

July 7, 1959

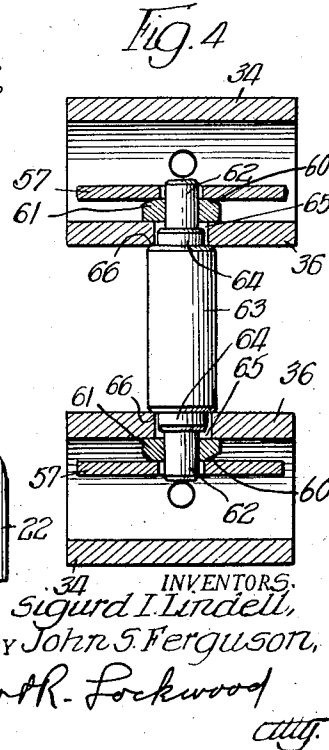
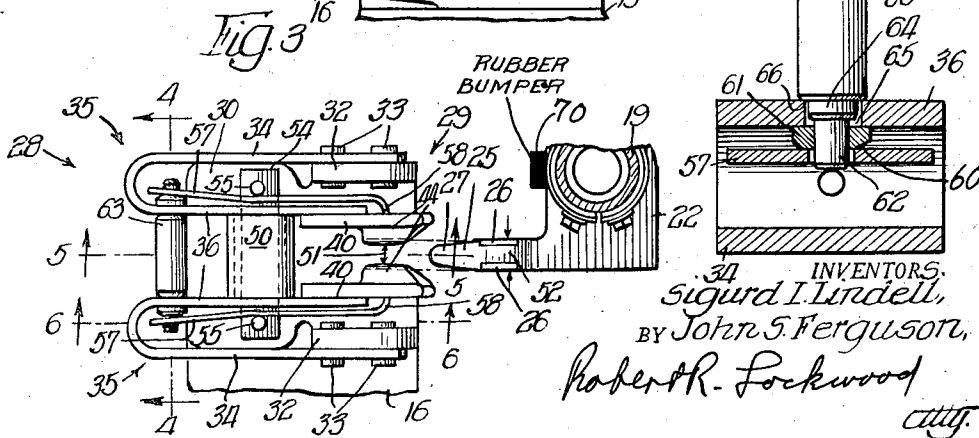
