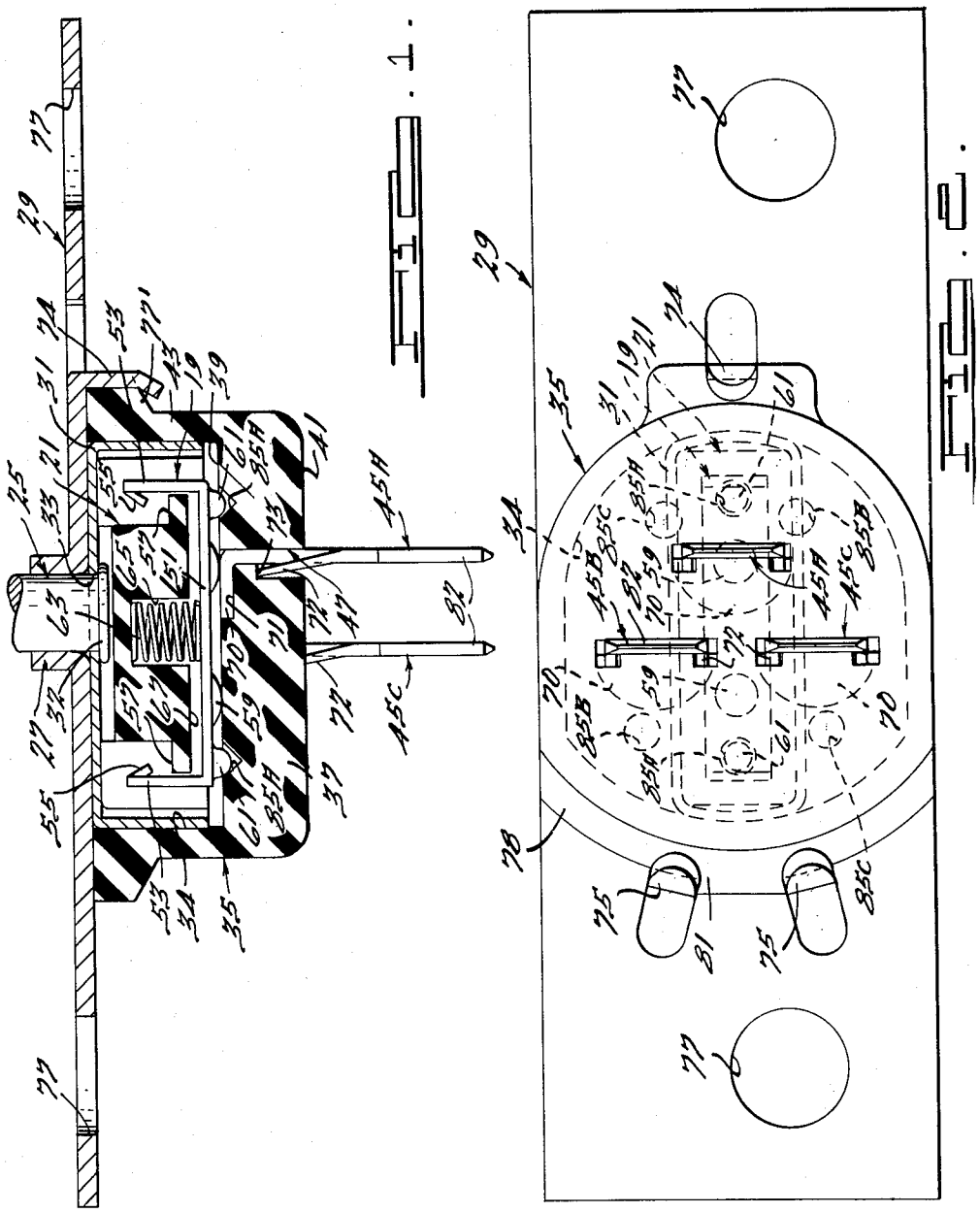
Aug. 1, 1961 J. LONG 2,994,748

BLOWER SWITCH

Filed June 3, 1957 3 Sheets-Sheet 1



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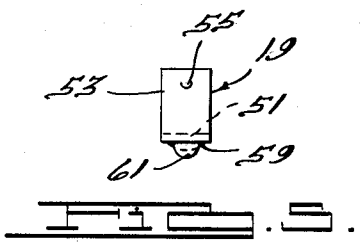

FIG. 5.

