July 16, 1940. H. J. CRABBS 2,208,411

ELECTRICAL SWITCH

Filed Dec. 17, 1937 5 Sheets-Sheet 1

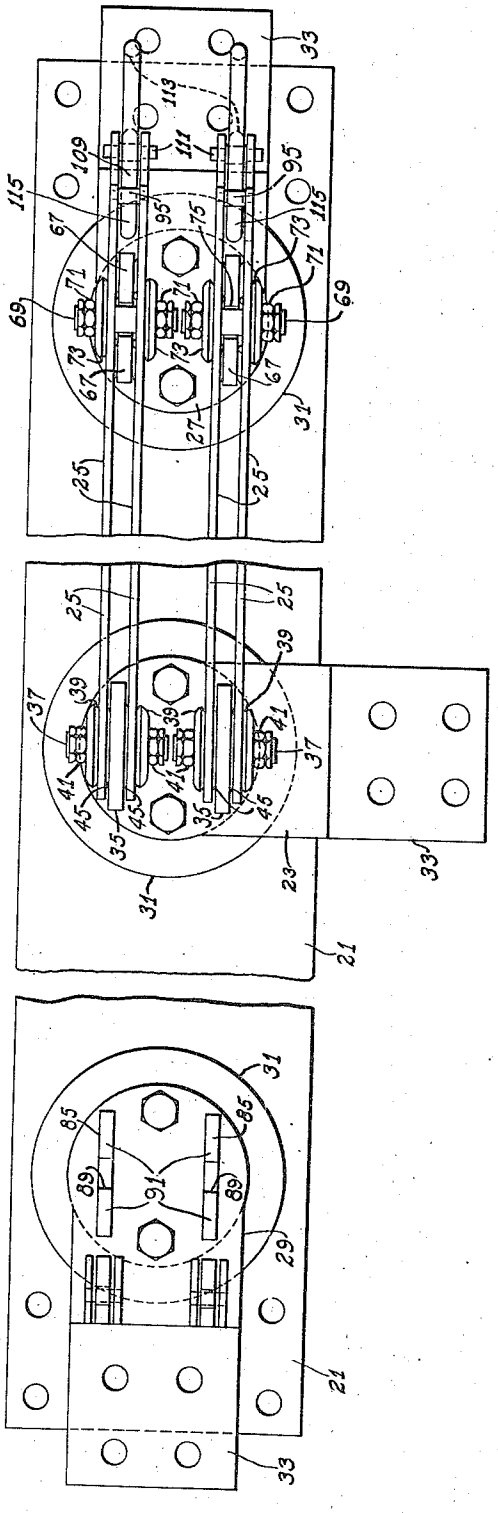

Fig. 1.

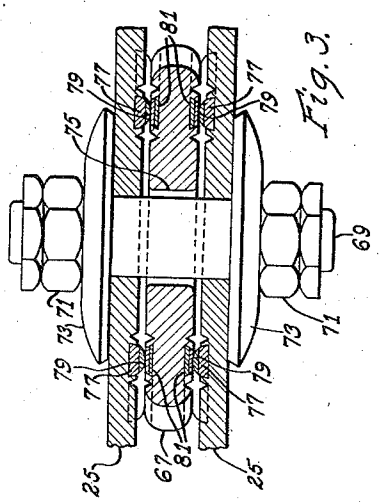

Fig. 3.

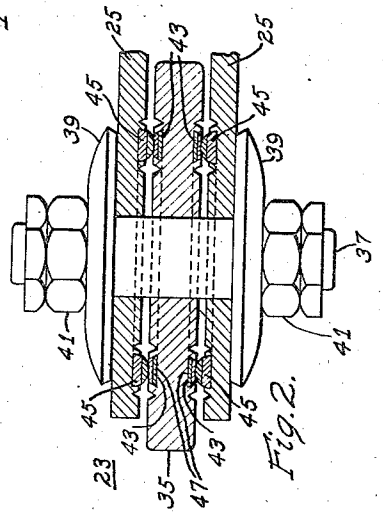

Fig. 2.

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July 16, 1940. H. J. CRABBS 2,208,411

ELECTRICAL SWITCH

Filed Dec. 17, 1937 5 Sheets-Sheet 2

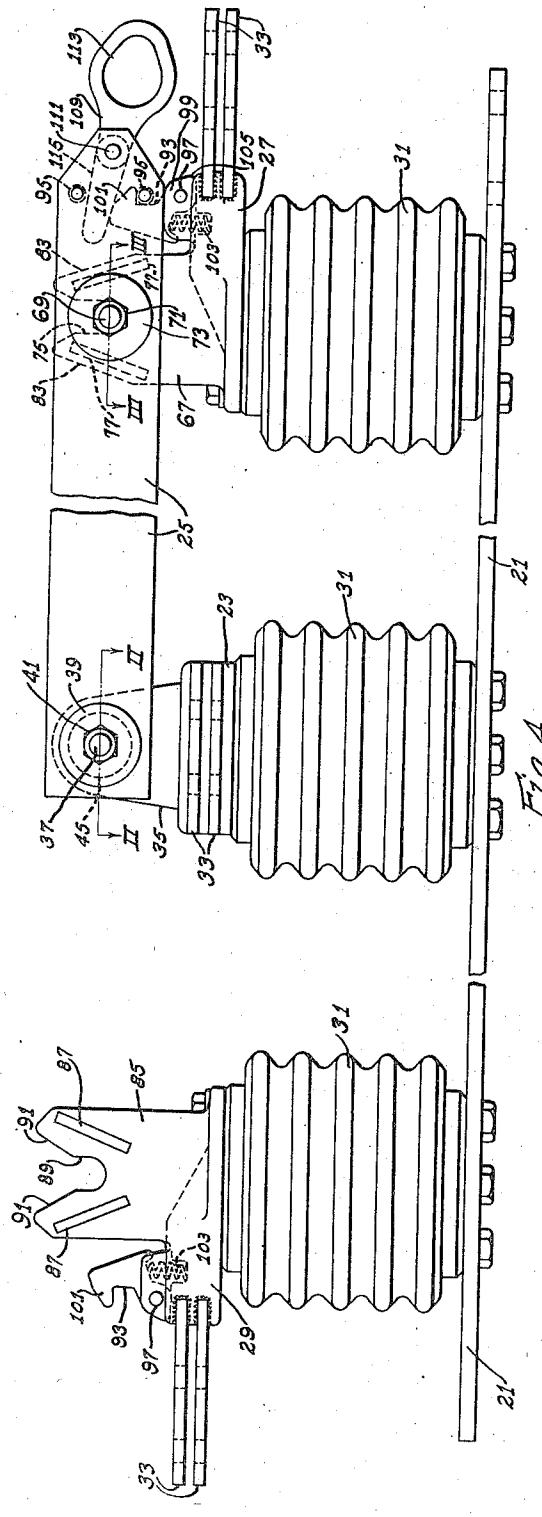

Fig. 4.