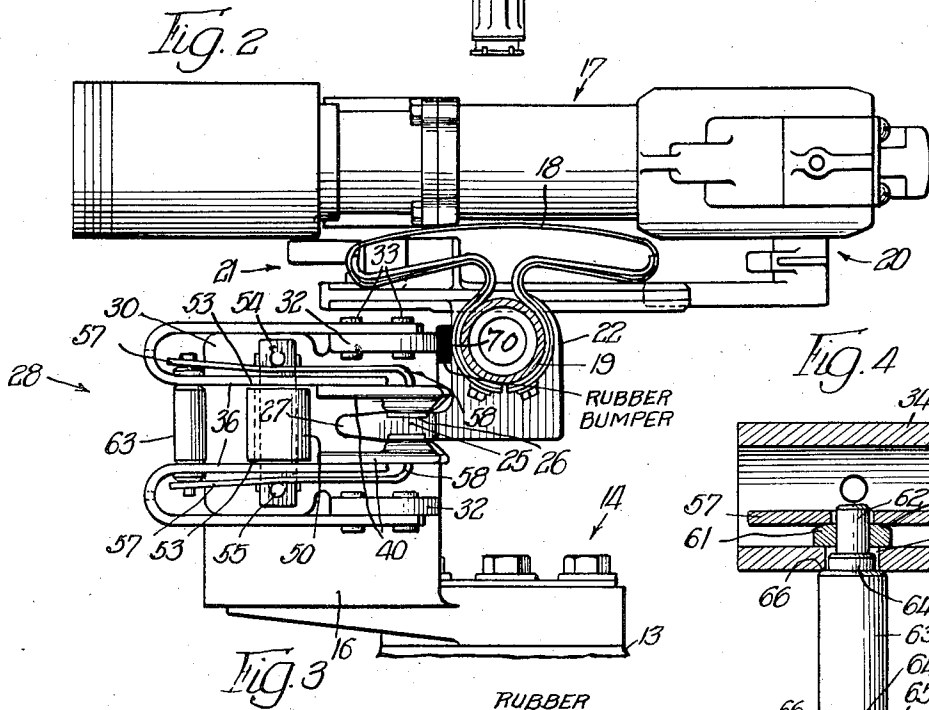
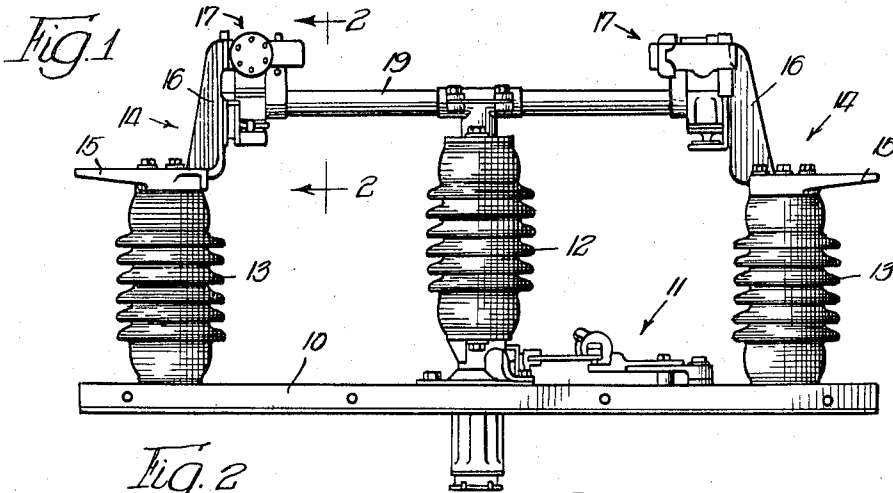
S. I. LINDELL ET AL