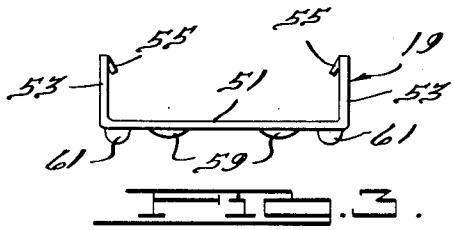

FIG. 3.

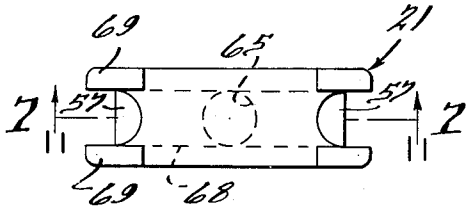

FIG. 6.

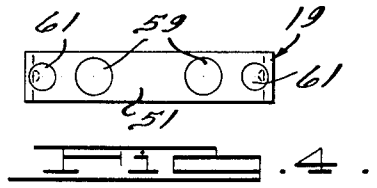

FIG. 4.

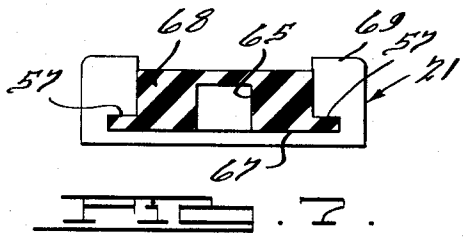

FIG. 7.

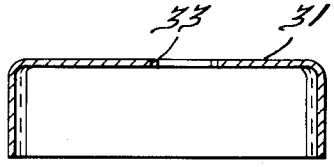

FIG. 10.

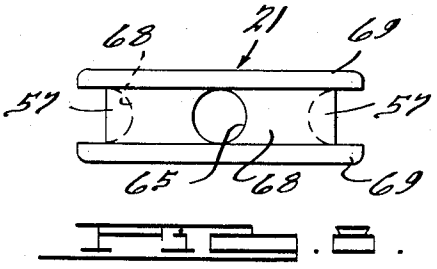

FIG. 8.

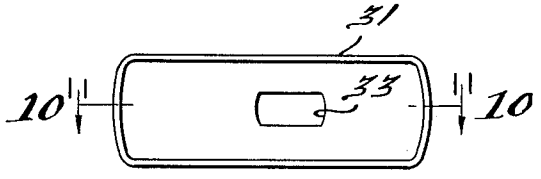

FIG. 9.

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BLOWER SWITCH

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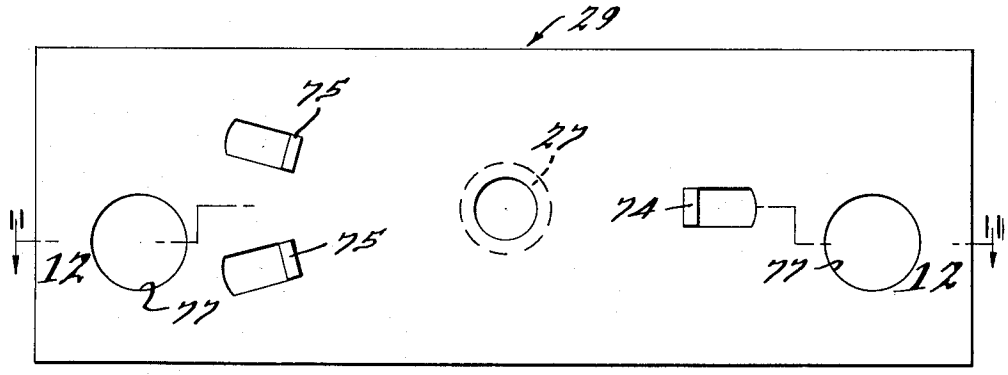


FIG. 11.

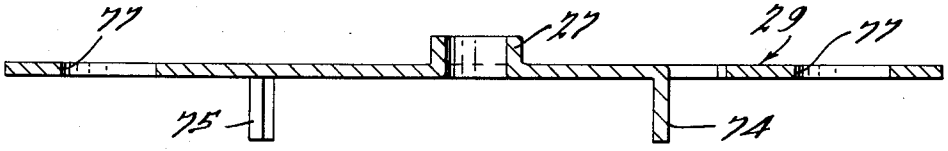
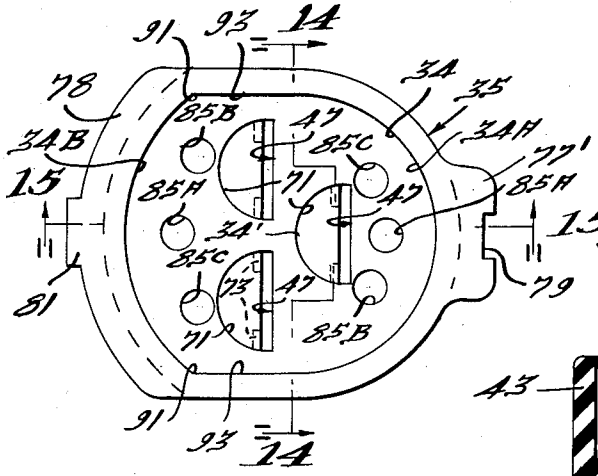


