March 22, 1932. A. E. ANGOLD 1,850,703

ELECTRIC SWITCH

Filed May 9, 1928 3 Sheets-Sheet 1

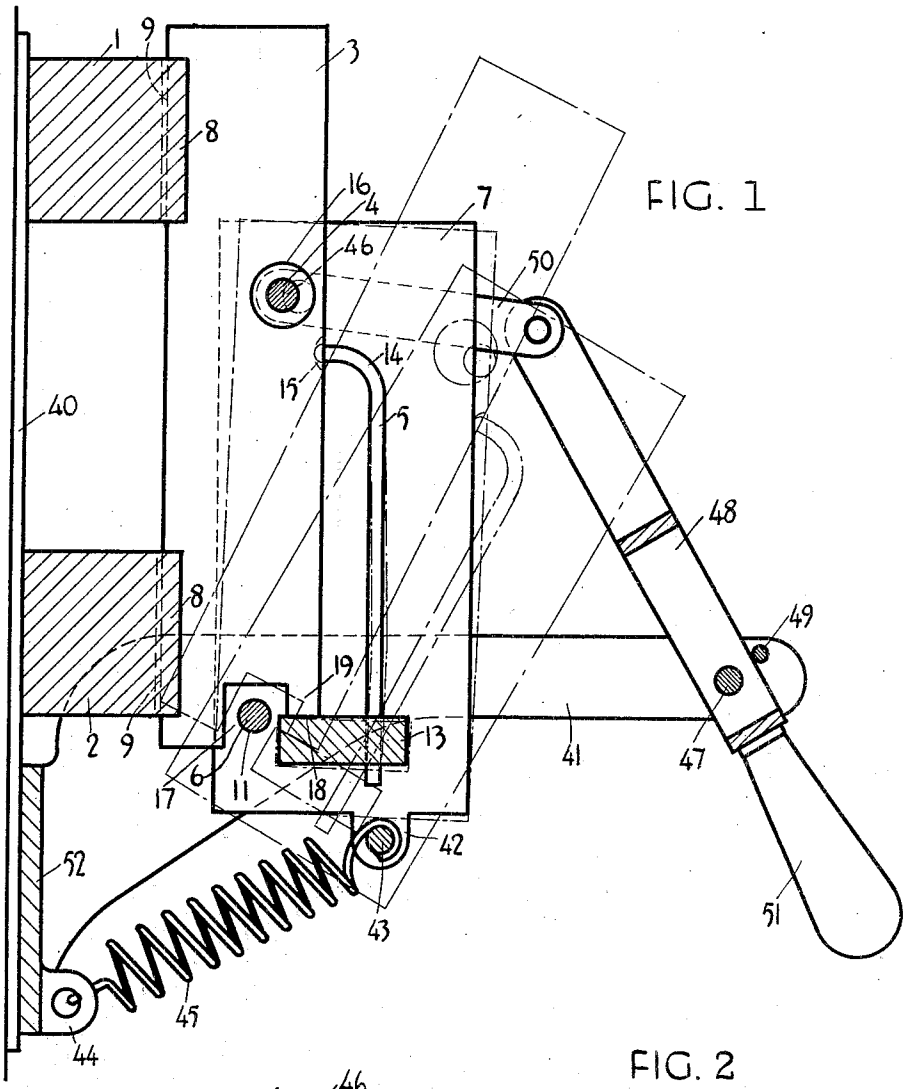


FIG. 1