2,894,101

SWITCH CONTACT CONSTRUCTION

Filed Jan. 20, 1958

7 Sheets-Sheet 1



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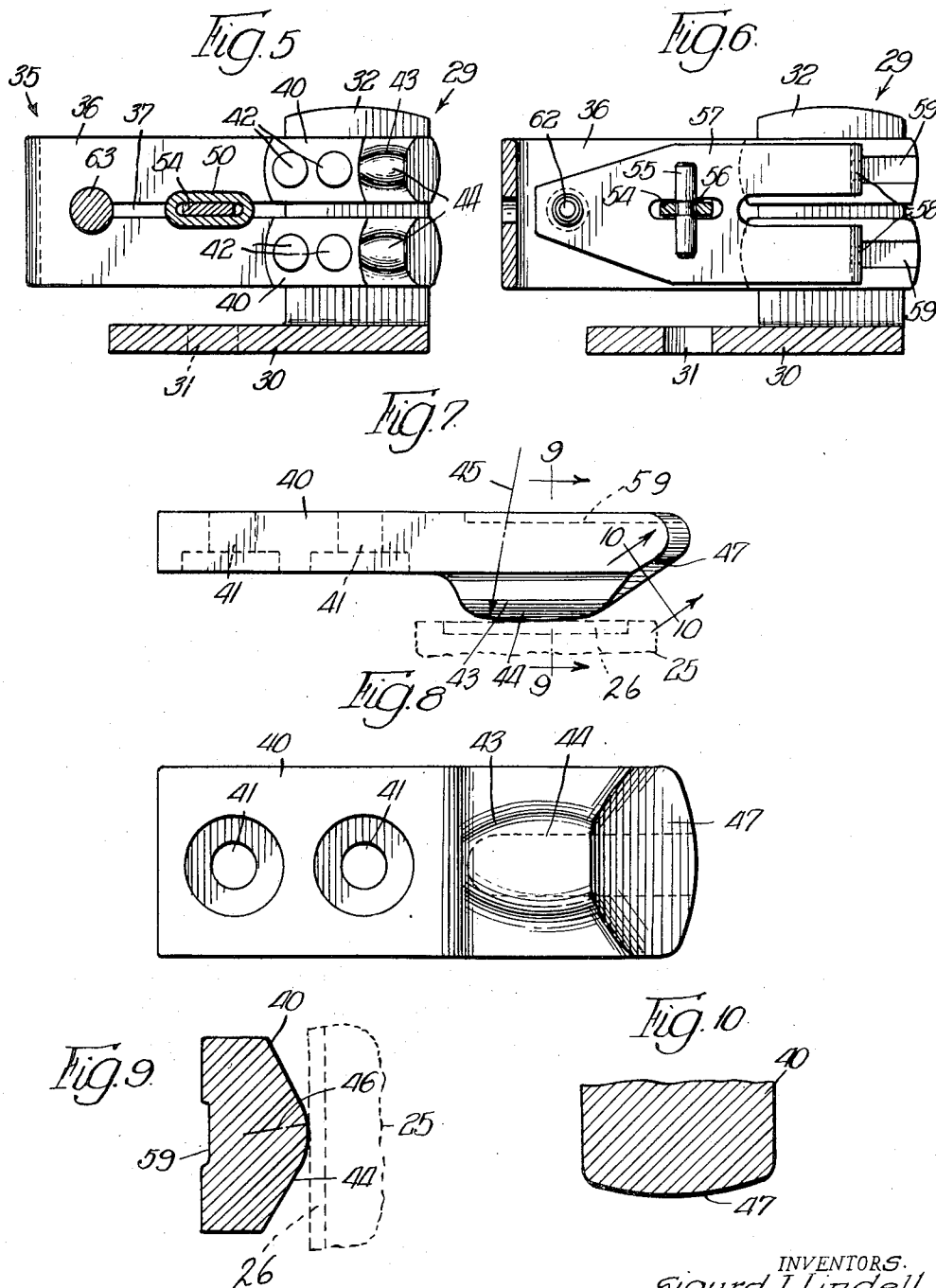
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SWITCH CONTACT CONSTRUCTION

