirit and scope of the invention as defined by the following claims.

I claim:

1. Apparatus of the class described, comprising a block of insulating material, said block having an approximately rectangular upper portion with a longitudinal median rib extending on its upper face from end to end and a hole therethrough on either side of said rib, a switch and fuse device including elements arranged in two parallel lines on the upper face of said block on either side of said rib, the elements in each said line consisting of a line terminal and a fixed contact member connected together, a second fixed contact member and a fuse terminal connected together, and a second fuse terminal and a second line terminal connected together, said fixed contact elements in each line extending into a corresponding hole in said block, said device also including a switch member movable in each hole in a direction perpendicular to the plane of said lines into and out of connecting relation to the corresponding pairs of fixed contact elements, and a pair of operating levers for said movable switch members, each said lever being disposed below said upper portion of the block and substantially in a plane of a set of said line and fuse terminals and the hole corresponding thereto.

2. In an electrical switch, a block of insulating material with a cavity therein, a pair of switch elements fixed on the upper surface of said block with portions projecting downwardly into said cavity and presenting opposed spaced contact faces within the cavity, a pair of line terminals and a pair of fuse terminals mounted on the upper surface of said block all in line with said switch elements, a barrier of insulating material loosely slidable between said faces in a direction at right angles to upper surface of the block, and a third switch element carried by said barrier and movable therewith into and out of simultaneous contact with the two fixed elements.

3. In an electrical switch, a block of insulating material having a cavity therein, and a pair of grooves in the cavity on opposite sides thereof, a pair of switch elements and a pair of line terminals mounted in line on the upper surface of said block, said elements having portions projecting downwardly into said cavity and presenting opposed spaced contact faces, a barrier of insulating material loosely slidable between said faces in a direction at right angles to said upper surface of the block, said barrier having its side edges slidable in and guided by said grooves and a third switch element carried by said barrier and projecting therethrough, said third switch element being movable therewith into and out of simultaneous contact with said downwardly projecting portions.

4. In an electrical switch, a block of insulating material, and fuse terminals and line terminals all mounted on the upper face of said block, the lower portion of said block being cut-away at the sides to provide spaces for switch-operating levers, said block having a pair of holes therein each extending downwardly from the top at a point between a line terminal and its adjacent fuse terminal to one of said spaces and a transverse channel in the lower portion thereof for an operating shaft, each said hole having a pair of vertical guide grooves for a movable contact member.

5. An electrical switch comprising a platform of insulating material, supporting means for said platform beneath its longitudinal median, said platform having a hole therethrough on each side of said median, two pairs of fuse-holding clips mounted on said platform, a pair being on each side of said median and aligned with one of said holes, a pair of fixed contact elements projecting into each said hole, one of each pair of contact elements being electrically connected to a fuse clip, a line terminal connected to the other contact element of each pair, a barrier member of insulating material in each hole between the pair of contact members therein, a bridging conductor on each said barrier member and movable therewith into and out of contact with the corresponding pair of contact elements, a transverse rock-shaft beneath said platform, a pair of lever arms mounted on said shaft and operatively connected to respective barrier members, and handle means actuable to rock said shaft.

6. An insulator block for a fused switch, comprising a substantially rectangular platform with a median longitudinal rib thereon and a median longitudinal supporting rib thereunder, the side portions of said platforms projecting laterally beyond said ribs and each having a hole therethrough, each said hole having a pair of opposed parallel guide grooves to receive the edges of a sliding switch member, one of each said pair of guide grooves extending across the adjacent side face of the rib under the platform.

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