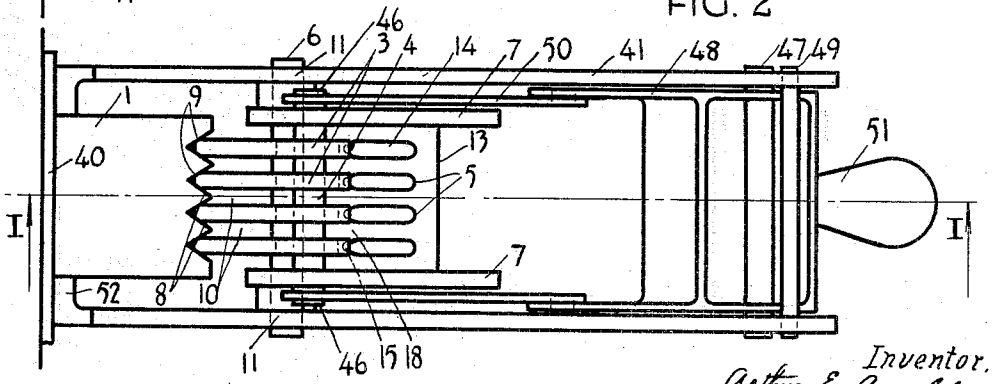


FIG. 2

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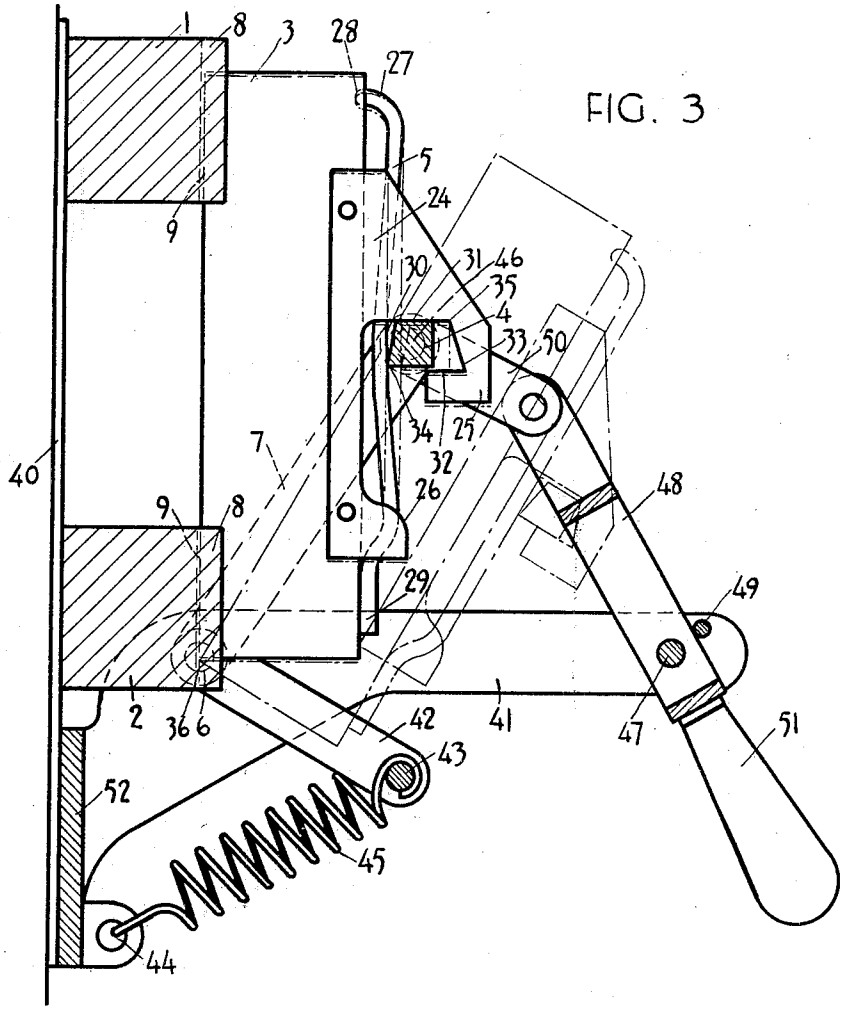