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7 Sheets-Sheet 2



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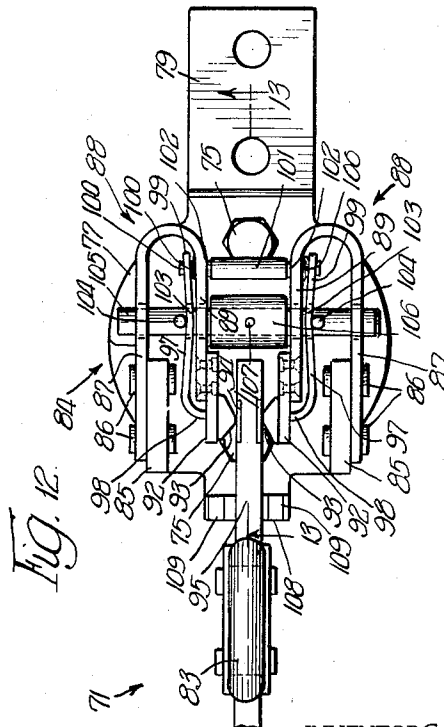
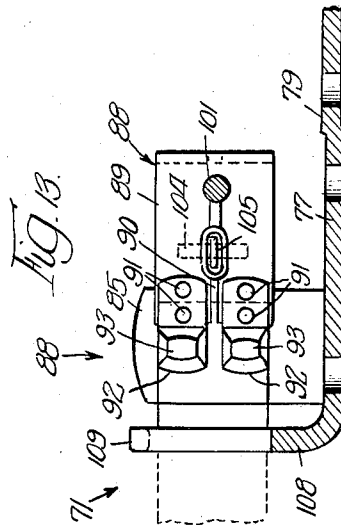
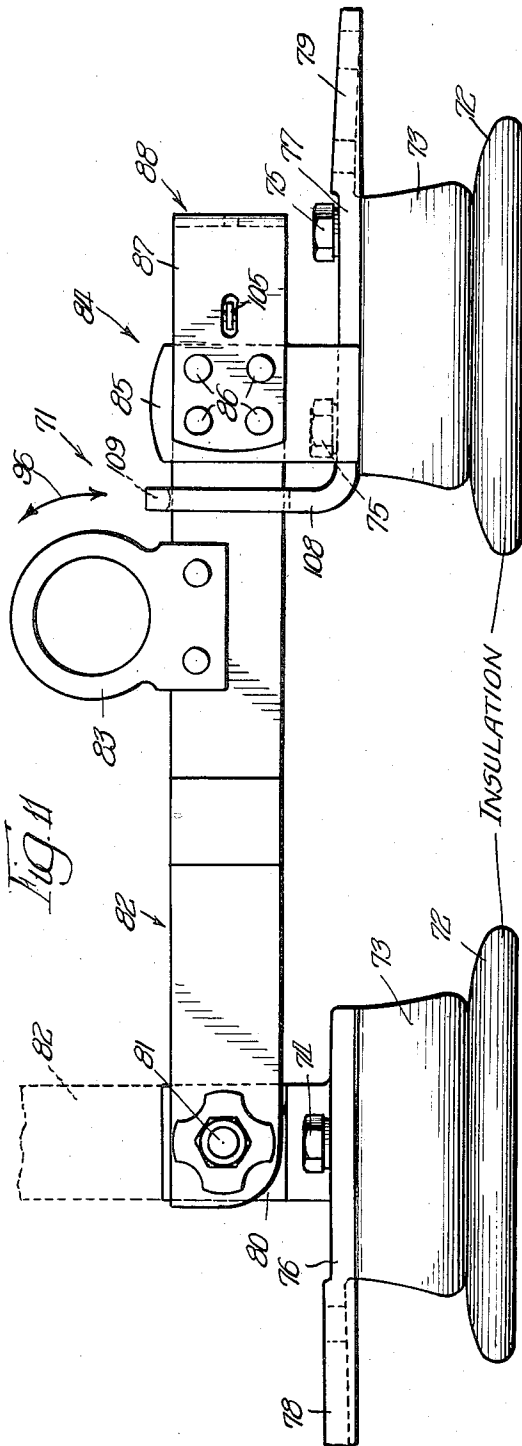
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SWITCH CONTACT CONSTRUCTION