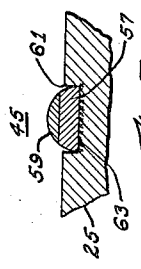

Fig. 7.

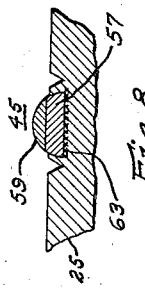

Fig. 8.

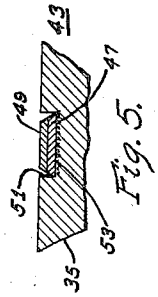

Fig. 5.

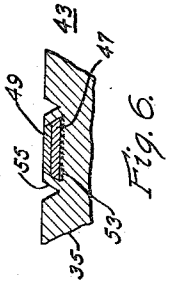

Fig. 6.

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ELECTRICAL SWITCH

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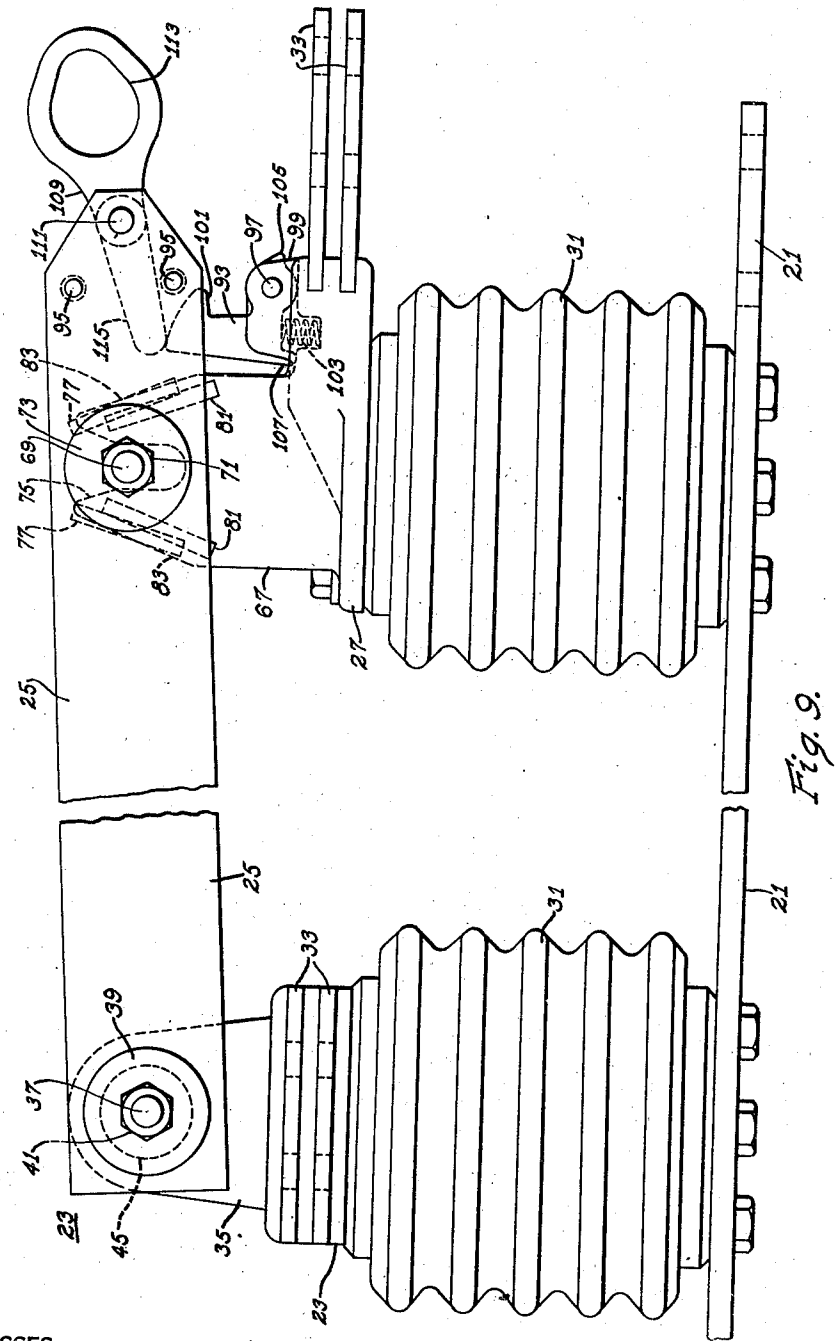

Fig. 9.

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ELECTRICAL SWITCH

Filed Dec. 17, 1937 5 Sheets-Sheet 4

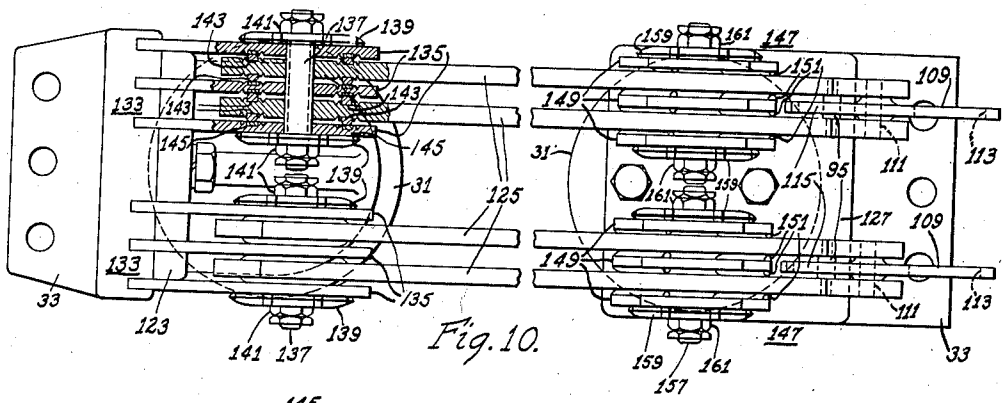

Fig. 10.

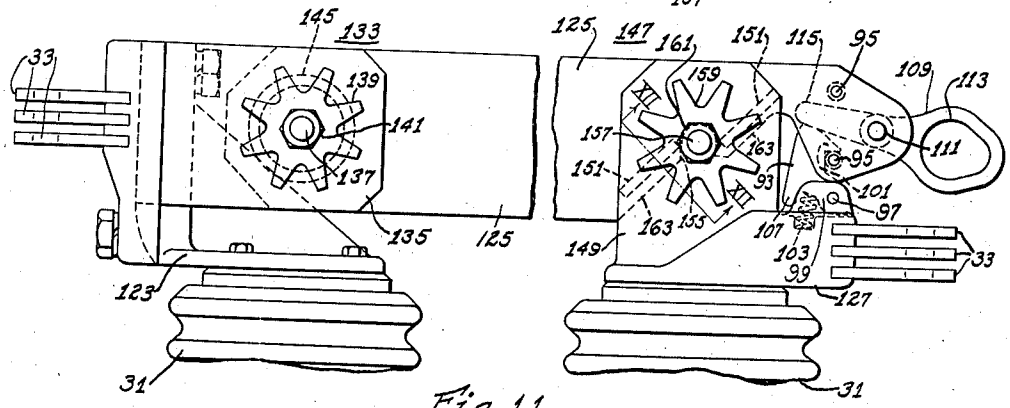

Fig. 11.