FIG. 3

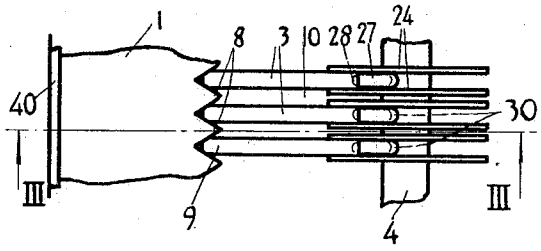


FIG. 4

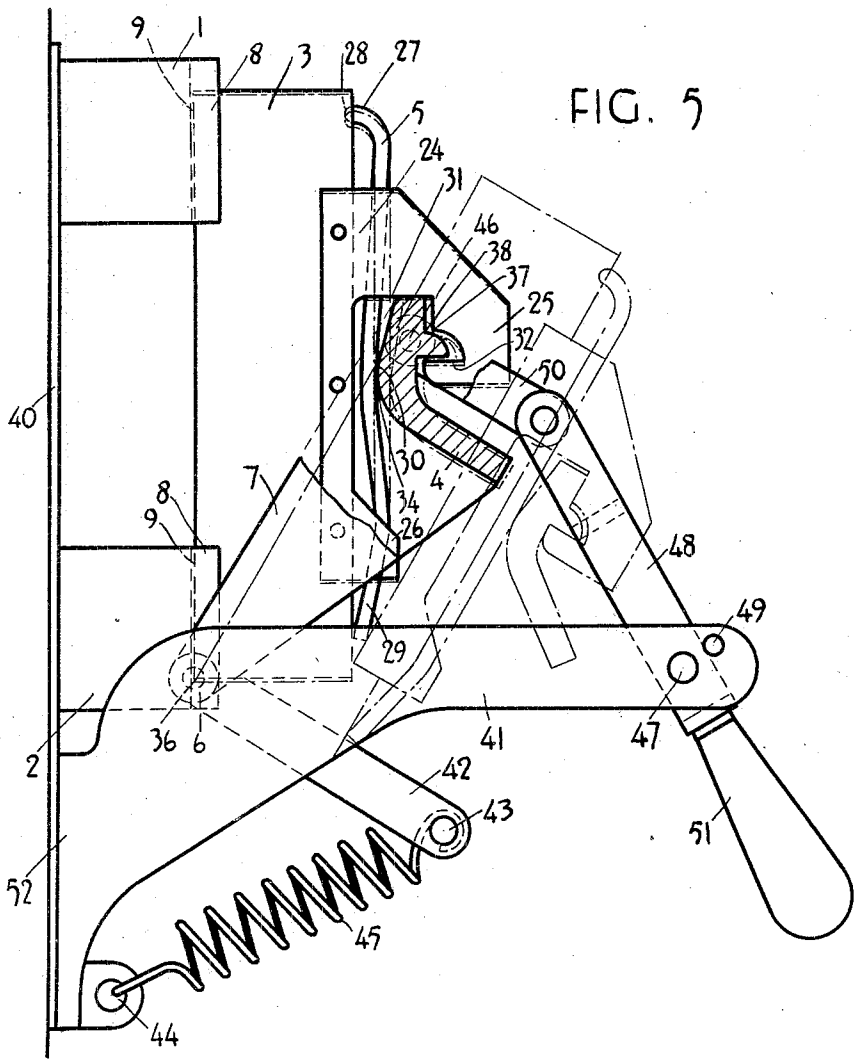
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FIG. 5



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UNITED STATES PATENT OFFICE

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ELECTRIC SWITCH

Application filed May 9, 1928, Serial No. 276,249, and in Great Britain June 27, 1927.

This invention relates to electric switches, for example, circuit breakers adapted to be opened by force stored during the closing thereof, and is particularly useful in connection with switches which in service carry relatively large currents. One object of the invention is to provide reliable contacts which will not become damaged by overheating, another object is to provide an improved contact comprising a plurality of separate elements which individually may readily be renewed or changed.

In the accompanying drawings, showing the switches with parts thereof omitted, Figure 1 is a sectional side elevation of one form of switch on the line I—I of Figure 2; Figure 2 is a plan view of Figure 1; Figure 3 is a sectional side elevation of another form of switch on the line III—III of Figure 4; Figure 4 is a plan view of Figure 3 with parts broken away; whilst Figure 5 shows a side elevation of a switch with a modified form of retaining member in section. In Figs. 1, 3 and 5 parts of the moving switch contact are shown in the positions occupied when the switch is closed by full lines, in the positions occupied when the switch is being closed and has just reached the position in which the moving contact first bridges the fixed contacts by short chain lines and in the positions occupied when the switch is open by long chain lines.