FIG. 12.



15 FIG. 13.

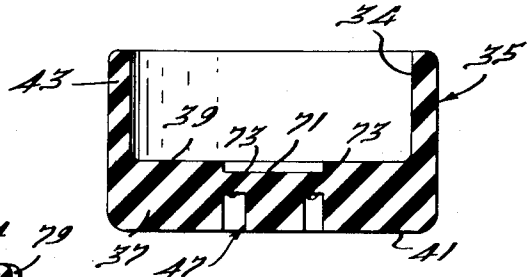


FIG. 14.

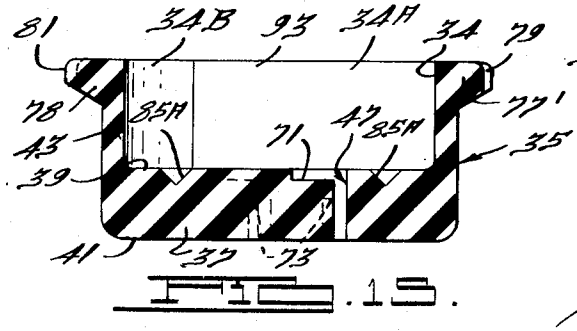


FIG. 15.

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United States Patent Office 2,994,748 Patented Aug. 1, 1961

2,994,748

BLOWER SWITCH

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Filed June 3, 1957, Ser. No. 663,128
10 Claims. (Cl. 200—11)

This invention relates to electrical switches of the type having a movable insulator block which carries metal bridging means over stationary metal contact members.

Electrical switches of the type indicated normally employ a sliding contact between the bridging means and the stationary contact members. However, at high currents this is undesirable.

Accordingly, important objects of the invention are to provide an electrical switch of the type specified which embodies improved means for effecting a quick opening and closing action for controlling electrical circuits; to provide in an electrical switch of the type which employs a movable insulator block improved means for preventing sliding contact between the bridging means and the stationary contact members; to provide an improved construction for electrical switches of the character indicated which includes resilient mounting means for the bridging means and positioning means on the latter which raise and lower it at predetermined positions in its movement relative to the stationary contact members and which retain the movable insulator block in its several selectively settable positions; and to provide an electrical switch of the type indicated which is of minimum size and rugged in construction and reliable in operation and which has relatively few parts which may be economically manufactured and assembled on a production basis.

The above and related objects will appear more fully during the course of the following description taken in conjunction with the accompanying drawings.

In the drawings:

FIGURE 1 is a longitudinal sectional view of the switch embodying the invention;

FIG. 2 is a bottom plan view of the structure of FIG. 1;

FIGS. 3, 4 and 5 are various elevational views of the metal bridging means employed in the switch embodying the invention, FIG. 3 being a front elevational view and FIGS. 4 and 5 being underside and left side elevational views, respectively, of the structure of FIG. 3;

FIG. 6 is a plan view of the movable insulator slide block employed in the switch embodying the invention;

FIG. 7 is a longitudinal sectional view of the structure of FIG. 6 along the line 7—7 thereof;

FIG. 8 is an underside elevational view of the structure of FIG. 7;

FIG. 9 is an underside view of a cup member employed in the switch embodying the invention;

FIG. 10 is a longitudinal sectional view of the structure of FIG. 9 along the line 10—10 thereof;

FIG. 11 is an underside view of a metal bracket employed in the switch embodying the invention;

FIG. 12 is a longitudinal sectional view of the structure of FIG. 11 along the line 12—12 thereof;

FIG. 13 is a plan view of the insulator housing employed in the switch embodying the invention; and

FIGS. 14 and 15 are, respectively, transverse and longitudinal sectional views of the structure of FIG. 13 taken substantially along the lines 14—14 and 15—15 thereof.