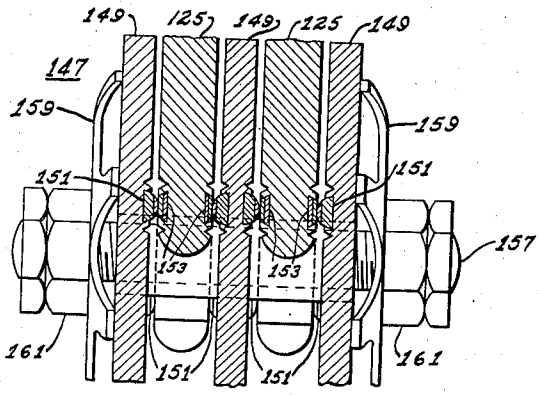

Fig. 12.

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ELECTRICAL SWITCH

Filed Dec. 17, 1937 5 Sheets-Sheet 5

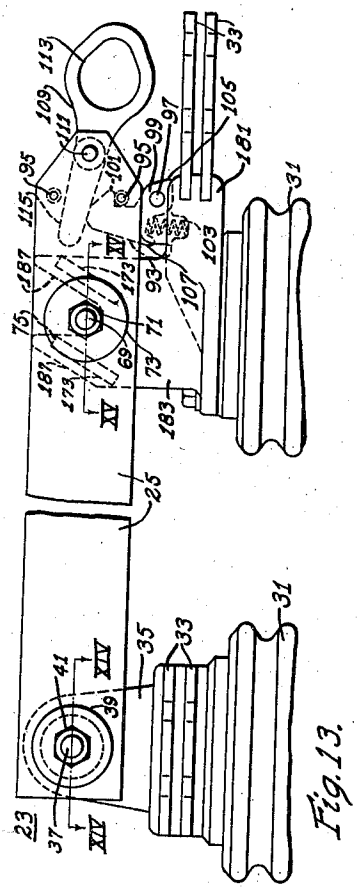
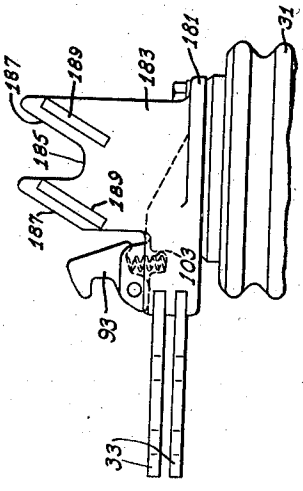


Fig. 13.



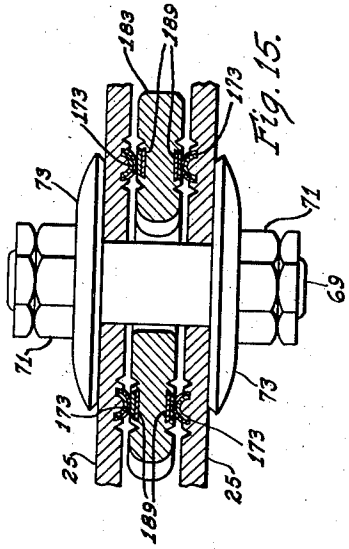


Fig. 15.

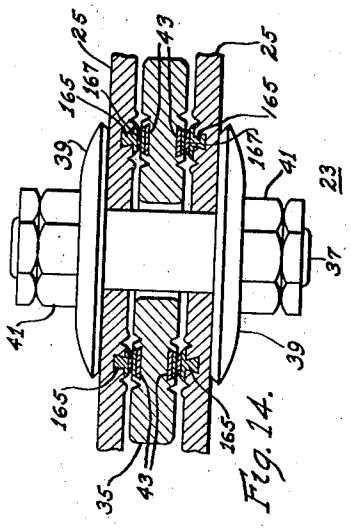


Fig. 14.

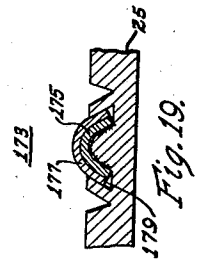


Fig. 19.

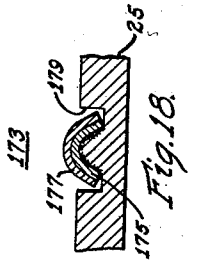


Fig. 18.

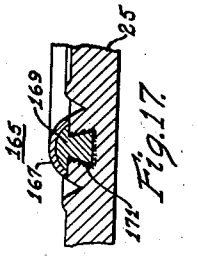


Fig. 17.

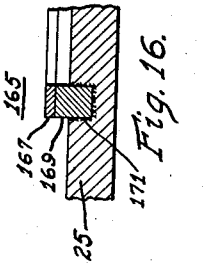


Fig. 16.

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Patented July 16, 1940

2,208,411

UNITED STATES PATENT OFFICE

2,208,411

ELECTRICAL SWITCH

Herbert J. Crabbs, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application December 17, 1937, Serial No. 180,394

13 Claims. (Cl. 200—162)

The invention relates to electrical switches in general and more particularly to disconnecting switches of the high contact pressure type for carrying relatively high currents.

An object of the invention is the provision of an electrical switch embodying improved contact means for restricting the contact area between the relatively movable contact members of the switch.

Another object of the invention is the provision of an electrical switch of the knife type embodying an improved contact means for providing substantially line contacts between the relatively movable contact members of the switch, which contact means have a low resistance under all conditions of operation.

Another object of the invention is the provision of an electrical switch embodying contact inserts to provide line contacts between the relatively movable contact members of the switch, at least the contacting surfaces of the inserts being of noble metal such as silver or the like.

Another object of the invention is the provision of an improved method of attaching contact area restricting inserts to the relatively movable contact members of an electrical switch.

Another object of the invention is the provision of an electrical switch of the knife type embodying an improved hinged contact construction consisting of cooperating annular rings attached to both the hinge and blade members for providing silver to silver circular line contacts.

Another object of the invention is the provision of an electrical switch of the knife type embodying improved contact means for providing line contacts between the break jaw and blade members, in which the actual contacting action takes place only when the blade member is relatively close to its final closed position.

Another object of the invention is the provision of an electrical switch of the knife type embodying an improved break contact construction for providing one or more high pressure line contacts, in which the wear on the contacting portions is reduced to a minimum.

Another object of the invention is the provision of an electrical switch of the knife type embodying raised contact portions on either the blade member or break jaw member for providing a restricted contact area between the members, the raised portion being arranged so that they engage the other member only during the final closing movement of the blade member and so that the lateral forces produced on the break jaw and its support are equal and opposite.

Another object of the invention is the provision of an electrical switch of the knife type embodying an improved latch means for locking the switch closed and a cooperating operating eye carried by the blade means which is operable to release the latch means and cooperate with a part of the latch means to pry the blade means out of the break jaw before moving the blade means to open position.