In the drawings the switch is provided with fixed contacts 1 and 2 made of solid copper blocks insulatingly mounted upon the supporting member 40 and adapted to be bridged by a moving contact formed of copper blades 3 that are mounted on a supporting member in the form of a bar 4 and that are acted upon by steel rod biassing springs 5. The bar 4 forms part of a frame including two side members 7 between which the bar extends and to which the bar is rigidly secured. Held to the supporting member 40 is a bracket 52 formed with two arms 41 provided with pivots 6 on which the side members 7 are adapted to turn. The side members are formed with lugs or arms 42 between which passes a bar 43 and the bracket 52 is formed with an eye 44 and between the bar 43 and eye 44 acts a tension spring 45 to bias the moving switch contact to the open position.

Pivoted at 47 to the arms 41 of the bracket 52 is an operating lever 48 provided with a handle 51 and acting between the end of the lever remote from the handle and pivots 46 formed at the ends of the bar 4 are the links 50. In the closed position of the switch the toggle formed by the lever 48 and link 50 is slightly overset, but movement of the lever is prevented by a stop 49 extending between the arms 41. If, however, the lever 48 is turned slightly in a counter clockwise direction away from the stop the spring 45 causes the toggle to collapse and rotates the side members 7 quickly in a clockwise direction to the open position. If the lever 48 is then rotated in a clockwise direction back to the position in which it engages the stop 49 the side members 7 are forced to rotate in a counter clockwise direction against the force of spring 45 to the closed position.

The fixed contacts 1 and 2 are formed with the longitudinal teeth 8 the sides of which converge at an angle of about 60°, whilst the edges 9 of the blades 3 adjacent to the fixed contacts are made wedge shaped, the angles of the wedge being equal to the angles between opposite faces of the teeth 8. The wedge shaped edges 9 are blunt so that the edges do not extend to the roots of the teeth 8, whilst the thickness of blades 3 is less than the pitch of teeth 8 and there are substantial air gaps 10 between the teeth.

In Figs. 1 and 2 of the drawings the pivots 6 are constituted by parts of a spindle 11 extending between the arms 41 of bracket 52 and rigidly attached to and extending between the side members 7 is a cross piece 13. Secured to cross piece 13 and projecting therefrom are the four springs 5 of inverted L-shape, one for each blade 3. The end of the short limb 14 of each spring 5 engages in a socket 15 formed in the blade at a point thereof about midway between the fixed contacts 1 and 2, and thereby positions the blade longitudinally on bar 4. A short distance above the sockets 15 the blades 3 are pierced by circular holes 16 considerably larger than the round bar 4 which is threaded through

the holes 16 and is secured rigidly to the side members 7. The blades 3 are also provided at their lower ends with recesses 17 for avoiding interference of the spindle 11 therewith. Moreover, the front part 18 of the upper edge of the cross piece 13 acts as a stop with which, during the later part of the closing movement of the switch, the ends 19 of the blades contact, thus limiting longitudinal movement of the blades 3 relatively to the side members 7, and causing the blades to move lengthways relatively to the fixed contacts 1 and 2.

When the switch is opened by rotating the side members 7 about the pivotal axis 6, the springs 5 press the blades 3 against the fixed contacts 1 and 2 until the bar 4 reaches the back edges of the holes 16 in the blades, when the said member draws the blades away from the upper fixed contact 1, and the springs 5 acting on blades 3 at socket 15 between the bar 4 and contact 2 cause the blades 3 to pivot about the bar 4, and maintain the lower ends of the blades pressed against the bottom edge of the lower fixed contact 2, thus avoiding sparking thereat.