The switch embodying the invention is shown assembled in FIGS. 1 and 2 and comprises movable bridging means which is indicated generally at 19. The bridging means 19 is resiliently mounted on and carried by an insulator block 21 which may be actuated by suitable means such as the pivotal shaft shown by way of example and indicated at 25. The shaft 25 is rotatably supported in a flange 27 centrally formed on a metal bracket 29. The details of the construction of the metal bracket 29 are shown in FIGS. 11 and 12. The shaft 25 is secured to an elongated hollow metal cup 31 of substantially rectangular shape as shown in FIGS. 9 and 10. The lower end of the shaft 25 as at 32 is staked over an opening 33 formed in the top plate of the cup 31. The insulator block 21 together with the bridging means 19 which it carries is confined within the cup 31 without being mechanically attached thereto. The cup 31 is movable within a cavity 34 formed in an insulator housing indicated generally at 35 which is secured at its upper portions to the bracket 29. The cavity 34 has opposite circular portions 34A and 34B formed respectively on radii from a center 34'. The insulator housing 35 is preferably molded of phenolic resin and the details of its construction are shown in FIGS. 13–15 to which reference will be hereinafter made. At this point it will suffice to note that the housing 35 is provided with a substantially flat body portion 37 having top and bottom faces 39, 41 respectively. The top face 39 defines the floor of the cavity 34 and upstanding from the top face 39 is an integrally formed vertical wall 43 defining the sides of cavity 34. The housing 35 carries spaced-apart stationary contact means which in the instance shown comprises three spade terminal contacts indicated at 45A, 45B, and 45C. The spade terminal contacts 45A—45C are secured in terminal receiving apertures indicated generally at 47 which are formed in and extend through the body portion 37. The spade terminals 45A—45C are disposed transversely with respect to the housing 19 and are arranged as shown in FIG. 2 from which it can be seen that the spade terminal 45A is an intermediate terminal which is aligned with the longitudinal axis of the switch and the other two terminals 45B and 45C are end terminals which are spaced from the same axis.

Referring now to FIGS. 3–5 which best show the details of the construction of the metal switch or bridging means 19 it will be noted that the same is formed from an elongated metal plate so that a flat body portion 51 is provided with upright arms 53 which projects from the inside face of the body portion 51. Each of the arms 53 has an inwardly projecting detent 55 which is struck out from the body of metal which forms the respective arm 53. The detents 55 are resilient and when the bridging means 19 is assembled on the insulator block 25 the detents 55 snap over shoulders 57 (FIGS. 6–8) which are centrally formed on opposite ends of the said insulator block. The bridging means 19 is provided with a pair of spaced contact bosses 59 which protrude from the outside face of body portion 51 and also with a pair of positioning bosses 61 which are spaced outwardly of the contact bosses 59 and are likewise formed on the body portion 51 so as to protrude from the outside face thereof. The positioning bosses 61 project from the outside face of the body portion 51 a greater distance than the contact bosses 59. Before the bridging means 19 is assembled on the insulator block 21 a compression spring 63 (FIG. 1) is positioned in a well 65 which is integrally formed in the said insulator block. The well 65 is disposed so that its center coincides with the center of the block 21 and is recessed inwardly from the bottom face of 67 (FIG. 7) of a central portion of the insulator block 21 which is indicated at 68. The central portion 68 as can be seen from FIG. 7 has arcuate ends from which shoulders 57 project. From the same figure it can be seen that the long sides of the insulator block which are designated 69 project below the bottom face 67 over the length of the block 21 and at their ends they extend beyond the shoulders 57 and project above the top face of the central portion 68.