Another object of the invention is the provision of an electrical switch of the knife type having high unit pressure between restricted areas of the contact members, with an improved latch means for locking the switch closed, and a cooperating operating eye pivoted intermediate its ends on the blade means which is operable to release the latch means and then fulcrum on a part of the latch means to pry the contact portions of the blade means out of pressure engagement with the break jaw before swinging the blade means to open position.

The novel features that are considered characteristic of the invention are set forth in particular in the appended claims. The invention itself, however, both as to structure and operation, together with additional objects and advantages thereof, will be best understood from the following detailed description of several embodiments thereof when read in connection with the accompanying drawings, in which:

Figure 1 is a plan view of a double throw switch constructed in accordance with the invention, portions of the switch being broken away to reduce the length of the figure.

Fig. 2 is an enlarged sectional view of one of the hinge joints of the switch shown in Fig. 1, taken along the line II—II of Fig. 4.

Fig. 3 is a fragmentary view, partly in section, of one of the break tongues and the break end of the cooperating blades of the switch shown in Fig. 1, the section being taken substantially on the line III—III of Fig. 4.

Fig. 4 is a side elevational view of the switch shown in Fig. 1.

Fig. 5 is a fragmentary sectional view of one of the tongues of the switch illustrating a part of the method of attaching a contact insert to the tongue, the insert being shown attached in its recess before the pressing or swedging operation.

Fig. 6 is a view similar to Fig. 5 showing the contact insert and adjacent portion of the tongue after the pressing or swedging operation.

Fig. 7 is a fragmentary sectional view illustrating the construction and a part of the method of attaching a contact insert to a blade of the switch, the insert being shown attached in its recess before the pressing or swedging operation.

Fig. 8 is a view similar to Fig. 7 showing the contact insert and adjacent portion of the blade after the pressing or swedging operation.

Fig. 9 is a side elevational view of one part of the switch shown in Fig. 1, the blades being shown in partly open position illustrating the manner in which the operating eye fulcrums on the latch to pry the inserts of the blades out of engagement with the break tongues of the switch during an opening operation.

Fig. 10 is a plan view, partly in section, of a modified form of switch of greater current carrying capacity constructed in accordance with the invention.

Fig. 11 is a side elevational view of the switch shown in Fig. 10.

Fig. 12 is an enlarged sectional view taken substantially on the line XII—XII of Fig. 11 illustrating the contact means of the break end of the switch.

Fig. 13 is a side elevational view of another modified form of switch.

Fig. 14 is an enlarged fragmentary view, partly in section, of one of the hinge joints of the switch shown in Fig. 13 showing the contact means thereof, the section being taken on the line XIV—XIV of Fig. 13.

Fig. 15 is an enlarged fragmentary view, partly in section, of one of the break tongues and the break end of the cooperating blades of the switch shown in Fig. 13, the section being taken on the line XV—XV of Fig. 13.

Fig. 16 is a fragmentary sectional view of the hinge end of one of the blades of the switch shown in Fig. 13 illustrating a part of the method of attaching the insert to the blade, the insert being shown attached in its recess before the pressing or swedging operation.

Fig. 17 is a view similar to Fig. 16 showing the insert and adjacent portion of the blade after the pressing or swedging operation.

Fig. 18 is a fragmentary sectional view of the break end of one of the blades of the switch shown in Fig. 13 illustrating a part of the method of attaching a contact insert thereon, the insert being shown in its recess before the pressing or swedging operation, and

Fig. 19 is a view similar to Fig. 18 showing the insert and adjacent portion of the blade after the pressing or swedging operation.

Referring to Figs. 1 and 4 of the drawings, the switch illustrated is of the double throw multiple blade type and comprises, in general, a rigid supporting base **21**, a hinge terminal **23**, two pairs of spaced parallel blades **25** pivoted on the hinge terminal for rotation about a common axis, and two contact terminals **27** and **29** disposed on opposite sides of the hinge terminal in positions to be engaged by the blades **25** when they are rotated to either of their two closed circuit positions.

The terminals **23**, **27** and **29** are rigidly secured to the metal cap pieces of the insulating columns **31** which are preferably of vitreous insulating material such as porcelain or the like. The lower ends of the insulating columns **31** are rigidly bolted to the supporting base **21**.

Each of the terminals **23**, **27** and **29** are of suitable conducting material preferably copper or a copper alloy and are provided with terminal lugs or straps **33** for connecting electrical conductors to the terminals.

The hinge terminal **23** is provided with a pair of spaced parallel hinge tongues **35** having the form of flat plates or bars of suitable conducting material. The tongues **35** are either formed integral with the hinge terminal **23** or are welded thereto.

The pairs of blades **25** are pivotally mounted on their corresponding hinge tongues **35** by means of bolts **37** which pass through suitable openings provided therefor in the blades and tongues. The hinge ends of each pair of blades are yieldingly biased towards each other and against the opposite sides of their tongues **35** by means of a pair of spring washers **39** which have their outer edges engaged with the outer surfaces of the blades **25**. The spring washers **39** are held in stressed condition against the sides of the blades by the nuts **41**. Thus the spring washers **39** and the nuts **41** serve as a means for providing a high contact pressure between the contact means of the hinge joints of the switch.

In order to restrict the contact area between each pair of blades **25** and the hinge tongues **35** to which they are pivoted, there is provided a contact means consisting of annular ring inserts **43** and **45** attached to the opposite faces of the hinge tongue **35**, and the inner opposed surfaces of the blades **25** respectively. Referring to Figs. 2, 5 and 6 the inserts **43** for the hinge tongues **35** consist of flat metal rings preferably formed of bimetallic material, the body portion or backing portion **47** of which is of a suitable conducting material such as copper or a copper alloy and the contact portion **49** of which is of a noble metal such as silver or the like. The bimetal portions **47** and **49** of the rings **43** are secured together in any suitable manner as, for example, by brazing or welding the engaging surfaces together. The opposite faces of each hinge tongue **35** are provided with annular grooves **51** for receiving the inserts **43**. After being placed in the recesses **51**, the inserts **43** are soldered or brazed to the back wall of the recess as indicated at **53** (Fig. 5). After the inserts **43** have been attached in the recesses **51** provided therefor, the inserts and the portions of the material of the hinge tongue surrounding the edges of the recesses **51** are pressed or swaged to effect a cold flow of the material surrounding the edges of the recesses **51** over and against the inserts **43** as indicated at **55** in Fig. 6. The pressing operation also makes the contact surface level with the surface of the blade. The soldering and swedging operations of the method of attaching the inserts **43** to the hinge tongue provide a good electrical joint between the insert and the tongue member, and also securely and rigidly position the inserts in the faces of the tongue **35**.

Referring to Figs. 2, 7 and 8, the annular inserts **45** which are attached to the hinge ends of the blades **25** comprise annular rings which have a semi-cylindrical cross section to provide a convex raised contact surface. The inserts **45** are preferably of bimetallic material similar to that of the inserts **43**; that is, the inserts have a copper or copper alloy body portion **57** and a contact portion **59** of noble metal such as silver, the two portions being brazed together to form the composite insert. Referring to Figs. 7 and 8, the ring inserts **45** are placed in annular recesses or grooves **61** provided therefor in the inner opposed faces of the blades **25** adjacent their hinged ends.