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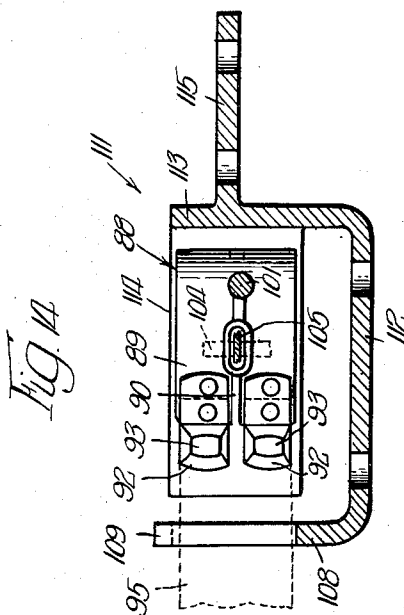
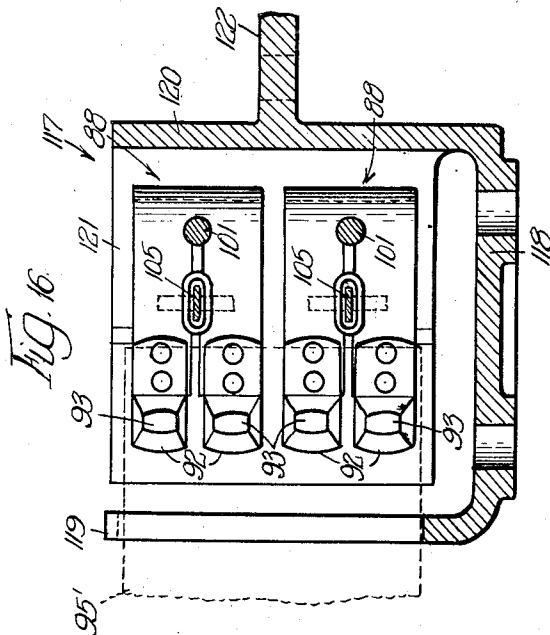
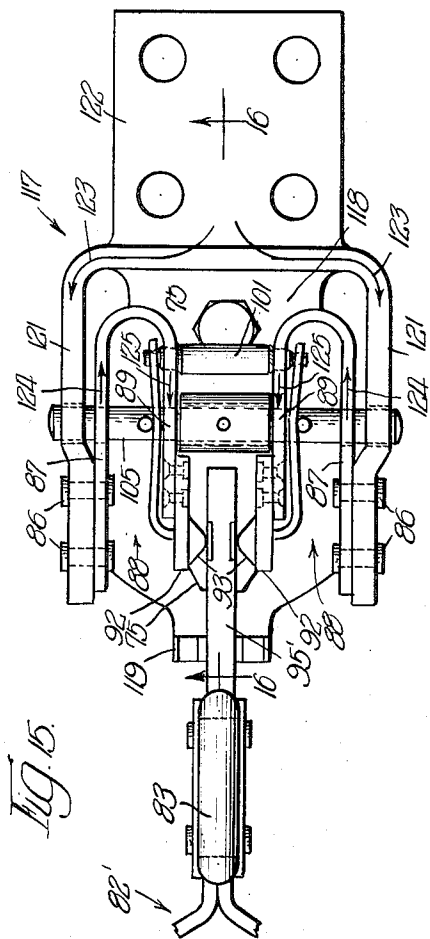
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SWITCH CONTACT CONSTRUCTION

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SWITCH CONTACT CONSTRUCTION

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Fig. 20.