With the spring 63 positioned in the well 65 the bridg-

ing means 19 is assembled on the insulator block 21 by snapping the detents 55 over the shoulders 57 which cooperate to retain the elements together while the spring 63 yieldably urges the bridging means 19 in a direction away from the face 67, the substantial clearance between the tongues 55 and shoulders 57 permitting tilting of the contact 19. When the insulator block 21, the spring 63 and the bridging means 19 are thus assembled they are inserted as a unit into the cavity 34 and the cup 31 is placed over the block 21, the top plate of the cup resting on the sides 69. Before the cup 31 is placed over the insulator block 21 the shaft 25 is secured in the opening 33 as previously described and it will be noted from FIG. 9 that the opening 33 is offset slightly with respect to the central transverse axis of the cup 31, i.e. the opening 33 is closer to one of the short sides (i.e. 34A) of the cup than to the other and aligned with center 34'. After the shaft 25 is secured to the cup 31 and the latter is placed over the insulator block 31 the flange 27 on the metal bracket 29 is slipped over the shaft 25. As can be seen from reference to FIGS. 11 and 12 the metal bracket 29 is formed with a flat rectangular body portion from one face of which the flange 27 projects. From the other face of the body portion of the bracket 29 a plurality of metal tabs protrude and in the example shown three such tabs are provided, one of which is disposed on one side of the flange 27 and designated 74 and the other two which are disposed on the opposite side of the flange 27 are designated 75. The tabs 74 and 75 are struck out from the metal of the body portion of the bracket 29 and outwardly of the tabs a pair of apertures 77 is formed by which the bracket may be secured to suitable stationary structure. The bracket 29 is secured to the housing 35 by way of its tabs 74 and 75 which are bent over structure formed on the upper portions of the housing 35 and when thus assembled on the housing the central portion of the bracket closes off the top of the cavity 34. The structure on the upper portions of the housing 35 which cooperates with the tabs 74 and 75 is best shown in FIGS. 13–15 and comprises projecting abutments 77 and 78 which are integrally formed with the wall 43 on opposite ends of the housing 35 and are disposed centrally of the longitudinal axis thereof. The abutment 77 is provided with a vertical recess 79 and the tab 74 is bent over the abutment 77 so that it is received in the recess 79. The other abutment 78 is wider than the abutment 77 extending as shown in FIG. 13 over the width of its respective side of the housing 35, and is provided with a projecting extension 81 which has a width equal to the space between the tabs 75. The tabs 75 are located on the housing 35 so that the projection 81 is disposed between them before they are bent over the abutment 78 as shown in FIG. 2.

With the plurality of elements arranged as described above and with the housing 35 and the bracket 29 secured together the switch is thus assembled as shown in FIGS. 1 and 2. In this condition the insulator block 21 is yieldably urged against the inner face of the top plate of the cut 31 by the spring 63 and the bridging means 19 is yieldably urged against the top face 39 of the body portion 37 throughout its movement relative to the terminal contacts 45A—45C.

The construction of the terminal contacts 45A—45C is identical and are also described in detail in my copending case, Serial No. 610,582, filed September 18, 1956. As shown in FIGS. 1 and 2 each terminal includes a flat semicircular contact portion 70 which is bent to form a right angle or slightly less with the main body of the terminal and which rests in cooperatively shaped seats 71 which are formed in the body portion 37 recessed from the top face 39 so that the contact portion 70 is flush with the face 39. Each spade terminal is also provided with a pair of resilient coined, tapered tongues 72 only one of which is shown in FIG. 1. The tongues 72 are formed along the side edges of each terminal and project outwardly from the main body of the terminal and rearwardly toward the contact portion 70. The terminal contacts 45A—45C are inserted into the body portion 37 from above and as each is inserted into its respective aperture 47 the pair of tongues 72 snap over spaced shoulders 73 which are formed in the respective terminal receiving aperture 47 and face downwardly toward the bottom face 41 of the body portion 37 as shown in the sectional views of FIGS. 1 and 14. Each terminal also includes a spade portion 82 which projects from the bottom face 41 of the body portion 37 for connecting to an electrical circuit which is to be controlled by the switch of the invention. The switch of the invention is particularly adapted for use in automotive vehicles for controlling the heater fan motor or blower motor in the air conditioning system of the vehicle and for this purpose the spade portions 82 may engage corresponding socket terminals (not shown) suitably located on the vehicle for establishing the desired electrical connection. For example the spade terminal 45A may be connected to ground and the terminals 45B and 45C to different current carrying circuits for operating the heater fan or blower motor as desired.