After being placed in the recesses 61, the inserts 45 are rigidly secured in the recesses by brazing or soldering the back surface thereof to the back wall of the recess as indicated at 63. The inserts 45 and the portions of the material of the blades 25 adjacent the edges of the annular recesses 61 are subjected to a pressing or swedging operation to effect a cold flow of the material surrounding the inserts over and against the same. The soldering and swaging operations serve to provide a good electrical joint between the inserts 45 and the blades 25 and also rigidly secure the inserts to the blades.

The inserts 43 and 45 have the same diameter, so that their contact surfaces engage in all angular positions of the blades 25. The convex raised surfaces of the inserts 45 of the blades 25 provide substantially circular line contacts between the blades 25 and the hinge tongues 35, and the spring washers 39 provide a high pressure engagement of the line contacts.

The right hand contact terminal 27 is provided with a pair of spaced parallel contact members or break tongues 67 which are disposed in the same planes as the hinge tongues 35. Each tongue 67 is adapted to be straddled by a corresponding pair of blade members 25 in the closed position of the switch. The break tongues 67 are of suitable conducting material and are either formed integral with the contact terminal 27 or welded thereto.

Each of the pairs of blades 25 have the form of flat elongated bars of suitable conducting material such as copper or the like and are of such length that their ends extend beyond the contact terminals 27 or 29. The ends of each pair of blades are spaced the proper distance apart by suitable spacer means. The blades of each pair are connected for rotation together by means of a bolt 69 which passes through openings provided therefor in the blades and the ends of which are threaded for receiving the nuts 71. A pair of spring washers 73 are mounted on the bolt 69 for yieldingly urging the contact portions of the blades 25 of each pair towards one another and against the break tongues 67 to provide a high contact pressure between the blades and the break tongues in a well known manner.

Each of the break tongues 67 are recessed as indicated at 75 for accommodating the bolts 69 in the closed position of the switch.

A contact means is provided for restricting the contact area between each pair of blades and its corresponding break contact tongue 67. Referring to Fig. 3 the contact means for the break end of the switch comprises a pair of raised contact inserts 77 carried on the inner surface of each of the blades 25 and projecting beyond the inner surface. The inserts 77 are preferably of a bimetallic material similar to the inserts 45 at the hinge end of the blades and are attached in suitable recesses or grooves provided therefor in the blade members 25 and in the same manner as described in connection with the inserts 45 at the hinge end of the blades. The inserts 77 instead of being annular as in the case of the inserts 45, are in the form of straight metal bars. There are two inserts 77 attached to the inner surface of each blade in the positions illustrated in Fig. 4, the two inserts converging toward the outer longitudinal edge of the blade 25 and being at equal and opposite angles to said edge and on opposite sides of the connecting bolt 69. The inserts 77 have contact portions 79 of noble metal such as silver raised above the surface of the blade. For cooperating with these silver contact portions the opposite faces of each of the break tongues 67 are provided with the contact inserts 81 having contact surfaces level with the face of the tongues and which are similar in construction and attached in the same manner as the inserts 43 of the hinge tongue 35. The inserts 81 have the form of straight bars which are of the same length as the inserts 77 and which are attached to the break tongue 67 in the same relative positions as the inserts 77 of the blade members 25, so that they are alined with and engaged by the inserts 77 in the final closed position of the switch blades.

The edges of each of the break tongues 67 which are crossed over by the convex projecting contact surface of the inserts 77 of the blade members as they are moved to closed position are cut off at angles as indicated at 83, so that these edges of the break tongues lie substantially parallel to, and relatively close to, the adjacent inserts 77 of the blades in the closed position of the switch as shown in Fig. 4. This construction of the break tongues cooperates with the arrangement of the raised inserts 77 of the blades 25 so that the raised inserts slide transversely over only a very small portion of the faces of the break tongue 67 and this only during a small portion of the final closing movement of the blades. This reduces wear on the silver contact faces of the inserts 77 to a minimum.

The arrangement of the raised contact inserts 77 on the blades 25 so that they lie in opposed angular relation to each other, produces equal and opposite lateral forces on the contact terminal 27 and its supporting insulating column 31 as well as the hinge terminal 23 and its supporting column 31, thus eliminating any lateral or end thrust on the insulators 31 which would tend to break or crack the same.

The left hand contact terminal 29 is provided with a pair of spaced parallel contact members or break tongues 85 which correspond to and lie in the same planes as the break tongues 67 of the terminal 27 so that each is straddled by the corresponding pair of blades 25 when the blades are rotated in a counter-clockwise direction to their lower closed position. The opposite faces of each of the break tongues 85 are provided with flat contact inserts 87 which are similar to and attached in the same manner as the inserts 81 of the break tongues 67. The inserts 87, however, are disposed in inverted relation with respect to the inserts 81 of the upper terminal member 27 in order to make them aline with and be engaged by the raised inserts 77 at the break end of the blades when the blades are rotated to their lower closed circuit position. Each of the tongues 85 is recessed as indicated at 89 to receive the through bolts 69 which connect the blade members 25. The edges of each of the break tongues 85 which are crossed by the raised inserts 77 of the blades when the blades are closed on the tongues 85 are cut away as indicated at 91 so as to lie substantially parallel and relatively close to the raised inserts 77 in the lower closed circuit position of the blades. The edges 91 are cut away as indicated in order to reduce the surfaces over which the raised inserts 77 must slide during closing of the blades to a minimum. It will be noted that the opposed angular relation of the raised inserts 77 produce equal and opposite lateral end thrusts or forces on the lower contact terminal 29 and the blades, when the blades are closed thereon, the same as in the case of the upper contact terminal 27, thus there is no lateral or end

thrust produced on any of the insulating columns 31 during operation of the switch.

The terminal members 27 and 29 are provided with a pair of locking elements or latch members 93 which are adapted to engage cooperating locking elements 95 carried between each pair of blades 25 to lock the blades in either of their closed circuit positions. The latch members 93 of each contact terminal are pivotally mounted on the terminal by means of pivot pins 97 which are supported transversely between the spaced lugs or ears 99 (Fig. 9). The latch members 93 are mounted in spaced relation on the terminals so that their outer ends enter in the spaces between the pairs of blades 25 when the blades are closed. The outer ends of the latch members 93 are provided with hooked noses 101 which are adapted to engage over the locking elements 95 when the blades are closed as shown in Fig. 4, and each of the latch members is biased to its latching position by means of a compression spring 103, the lower ends of which seat in recesses provided therefor in the terminal. Each of the latch members 93 are provided with a pair of projections 105 and 107 which lie on opposite sides of the pivot pin 97 for cooperating with the outer surface of the contact terminal for limiting the movement of the latch member between its latched and released positions.