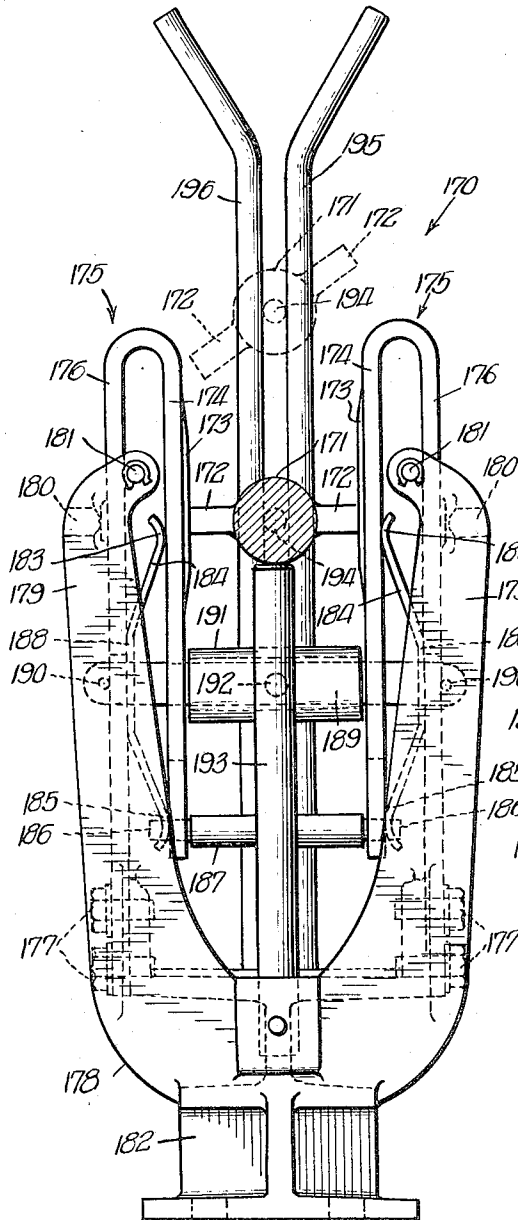
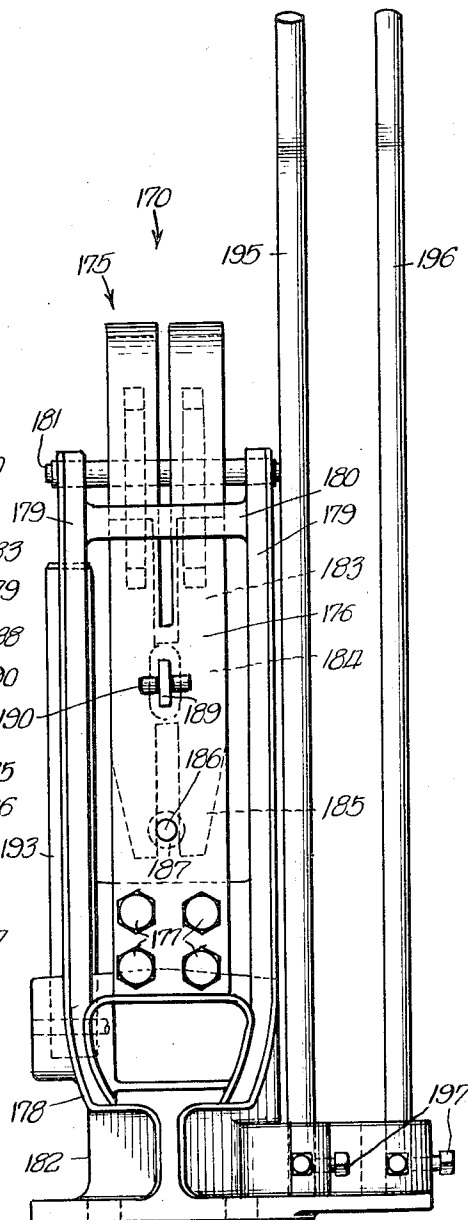