The top face 39 is formed with a plurality of detent depressions which are arranged in pairs over the face 39 as shown in FIGS. 2 and 13 and indicated at 85A, 85B, and 85C respectively. The detent depressions 85A—85C are located so as to engage the positioning bosses 61 at predetermined positions in the pivotal movement of the bridging means 19 over the stationary contacts 45 about axis 34'. Each detent depression is formed with relatively steep sides on which the respective positioning boss 61 rides up or down as the case may be depending upon whether the bridging means is being moved into or out of engagement with the stationary contacts 45. The depressions, the bosses, and the spring 63 act to positively cam the contacts into and out of engagement with a quick snap action. In the instance shown each detent depression is substantially conical in shape and the depth and slope of the sides of all of the detent depressions are commonly selected to obtain the desired opening and closing action between the bridging means and the stationary contacts. As shown in FIGS. 2 and 13 the pair of detent depressions 85A is aligned with the longitudinal axis of the housing 35 and is arranged to cooperate with the pair of positioning bosses 61 in the intermediate position of the bridging means 19 which is that shown in dotted lines in FIG. 2. The pair of detent depressions 85A is disposed outwardly of the terminal 45A one of them being closer to the said terminal than the other. The two other pairs of detent depressions 85B and 85C are disposed at an angle with respect to the longitudinal axis of the housing and are arranged to engage the positioning bosses 61 in the two extreme positions of the bridging means 19. The terminals 45A and 45B which are engaged by the bridging means in one of its extreme positions are disposed with respect to the pair of detent depressions 85B so that they are generally located between the latter while the terminals 45A and 45C which are engaged by the bridging means in the other of its extreme positions are located generally between the pair of detent depressions 85C. It should be noted from FIGS. 2 and 13 that three detent depressions (consisting of one from each pair 85A—85C) on the left side of the housing as viewed in these figures are spaced from each other a greater distance than the three corresponding detent depressions on the right side of the housing and this is because of the eccentricity of the opening 33 in the cup 31 which causes the left side of the bridging means 19 to move through a greater arc than the right side.

In operation of the switch with the terminal contacts 45A—45C connected to suitable current sources as mentioned, the bridging means 19 has three operative positions through which it is rotatably carried by the insulator block 21 when the latter is actuated through movement of the cup 31 upon rotation of the shaft 25.

One of the positions of the bridging means is an intermediate position wherein, as before stated, its longitudinal axis coincides with the longitudinal axis of the bracket and housing and in this position, the positioning bosses **61** are engaged in the pair of detent depressions **85A**. When the bridging means **19** was first moved into this position it was lowered relative to the stationary contact means so that one of the contact bosses **59** rested on the terminal contact **45A** and the other of the contact bosses **59** rested on a flat undepressed portion of the face **39**. Upon actuation of the insulator block **21** the bridging means may be carried from its intermediate position to one or the other of its extreme positions and it will be assumed that the shaft **25** is rotated so that the block **21** moves in a clockwise direction as viewed in FIG. 2. As the block **21** is so moved the positioning bosses **61** ride up the steep sides of the pair of depressions **85A** and the bridging means is quickly raised relative to the face **39** and the contact boss **59** quickly breaks contact with the terminal **45A**. In this raised position the bridging means is carried over the stationary contact means in a spaced relation thereto, the positioning bosses **61** riding on undepressed portions of the face **39**. As the extreme position of the bridging means is reached the positioning bosses **61** find the pair of depressions **85B** and begin to ride down their steep sides. At this instant the bridging means is disposed so that the contact bosses **59** are positioned over the flanges **70** of terminals **45A** and **45B**. As the bosses **61** ride down the sides of the depressions **85B** the bridging means is lowered and a quick connection is made between the pair of contact bosses **59** and the terminals **45A** and **45B**. Resistance produced by the connection thus made is substantially reduced as compared with sliding contact resulting in longer life of the contact surfaces. Upon rotation of the shaft **25** in a counterclockwise direction to return the bridging means to its intermediate position, the positioning bosses **61** ride up the steep sides of depressions **85B** and the bridging means is again quickly elevated to a spaced position relative to the stationary contact means effecting a quick break of the connection between the pair of contact bosses **59** and the terminals **45A** and **45B**.

The same action just described of course occurs when the bridging means is actuated to the other of its extreme positions from its intermediate position upon rotation of the shaft **25** so as to move the block **21** in a counterclockwise direction as viewed in FIG. 2. It will be seen that the left end of the cup **31** will abut the corners **91** between the circular portion **34B** and the straight sides **93** of the cavity **34** to positively define the extreme limits of switch movement.

By eliminating any sliding contact between the bridging means and the stationary contacts the bridging means can be pressed against the stationary contacts with greater force and a more positive connection made which has less resistance to current flow than would be the case where the bridging means must slide relative to the stationary contact means and cannot be pressed too tightly thereagainst. Thus, not only is the resistance to current flow decreased during the times when connection is made by the construction and arrangement described but also the time in which the contact bosses on the bridging means and the stationary terminals are in engagement for circuit making and breaking is also considerably reduced. It will also be observed that the parts may be quickly and easily made and assembled in the present switch and that the disposition of the axes **34'** and the contacts and the shape of cavity **34** provides a device of minimum size.