When the side members 7 are rotated in the opposite direction to close the switch, the wedge shaped contact faces of the blades 3 after preliminary movement of the blades fully engage between the teeth 8 of the lower fixed contact 2, and at the same time engage between the teeth 8 of the upper fixed contact 1, after which the bar 4 moves away from the back edges of the holes 16 in the blades, the springs 5 that are already strained are further strained, and the full force thereof is effective in pressing the blades against the upper and lower fixed contacts. During the closing of the switch, since the movement of cross piece 13 has a component in an upward direction, movement of the blades 3 occurs lengthways relatively to the fixed contacts 1 and 2, thereby giving a self cleaning action to the switch contacts. The extent of the rubbing movement between the contents depends on the distance of cross piece 13 from the axis of rotation 6 thereof.

An alternative way of causing such lengthways movement of the blades relatively to the fixed contacts would be to form the holes 16 in the blades through which the bar 4 passes as sloping slots, the arrangement being such that the bar engages the upper ends of the slots when the switch is open and the lower ends of the slots when the switch is closed, thus causing the blades to slide upwards during the closing movement, and to rub on the fixed contacts 1 and 2.

In Figures 3, 4 and 5 each blade 3 has riveted to its sides two plates 24, formed with hooks 25, and lugs 26, that together with the hooks 25 help to position the springs 5. The upper end of each spring is formed with a head 27 which engages a small recess 28 in the back edge of the associated blade, whilst the bottom end of each spring is formed with a tail 29 that bears against the said edge of the blade. Each spring moreover, slidingly fits between the plates 24 riveted to the associated blade, and the greater part of the length of the spring is spaced from the back edge of the blade. The springs 5 near the mid points in the lengths thereof engage with the bar 4 formed with grooves 30 in which the springs find seatings, whereby the blades are positioned longitudinally on bar 4.

The hooks 25 are provided with upper and lower surfaces 31 and 32 which loosely engage the upper and lower surfaces of the bar 4. In Figures 3 and 4 the bar 4 is of square cross section, but the back surface 33 of each hook 25 is not at right angles to the surfaces 31 and 32 thereof, and slopes backwards from the surfaces 31 to the surface 32. The blades 3 are shown in short chain lines in the position in which they have first engaged the contacts 1 and 2, but the bar 4 has not moved forward between the surfaces 31 and 32 of hooks 25 further to compress the springs 5, and to press the wedge shaped edges of the blades 3 strongly between the teeth 8 of the fixed contacts 1 and 2. Figure 3 shows also that the grooves 30 slope backwards from the lower to the upper surfaces of bar 4, so that when the switch is closed the springs 5 contact only with the lower edges 34 of the grooves.

When the bar 4 has been rotated around the axis 6 in a clockwise direction as seen in Figure 3, from the fully closed position so that bar 4 slides between surfaces 31 and 32 of hooks 25 away from the blades 3 to the position shown in short chain lines, in which the strain on springs 5 is partially relieved, and is then further rotated to open the switch by moving the blades 3 from the fixed contact 1, the springs 5 acting on the edges 34 of the grooves 30 cause the blades to tend to pivot about the edge 35 of bar 4, with the result that the lowermost edges 36 of the wedge shaped faces of the blades 3 are maintained in contact with the sides of the teeth 8 of the fixed contact 2. Similarly the edges 36 are maintained in contact with the fixed contact 2 whilst the switch is being closed by rotating the blades 3 in a counterclockwise direction about the axis 6. The initial and final movements of bar 4, when the switch is being opened and closed respectively, and the bar slides between the surfaces 31 and 32 of hook 25, cause the blades 3 to slide over the contacts 1 and 2, since the bar has a component of movement in a direction parallel to the longitudinal axes of the blades, which movement is transmitted to the blades by the bar 4 bearing on the surface 32 or on the surface 31.

Figure 5 shows parts of a switch similar to that of Figure 3 except that the bar 4 is shaped as an angle iron suitable for use when

a strong bar is required for carrying a relatively large number of blades. In this instance for the purpose of maintaining the blades 3 in engagement with the fixed contact 2 whilst the switch is open, or is being opened, the blades are arranged to tend to pivot about the points 37 of plates 24, which points engage the recess 38 of the bar 4.