Each pair of blades 25 is provided with an operating lever 109 which is pivoted intermediate its ends on a transverse pivot pin 111 extending transversely between the two blades 25. One end of the lever 109 is formed to provide an operating eye 113 adapted to receive a hook stick or other form of operating member for opening and closing the pair of blades. The arm 115 of the lever 109 cooperates with the rounded nose 101 of the latch member, so that when the operating lever 109 is pulled or pushed in an opening direction by a hook stick, the arm 115 of the lever cams the latch member 93 to its released position as shown in Fig. 9. When the latch 93 has been cammed or moved to its released position, the projection 107 thereof engages the outer surface of the terminal to stop any further movement of the latch member 93. The continued opening pull or thrust applied to the operating lever 109 in an opening direction causes the operating lever 109 to fulcrum on the end or nose of the latch 93 to exert a prying or multiplied leverage action on the blade members 25 as shown in Fig. 9. The prying action of the lever 109 continues until the raised contact inserts 77 of the blade members 25 have substantially disengaged the break tongue of the contact terminal, thus disconnecting the high pressure line contacts. After the line pressure contacts are disengaged as described above, the blades 25 are lifted freely, being retarded only by the friction of the hinge joint. As the open pull or thrust is continued on the operating lever 109, the arm 115 of the lever engages the locking pin 95 which extends between the blades, so that continued pull or thrust on the operating lever swings the blades 25 to their open vertical position.

The above operation of the operating lever and latch has been described in connection with one pair of the blades 25 and one break tongue and terminal. It will be readily understood that the operating eye and latch means for the other pair of blades functions in the same manner in operating the switch. The operating lever 109 operates in the same manner to release the latch means and pry the blades out of engagement with the break tongue of either of the opposite terminal members. In closing the blades to either of their closed positions, the operating lever 109 is first moved until the arm 115 engages the appropriate pin 95 after which the operating lever 109 becomes rigid with respect to the blade members so that continued pull or thrust on the operating member swings the blade members to their closed circuit position.

It will thus be seen that in opening the switch, one continuous pull or thrust on the operating lever 109 serves to first release the latch means, then to pry the blades to disengage the line pressure contacts, and then to swing the blades to their open circuit position. The closing operation is also accomplished by one continuous pull or thrust on the operating lever. In closing, the locking pins 95 cam the latch members to released position to clear the same as the blades are moved into engagement with either contact terminal. When the blades have reached their final closed position the springs 103 move the latches 93 to their latching position to lock the blades.

Fig. 10 illustrates a modified form of switch of larger current carrying capacity. The switch is of the single throw multiple blade type and comprises in general a base (not shown), a hinge terminal 123, two pairs of blades 125 pivoted on the hinge terminal for rotation about a common axis, and a contact terminal 127.

The terminals 123 and 127 are rigidly secured to the metal cap pieces of the insulating columns 31 which are preferably of vitreous insulating material. The lower ends of the columns 31 are bolted to the rigid base.

Each of the terminals 123 and 127 are of suitable conducting material such as copper or a copper alloy and each is provided with appropriate terminal lugs or connecting straps 33 for connecting the switch in an electrical circuit.

The hinge terminal 123 is provided with two sets of hinge members 133 (Fig. 10), each of which comprises three contact members or jaws 135 in the form of spaced plates of suitable conducting material which are either formed integral with or welded to the hinge terminal 123.

Each pair of blades 125 is pivoted on its hinge member 133 by means of a bolt 137 which extends through suitable openings provided in the blades 125 and jaws 135. The blades 125 of each pair straddle the central jaw member 135 and are sandwiched between the two outer jaw members 135 of each hinge member as shown in Fig. 10. The jaw members 135 for each pair of blades are yieldingly biased towards each other to provide a high contact pressure between the blades and jaw members by means of a pair of cup washers 139 which are mounted on the bolts 137 and held in pressure engagement with the outer face of the outer jaw members by means of the nuts 141. A contact means is provided for each pair of blades and their hinge jaw members for restricting the contact area between the blades and the jaws. The contact means comprises raised annular inserts 143 on the blades 125 which cooperate with flat annular inserts 145 on the hinge contact members or jaws 135. The inserts 143 and 145 are substantially identical to the ring inserts as shown and described in connection with the switch illustrated in Figs. 1 through 9 and are attached in the same manner. The inserts 143 and 145 are of bimetallic material having copper or copper alloy body portions or backs and contact portions of noble metal such as silver or the

like. The inserts are attached in suitable grooves provided therefor in the cooperating surfaces of the hinge jaws 135 and the hinge ends of the blades 125 by a soldering operation to ensure a good electrical contact. Following the soldering operation, the inserts and the surrounding portions of the jaws or blades, as the case may be, are subjected to a swaging operation to effect a cold flow of the surrounding portion of the member over and against the inserts. The convexed raised surface of the inserts 143 engage the cooperating contact surface of the inserts 145 in all angular positions of the blades to provide a plurality of circular silver to silver line contacts between the hinge jaws and the blades. The line contacts are maintained in high pressure engagement by means of the spring washers 139 and the nuts 141.

The blades 125 have the form of flat metal bars of suitable conducting material and are of a length to extend beyond the contact terminal 127 in the closed position of the switch. The blades are spaced at their outer ends by suitable spacer means.

The contact terminal 127, which is of conducting material, is provided with two sets of contact members 147 each consisting of three spaced parallel break jaws 149 having the form of flat plates of conducting material. The break jaws 149 lie in the same planes as the corresponding hinge tongues 135, so that the blades 125 are adapted when rotated to enter in the spaces between the break jaws 149 as shown in Fig. 10.

A contact means is provided for each pair of blades 125 and their corresponding break jaws 149 for restricting the contact area therebetween in the closed position of the blades. Referring to Figs. 11 and 12, these contact means comprise raised inserts 151 attached to the opposed surfaces of the break jaws 149. The inserts 151 are substantially identical in construction to the raised inserts 77 at the break ends of the blades of the switch shown and described in connection with Figs. 1 through 9, consisting of bimetallic material having a copper body or back portion and a contact portion of noble metal such as silver. The inserts 151 have the form of straight metal bars and are attached in grooves provided therefor in the break jaws and disposed in parallel tandem relation at an angle to the line of motion of the break end of the blades 125 as they engage the contact terminal as shown in Fig. 11. The inserts 151 are attached in the grooves provided therefor by a soldering operation following which the portions of the jaws adjacent the edges of the grooves and the inserts are subjected to a swaging operation in the same manner as has been previously described in connection with the inserts of the switch illustrated in Figs. 1 through 9.

For cooperating with the raised inserts 151 of the break jaws 149, the opposite surfaces of the blades 125 which aline with the break jaws 149 are provided with angularly disposed flat bar inserts 153 of bimetallic material which are adapted to aline with and be engaged by the raised inserts 151 in the closed position of the blade members. The inserts 153 have contact portions of noble metal such as silver and are attached in suitable recesses provided therefore in the blades in the same manner and by the same method as described in connection with the inserts 151.