Variations in the specific structure shown are within the purview of the invention.

What is claimed is:

1. In an electrical switch an insulator housing, spaced-apart stationary contact members carried by the housing, said housing having a surface exposing portions of said contact members and two sets of detent depressions formed in said surface, an insulator slide block movable within the housing, yieldably mounted bridging means carried by and supported at opposite ends on the slide block having a metal contact surface, operating means for the slide block which moves the contact surface of the bridging means over said housing surface and said portions of the stationary contact members, said bridging means having positioning bosses at opposite ends for engaging said housing surface which project outwardly from the contact surface thereof and which in predetermined positions in the movement of the bridging means are adapted to engage the respective sets of said detent depressions to quickly raise and lower the bridging means into and out of engagement with the stationary contact members, the positioning bosses riding on undepressed portions of said housing surface during movement of the bridging means between said predetermined positions to maintain the contact surface of the bridging means elevated and spaced relative to the stationary contact members.

2. In an electrical switch an insulator housing, spaced-apart stationary contact members carried by the housing, said housing having a surface exposing portions of said contact members and two sets of detent depressions formed in said surface, an insulator slide block movable within the housing, yieldably mounted bridging means supported at opposite ends on and carried by the slide block, said bridging means having a metal contact surface provided with a pair of projecting contact bosses for engaging and making electrical contact with said portions of the stationary contact members, operating means for the slide block which moves the contact surface of the bridging means over said housing surface and said portions of the stationary contact members, said bridging means having a pair of positioning bosses for engaging said housing surface which are spaced outwardly from said contact bosses and which project outwardly from the contact surface thereof a greater distance than the contact bosses, each of said positioning bosses in predetermined positions in the movement of the bridging means being adapted to engage one set of said detent depressions to quickly raise and lower the bridging means into and out of engagement with the stationary contact members, the positioning bosses riding on undepressed portions of said housing surface during movement of the bridging means between said predetermined positions to maintain the contact surface of the bridging means elevated and spaced relative to the stationary contact members.

3. In an electrical switch an insulator housing, spaced-apart stationary contact members carried by the housing, said housing having a surface exposing portions of said contact members and detent depressions formed in said surface, an insulator slide block movable within the housing, yieldably mounted bridging means carried by the slide block having a metal contact surface, operating means for the slide block which moves the contact surface of the bridging means over said housing surface and said portions of the stationary contact members, detent depressions being each formed with relatively steep side walls and being arranged in spaced pairs over said surface, each pair corresponding to an operative position of the slide block, said bridging means having a pair of positioning bosses for engaging said housing surface which project outwardly from the contact surface thereof and which in predetermined positions in the movement of the bridging means are adapted to be engaged by pairs of said depressions to quickly raise and lower the bridging means into and out of engagement with the stationary contact members, the positioning bosses riding on undepressed portions of said housing surface during movement of the bridging means between said predetermined positions to maintain the contact surface of the bridging

means elevated and spaced relative to the stationary contact members.

4. In an electrical switch an insulator housing, spaced-apart stationary spade terminal metal contact members carried by the housing so that portions thereof are exposed along an insulator surface of the housing, an insulator slide block movable within the housing, bridging means carried by said block and having a pair of spaced metal contact bosses on a surface thereof for engaging and making electrical contact with said contact members, operating means for the slide block which includes a cup-like member surrounding but detached from said slide block and which moves the contact surface of the bridging means over said housing surface, positioning bosses projecting outwardly from the contact surface of the bridging means on opposite sides of and a greater amount than the contact bosses thereon, spaced pairs of detent depressions formed inwardly into said housing surface and disposed with relation to the contact members that the latter are located generally between the pairs of detent depressions, actuation of the slide block carrying the bridging means from an intermediate position to an extreme position, the pair of positioning bosses riding on undepressed portions of said housing surface during movement of the bridging means between said two positions so that the contact surface of the bridging means moves over the stationary contact members in a spaced relation thereto with its pair of contact bosses out of engagement with said stationary contact members, the pair of positioning bosses entering a pair of the detent depressions as the bridging means is moved into each of said positions so that said bridging means is lowered relative to said housing surface whereby its contact bosses quickly engage said portions of the stationary contact members and as the bridging means is moved out of each of said positions it is raised relative to said housing surface whereby its contact bosses are quickly disengaged from said portions of the stationary contact members.