As the bar 4 rotates about the axis 6 in a clockwise direction as seen in Figure 5, pressure between the operative faces of the blades 3 and contacts 1 and 2 is maintained, since the springs 5 are initially strained to a predetermined extent, until the recess 38 engages the points 37 of plates 24, after which, upon further rotation of the bar, the switch opens, blades 3 leaving contact 1, whilst the lowermost edges 36 of the blades are maintained in contact with the sides of the teeth 8 of the fixed contact 2 in a manner similar to that already described in connection with Figures 3 and 4, the springs 5 acting on the lowermost edges 34 of grooves 30. Clearly when bar 4 is rotated in a counter-clockwise direction as seen in Figure 5 from the open position, in order to close the switch, the blades 3 pivot about the points 37 until the operative faces of blades 3 and contacts 1 and 2 engage, after which the points 37 disengage the recess 38 as the bar 4 moves forwards in hook 25, and the springs 5 are further strained.

The individual springs and blades of Figures 3, 4 and 5 can readily be removed or replaced without disturbing other parts of the switch, for if the head 27 of a spring 5 is drawn backwards out of engagement with the recess 28 of the corresponding blade the spring may be pulled upwards, thus removing it from between the plates 24. After the spring has been removed the blade may be disengaged from the bar 4 merely by sliding it backwards, so that the surface 32 of hook 25 is free of the adjacent under surface of the bar 4, and by then lifting the blade. Blades and springs may readily be replaced by converse operations.

If the contacts 1 and 2 and the bar 4 are made sufficiently long the capacity of the switch may readily be increased by adding more blades. The bar 4 may, for example, be extended on the outer sides of the side members 7 which support the bar and on which the bar is pivoted.

The blades 3 may be associated with any suitable opening and closing mechanism which may include catch gear for holding the circuit breaker closed. Furthermore, the blades may be associated with auxiliary sparking contacts of any suitable kind, whilst the various parts of the switch may be modified in many different ways, for example, the springs for acting on the blades in the type of switch shown in Figures 1 and 2 may be formed as plates or strips of steel tapered from the ends where they are secured to a cross piece towards their ends where they engage the blades, or a sheet of steel may be made with teeth adapted to serve as springs. Moreover, each spring may act on a group of blades such as two blades.

In operation the aforedescribed circuit breakers are normally prevented from becoming overheated since air circulates freely around the blades, whilst the springs are remote from the operative blade surfaces, so that should the latter owing to overload become hot the springs remain relatively cool and retain their elasticity. The pressure of the springs, moreover, is shared evenly between the top and bottom contacts, and the rubbing action that occurs on closing and opening the circuit breakers helps to ensure not only that the contact surfaces are clean, but that the blades are properly bedded against the fixed contacts when the circuit breakers are closed. Moreover, the voltage drops across the contacts are relatively low, and although the amount of work required to close a circuit breaker is small, adequate provision may readily be made against wear or distortion of the fixed contacts or contact blades.

I claim:—

1. An electric switch comprising a plurality of rigid strips having edges adjacent and substantially parallel to one another and constituting contact surfaces, means arranged to support the strips but to allow limited movement of the strips relatively thereto and biassing springs separate from the strips adapted to transmit pressure through the strips to the said contact surfaces when the switch is closed.

2. An electric switch comprising a plurality of rigid strips having bevelled edges adjacent and substantially parallel to one another and constituting contact surfaces, means arranged to support the strips but to allow limited movement of the strips relatively thereto and biassing springs separate from the strips adapted to transmit pressure through the strips to the said contact surfaces when the switch is closed.

3. An electric switch comprising a plurality of rigid strips spaced apart from one another and having edges adjacent and substantially parallel to one another and constituting contact surfaces, means arranged to support the strips but to allow limited movement of the strips relatively thereto and biassing springs separate from the strips adapted to act on edges of the strips remote from the said contact surfaces and to transmit pressure through the strips to the said contact surfaces when the switch is closed.

4. An electric switch comprising a plurality of rigid strips having edges adjacent and substantially parallel to one another and constituting contact surfaces, means arranged to support the strips but to allow limited move-

ment of the strips relatively thereto and biassing springs individually associated with but separate from the strips and adapted to transmit pressure through the strips to the said contact surfaces when the switch is closed.