Each of the blades 125 is recessed as indicated at 155 for accommodating the through bolts 157 which extends through the break jaws 139 and supports the spring washers 159 and nuts 161 which function to bias the break jaws 149 towards each other to ensure a high pressure engagement between the contact portions of the blades and break jaws in the closed position of the switch.

The edges of each blade which cross over the raised inserts 151 of the jaw during closing of the blade are cut away as indicated at 163, so as to lie parallel to and relatively close to the inserts 151 in the closed position of the switch, thus reducing the wear on the raised contact inserts 151 to a minimum in operation of the switch.

The switch is provided with latch means for locking the blades 125 in closed position and with cooperating operating levers for releasing the latch means and operating the blades, which are identical in structure and operation to the latch means and operating levers of the switch shown and described in connection with Figs. 1 through 9 and hence have been given the same reference characters. The latch members 93 are pivotally mounted in spaced relation on the pivot pins 97 supported by the contact terminal 127 so that their upper ends extend in spaces between the pairs of blades 125. The latch members 93 are biased to their latching positions by means of springs 103, so that their noses 101 engage the locking pins 95 carried by and extending transversely between each pair of blades 105 to lock the blades in closed circuit position. The operating levers 109 are pivoted between the blades 125 of each pair and are provided with arms 115 for cooperating with the latch members 93, and are also provided with operating eye portions 113 for receiving a hook stick or other operating member.

To open the switch, an opening pull or thrust is exerted on the operating levers 109 which causes the operating levers to first cam the latch members 93 to their released positions in which the stop projections 107 of the latch members engage the upper surface of the contact terminal 127. The continued pull or thrust on the operating levers 109 causes the arms 115 of the levers 109 to fulcrum on the upper ends of the latch members 93 to pry the blades 125 out of pressure engagement with the raised inserts 151 of the break jaws. The pull or thrust then swings the blades 125 to their open circuit position away from the contact terminal 127.

A further modified form of switch is illustrated in Fig. 13. This modified form of switch has the same general construction as the switch shown and described in connection with Figs. 1 through 9, with the exception of the contact terminals and the contact means for restricting the contact area at the hinge and break ends of the switch, and hence the same reference characters have been used to designate the corresponding parts wherever applicable. Since the general structure of the switch has been previously described in connection with Figs. 1 through 9, the following description will be limited to the modified form of contact terminals and to the contact means for restricting the contact area between the blades and the contact members.

Referring to Fig. 14, the contact means for restricting the contact area between the hinge tongues 35 and the hinge end of the blades 25 comprises raised annular inserts 165 attached to the opposed inner surfaces of the blade members 25 which aline with and engage flat annular inserts 43 attached to the opposite faces of the

hinge tongues 35. The inserts 43 are of the same construction and are attached to the hinge tongues in the same manner as the corresponding inserts on the hinge tongues 35 of the switch shown and described in connection with Figs. 1 through 9.

The inserts 165 each have convexed raised contact portions 167 (Fig. 17) of noble metal such as silver which projects beyond the surface of the blades 25, and a body or back portion 169 of copper or copper alloy which is secured in a groove provided therefor in the blade 25. Referring to Fig. 16, the inserts 165 originally have the form of metal rings which are secured by a soldering operation in annular grooves provided in the blades 25. Following the attachment of the ring inserts 165 in the grooves 171, as shown in Fig. 16, the rings and portions of the blades 25 surrounding the recesses 171 are subjected to a swaging operation which presses the projecting portions of the ring into a convex shape, and which effects a cold flow of the material of the blades 25 surrounding the recesses 171 over and against the sides of the lower portion of the rings as shown in Fig. 17, so that a section through the insert resembles the section through a mushroom or rivet. The method of attaching the insert 165 provides a good electrical joint between the insert and the blade, rigidly secures it to the blade and provides the contact portion of the insert with a convex raised contact surface. The silver contact portions 167 of the inserts 165 engage the silver contact portions of the cooperating inserts 43 of the hinge tongues 35 in all angular positions of the blades 25, the spring washers 39 providing a high pressure engagement between the contact portions.

The blades 25 adjacent their break contact ends are each provided with raised contact inserts 173 which are attached to the opposed inner surfaces of the blades for restricting the contact area between the break end of the blades and the contact terminals. Referring to Figs. 15, 18 and 19, the insets 173 for each blade comprise a pair of channel shaped bars of bimetallic material having a body portion 175 of suitable conducting material such as copper, and a contact portion 177 of noble metal such as silver. The inserts 173 are seated in grooves 179 provided therefor in the opposed surfaces of the blades 25, and are attached in the grooves by a soldering operation (see Fig. 18). Following the attachment of the inserts in the grooves, the inserts and portions of the blades adjacent the edges of the grooves 179 are subjected to a swaging operation to effect a cold flow of the portions adjacent the edges of the recess 179 over and against the sides of the inserts 173 to rigidly secure them in position on the blades as shown in Fig. 19. This method of attaching the inserts is the same as disclosed in connection with the switch shown in Figs. 1–9.

The two inserts 173 of each blade are arranged in spaced parallel relation at an angle to the direction of movement of the blades as shown in Fig. 13.

Each of the contact terminals 181 are provided with a pair of spaced parallel contact members or break tongues 183 in a position to be straddled by the pairs of blades 25 in the closed circuit positions thereof. Each of the break tongues 183 is provided with a recess 185 for accommodating the through bolt 69 which passes through the blades 25 adjacent their break ends. The edges of the break tongues 183 which are crossed over by the raised inserts 173 of the blades are cut away as indicated at 187 so that these edges lie substantially parallel to and relatively close to the raised inserts 177 of the blades 25 in the closed position thereof, thus reducing the amount of surface over which the raised inserts 177 must slide during closing and opening of the blades and reducing wear on the silver contact portions of the inserts 173 to a minimum.

For cooperating with the raised inserts 177 of the blades 25, each of the break tongues 183 is provided on its opposite faces with inserts 189 in the form of flat metal strips of bimetallic material having contact portions of noble metal such as silver. The inserts 189 are attached in suitable recesses provided therefor in the tongues 183 in the same manner as described in connection with the inserts of the break tongues of the switch shown and described in Figs. 1 through 9. The inserts 189 are of the same length as the raised inserts 177 on the blades 25 and are mounted in the same spaced angular relation, so as to align with and be engaged by the raised inserts 177 when the blades are in either of their closed positions. The inserts 177 of the blades 25 and the inserts 189 of the break tongues 183 provide silver to silver line contacts which are engaged with a high pressure by means of the spring washers 73 which bias the blades 25 towards each other.

It will be noted that the construction and shape of the hinge tongues 183 for each of the contact terminals 181 are identical thus enabling them to be manufactured in large quantities at a relatively low cost.

The switch illustrated in Fig. 13 is provided with latch means and operating levers which are of the same construction and which function in the same manner as the latch means and operating levers of the switch shown and described in connection with Figs. 1 through 9.

The contact inserts in each of the switches shown and described are of bimetallic material. If desired, however, the inserts may consist of solid noble metal or of a suitable alloy containing noble metal.