5. In an electrical switch an insulator housing having terminal receiving-apertures provided with spaced shoulders, spaced-apart stationary metal contact members carried by the housing so that portions thereof are exposed along an insulator surface of the housing, said contact members being snap-in type spade terminals which are provided with resilient tongues for engaging said shoulders to interlock in said apertures, an insulator slide block movable within the housing, bridging means carried by said block and having a pair of spaced metal contact bosses on a surface thereof for engaging and making electrical contact with said contact members, rotary operating means for the slide block including a cuplike member surrounding but detached from said slide block which moves the contact surface of the bridging means over said housing surface, a pair of spaced positioning bosses projecting from the contact surface of the bridging means for engaging said housing surface, the pair of contact bosses being located between the pair of positioning bosses and the latter projecting outwardly from the contact surface of the bridging means a greater distance than the contact bosses, spaced pairs of detent depressions formed inwardly into said housing surface and located with relation to the contact members that the latter are disposed generally between the pairs of detent depressions, each of said detent depressions having relatively steep side walls, actuation of the slide block carrying the bridging means from an intermediate position in opposite directions to extreme positions, the pair of contact bosses engaging a pair of contact members in said extreme positions and only one contact member in said intermediate position, the pair of positioning bosses riding on undepressed portions of said housing surface during movement of the bridging means between said two positions so that the contact surface of the bridging means moves over the stationary contact members in a spaced relation thereto with its pair of contact bosses out of engagement with said stationary contact members, the pair of positioning bosses entering a pair of detent depressions and riding down the side walls thereof as the bridging means is moved into each of said positions so that said bridging means is lowered relative to said housing surface whereby its contact bosses quickly engage said portions of the stationary contact members, and as the bridging means is moved out of each of said positions its pair of positioning bosses ride up on the side walls of a pair of detent depressions so that said bridging means is raised relative to said housing surface whereby its contact bosses are quickly disengaged from said portions of the stationary contact members.

6. In an electric switch, a housing having a pair of substantially parallel spaced side walls and arcuate end walls having the same center of curvature, one of said end walls having a relatively large radius of curvature and the other of said end walls having a relatively small radius of curvature, elongated bridging means pivotally mounted within said housing with the pivoting axis thereof passing through said center of curvature and being disposed closer to one end of the bridging means than to the other end thereof, a stationary contact carried by said housing adjacent to and adapted to be engaged by said one end of the bridging means, a pair of spaced stationary contacts carried by said housing adjacent to and adapted to be selectively engaged by the other end of said bridging means, said one end of the bridging means being adjacent said one end wall having the smaller radius, and the other end thereof being adjacent said other end wall, and means for pivoting said bridging member between two extreme positions the first wherein said other end thereof engages one of said pair of contacts and the second wherein said other end thereof engages the other of the pair of contacts, said one end of the bridging means engaging said stationary contact in both extreme positions.

7. In an electrical switch, a sheet metal mounting bracket for the switch having a flanged opening formed integrally therein, a switch operator comprising a cup having a face slidably engaging said mounting bracket and having an aperture aligned with said flanged opening, a shaft affixed to said operator so that angular movement of the shaft moves the operator in an angular direction, said shaft being rotatably supported in said flanged opening.

8. The invention set forth in claim 7 including an insulating body loosely mounted within said operator, said insulating body movably carrying a metal contact connecting switch member.

9. In an electric switch, an insulating body having a cavity opening out of one side, said cavity having diametrically opposite portions curved on respectively different radii, said opposite portions being connected by housing portions spaced together closer than are said opposite portions, a rotatable switch member mounted in said cavity in juxtaposition to said opposite portions, switch members in said cavity arranged to be operatively connected by said operator as it moves within angular limits defined by said curved portions, said housing portions serving to limit the motion of said operator.

10. In an electric switch, a housing having a cavity opening out of one face, apertures opening out of the other face of said housing and into the bottom of said cavity, portions of said aperture around its opening into the bottom of said cavity being recessed, metal contacts snapped into said apertures and having right angle flanges disposed in said recesses, a mounting bracket secured to said housing and closing the cavity opening in said one face, a metal switch operator bearing upon said bracket and pivotally connected to it, said operator being operatively connected to an insulative body, and a metal bridge member rockably mounted on said body and adapted to interconnect pairs of said contacts by engagement with said flanges, said cavity having diametrically opposite

curved portions which are curved on different radii, said opposite portions being connected by housing portions spaced closer together than are the curved portions, said switch operator being mounted in said cavity in alignment with the curved portions so that said housing portions serve to limit movement of the operator.

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