5. An electric switch comprising a contact element, a supporting member for supporting the contact element, a hook shaped positioning part provided on the contact element and releasably engaging with the supporting member and a bar shaped spring which is withdrawable and acts at its ends on the contact element and between its ends on the supporting member, the spring cooperating with the hook shaped positioning part in locking the contact element to the supporting member.

6. An electric switch comprising a contact element in the form of a strip having an edge which constitutes a contact surface, a supporting member for the contact element, a hook shaped positioning part provided on the strip remote from the contact surface and formed with a slot and releasably engaging with the supporting member, a bar shaped spring which fits through the said slot and acts at its ends on the contact element and between its ends on the supporting member and means for longitudinally positioning the spring which is withdrawable and which cooperates with the hook shaped positioning part in locking the contact element to the supporting member.

7. An electric switch comprising a moving bridging contact element, a supporting member for supporting the contact element, a positioning part provided on the contact element and formed with a pivotal edge and cooperating with the supporting member which is formed with one pivotal edge that is in engagement with the pivotal edge of the positioning part during opening of the switch and a second pivotal edge further towards an end of the bridging contact element than and oppositely disposed relatively to the first pivotal edge, and a bar shaped spring which is strained both when the switch is open and when the switch is closed and which acts intermediate its ends on the second pivotal edge and at opposite sides of the said edge on the contact element.

8. An electric switch comprising a moving bridging contact element, a supporting member for supporting the contact element, a positioning part provided on the contact element and formed with a pivotal edge and cooperating with the supporting member which is formed with a pivotal edge that is in engagement with the pivotal edge of the positioning part during opening of the switch and a second pivotal edge further towards an end of the bridging contact element than and oppositely disposed relatively to the first pivotal edge, a bar shaped spring which is strained both when the switch is open and when the switch is closed and which acts intermediate its ends on the second pivotal edge and at opposite sides of the said edge on the contact element, and a pivot spaced when the switch is closed to one side of the supporting member which is adapted to rotate about said pivot.

9. An electric switch comprising a moving bridging contact including a plurality of blades spaced apart with edges of the blades adjacent and substantially parallel to one another, the said edges being bevelled and constituting contact surfaces, a supporting member for supporting the bridging contact, hook shaped positioning parts provided on the blades and formed with slots and with pivotal edges and releasably engaging the supporting member which is formed with one pivotal edge that is in engagement with the pivotal edges of the positioning parts during opening of the switch and a second pivotal edge further towards an end of the bridging contact than and oppositely disposed relatively to the first pivotal edge, a group of bar shaped springs each of which is withdrawable and is strained when the switch is open and is further strained when the switch is closed and passes through a slot in a positioning part and acts intermediate its ends on the second pivotal edge and at opposite sides of the said edge on a blade remote from the bevelled edge thereof and cooperates with the hook shaped positioning part of the blade in locking the blade to the supporting member, means for longitudinally positioning the springs, and a pivot spaced when the switch is closed to one side of the supporting member which is adapted to rotate about the said pivot.

10. An electric switch comprising a moving bridging contact including a blade an edge of which constitutes a contact surface, supporting means arranged to support the blade but to allow limited movement of the blade relatively thereto and including a pivot, and a biassing spring arranged to act on the blade between the pivot and an end of the blade, the spring being strained when the switch is open and further strained when the switch is closed and being adapted to transmit pressure through the blade to the contact surface.

11. An electric switch comprising a moving bridging contact including a plurality of blades having bevelled edges adjacent and substantially parallel to one another and constituting contact surfaces, supporting means arranged to support the blades but to allow limited movement of the blades relatively thereto and including pivotal means, and bar shaped biassing springs arranged respectively to act on the edges of the blades remote from the said contact surfaces between the pivotal means and an end of the bridging

contact, the springs being strained when the switch is open and further strained when the switch is closed and being adapted to transmit pressure through the blades to the contact surfaces.

In testimony whereof I affix my signature.

ARTHUR ERNEST ANGOLD.