While the switch illustrated in Fig. 13 embodies raised contact inserts of different construction from the raised contact inserts of the switches shown in Figs. 1 and 10, it will be readily understood that either of the forms or constructions of inserts may be used with any one of the three switch structures illustrated.

While the invention has been disclosed in accordance with the provisions of the patent statutes, it is to be understood that various changes in the structural details thereof may be made without departing from the spirit of the invention. It is desired therefore that the appended claims be given the broadest reasonable construction permissible in the light of the prior art.

I claim as my invention:

1. In a double throw electrical switch, a hinge member, a pair of stationary contact members, a blade member pivoted on said hinge member for swinging movement into and out of engagement with either of said contact members, said blade member and said contact members being provided with contact portions which engage when the blade member is in either of its closed positions to provide limited area contacts between the blade member and contact member, said contact portions having their lines of contact at an angle to the longitudinal axis of the

switch, and said contact members being identical in construction.

2. In an electrical switch, a contact member, a blade member, one of said members being provided with raised contact ribs to provide line contacts between said members at an angle to the longitudinal axis of the blade member when the switch is closed, at least the contact surface of said ribs being composed of noble metal, the other of said members being shaped so that the raised contact ribs slide transversely over only a relatively small portion of the surface of the opposite member during opening and closing of the switch.

3. In an electrical switch, a contact member, a blade member, one of said members being provided with raised contact ribs to provide line contacts between said members at an angle to the longitudinal axis of the blade member when the switch is closed, at least the contact surface of said ribs being composed of silver, the other of said members having its edges which are crossed by the raised contact ribs formed to lie substantially parallel to and relatively close to the raised ribs in the closed position of the switch.

4. In an electrical switch, a contact member, a blade member movable into and out of engagement with said contact member, one of said members being bifurcated to provide portions for cooperating with the opposite faces of the other member, one of said members being provided with raised contact portions to restrict the contact area between said members to less than that of the transversely aligned surfaces of the members when the switch is closed, said raised portions lying in lines which are at opposed angles to the line of motion of the blade member as it engages the contact member so are to produce equal and opposite end thrusts on the contact member and blade member during the final closing movement of the blade member.

5. In an electrical switch, an insulating column, a contact member rigidly supported on said column, a blade member movable into and out of engagement with said contact member, one of said members being bifurcated to provide portions for cooperating with the opposite faces of the other member, one of said members being provided with raised contact portions to restrict the contact area between said members to less than that of the transversely aligned surfaces of the members when the switch is closed, means yieldingly urging the bifurcated branches of the bifurcated member towards each other to provide high contact pressure, said raised contact portions lying in lines which are at opposed angles to the line of motion of the blade member as it engages the contact member so as to produce equal and opposite lateral forces on the stationary contact members and its supporting column during the closing movement of the switch member.

6. In an electrical switch, a switch jaw comprising spaced parallel contact members having opposed faces, a blade member having a contact end movable into the space between said members, raised contact ribs projecting from the opposed faces of said members to provide limited area contacts between the blade and jaw at an angle to the longitudinal axis of the blade in the closed position of the switch, the contact end of said blade being formed so that its edges which slide transversely across said ribs are substantially parallel to and relatively close to the ribs in the closed position of the blade.

7. In an electrical switch, a pair of spaced parallel blades having opposed surfaces, means mounting said blades for rotation about an axis, a tongue disposed in the path of said blades to be straddled thereby, a pair of raised contact ribs projecting from each of the opposed surfaces of the blades to provide limited area contacts between the blades and tongue, the ribs of each surface being in opposed angular relation so as to produce equal and opposite lateral forces on the tongue during closing of the blades on the tongue, said tongue having its edges which are crossed by the ribs formed to lie substantially parallel to and relatively close to the ribs in the closed position of the switch.

8. In an electrical switch, a fixed contact member, a blade member movable into and out of engagement therewith, means providing pressure engagement of said members when the switch is closed, a latch pivotally mounted on said fixed contact member and a cooperating locking element carried by said blade member for locking said blade member in closed position, an operating lever pivoted intermediate its ends on said blade member for releasing said latch and operating said blade member, the latch carried by said fixed contact member serving as a fulcrum for said lever to pry said blade member out of pressure engagement with said contact member after said latch has been moved to a released position by said lever.

9. In an electrical switch, a fixed contact member, a blade member movable into engagement therewith, one of said members having raised contact portions to restrict the contact area between the members, means providing a high contact pressure engagement between said members in the closed position of the switch, means including a latch member pivotally mounted on said fixed contact member having a latching position in which it locks said blade member in closed position, and movable to a releasing position to release said blade member, a stop for preventing movement of said latch member beyond its released position, an operating lever pivoted intermediate its ends on said blade member operable to move said latch member to released position and said blade member to open position, said latch member in its released position serving as a fulcrum for said lever to pry said raised contact portion out of engagement with the other member.

10. In an electrical switch, a contact member, a blade member movable into and out of engagement with said contact member, said blade member having raised contact portions disposed in lines which are at opposed angles to the line of motion of the blade member as it engages the contact member, said raised contact portions restricting the contact area to an order less than that of the transversely aligned surfaces when the switch is closed.

11. In an electrical switch, a contact member, a blade member movable into and out of engagement with said contact member, said contact member being disposed perpendicular to the longitudinal axis of the blade member in the closed position of the switch, one of said members being provided with an elongated raised contact portion disposed at an angle to the line of motion of the contact portion of the switch member as it engages said contact member for restricting the contact area to less than that of the transversely aligned surfaces when the switch is closed, the other of said members being formed

so that the raised contact portion slides transversely over only a relatively small portion of the surface of the opposite member and this only during the final closing movement and initial opening movement of the switch member.

12. In a double-throw electrical switch, a hinge member, a pair of stationary contact members, a blade member pivoted on said hinge member for swinging movement into and out of engagement with either of said contact members, said blade member having at least one elongated raised contact portion disposed at an angle to the longitudinal axis of the switch for restricting the contact area to less than that of the transversely aligned surfaces when the switch is closed in either position, the edges of the two contact members which the raised contact portion slides transversely across during closing of the switch being parallel to each other and also parallel to the raised contact portion when the switch member is in either closed position.

13. In an electrical switch, a contact member, a blade member movable into and out of engagement therewith one of said members having an elongated raised contact portion disposed at an angle to the longitudinal axis of the blade member when the switch is closed for restricting the contact area, the other of said members being formed so that the raised contact portion slides transversely over only a relatively small portion of the surface of the member which it engages and this only during the final closing movement and initial opening movement of the switch member, means for providing a high contact pressure when the switch is closed, a latch pivotally mounted on the contact member and a cooperating locking element on the blade member for locking said blade member in closed position, an operating lever pivoted intermediate its ends on said blade member for releasing said latch and operating said blade member, the latch carried by said contact member serving as a fulcrum for said operating lever to pry said blade member out of pressure engagement with said contact member after said latch has been moved to a released position by said operating lever.

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