Fig. 21



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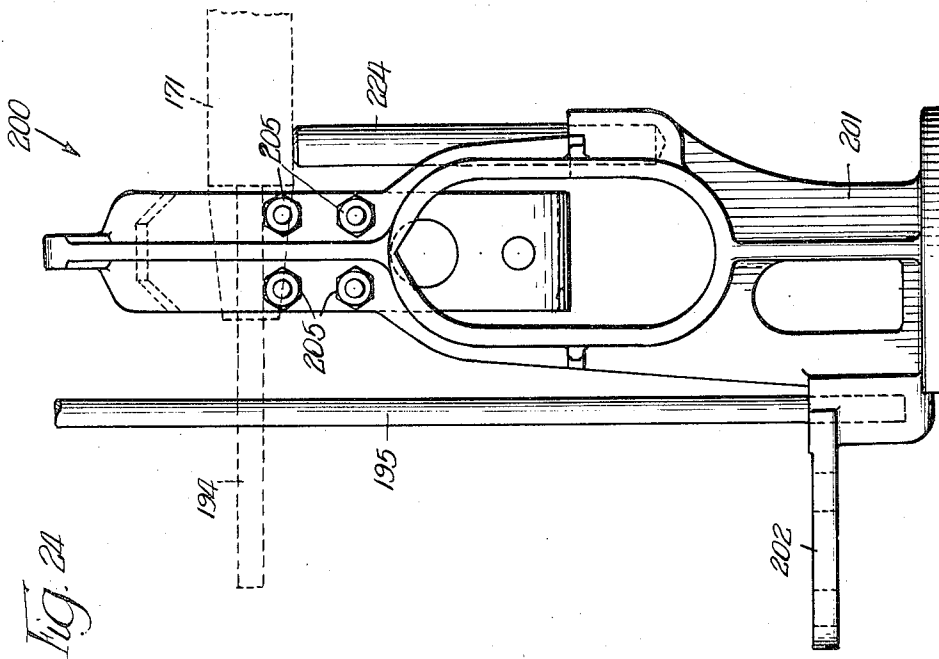
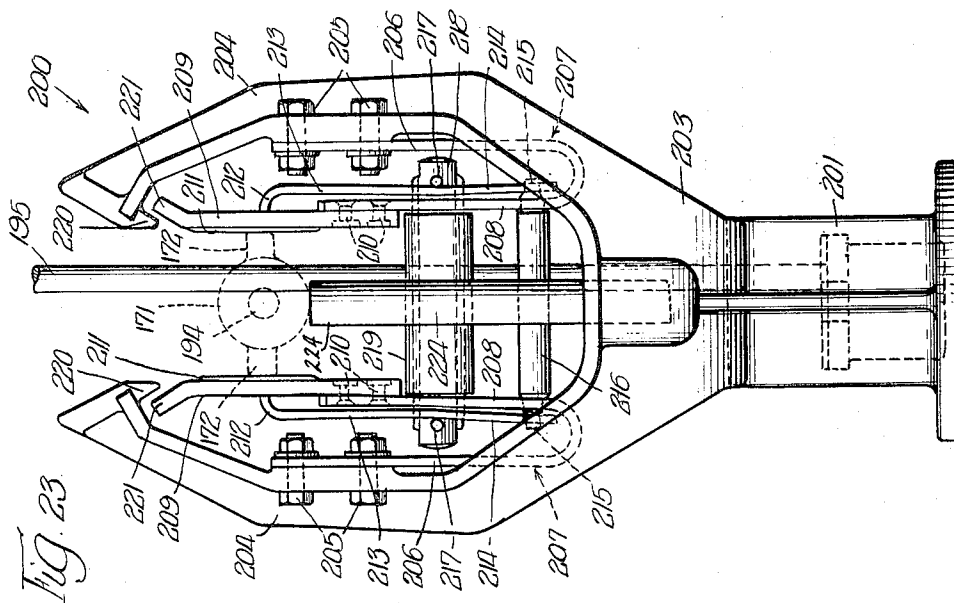
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SWITCH CONTACT CONSTRUCTION

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7 Sheets-Sheet 7



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2,894,101

SWITCH CONTACT CONSTRUCTION

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Application January 20, 1958, Serial No. 709,868

44 Claims. (Cl. 200—166)

This invention relates, generally, to high current capacity switches and it has particular relation to the construction of contacts for such switches, especially of the type illustrated in U.S. Patent No. 2,710,897, issued June 14, 1955, although it is not limited for use with the switch there shown. This application is a continuation-in-part of application Serial No. 613,401, filed October 2, 1956, now abandoned.

Among the objects of this invention are: To provide a switch contact construction in which the contact engagement is obtained under pressure with minimum effort being required to effect engagement and disengagement and permitting some lateral and angular misalignment; to employ relatively massive contact fingers to withstand the flow of short circuit current without permanent distortion or damage; to direct the current flow to the contact fingers along paths where the magnetic fields generated thereby act to increase the contact pressure; to employ a pair of U-shaped conductors as part of the contact construction with their outer arms rigidly mounted at their outer ends and their inner arms biased toward each other and carrying the contact fingers for engaging opposite sides of a switch blade which enters and leaves at the side at which the contact fingers are located; to prestress the inner arms toward each other by a floating spring arrangement in such manner that the contact fingers are independently flexible and independently spring biased; and to provide a relatively long and narrow convex contact surface on each contact finger for engaging a flat surface of a switch blade with a wiping action along a narrow path substantially in the direction of the blade movement while contact engagement is being made and broken to improve the cleaning action applied to the contact surfaces and reduce the operating effort and provide essentially a line contact engagement relatively unaffected by slight misalignment.

Additional objects of this invention are: To provide a switch contact construction of the character outlined above in which the switch blade, in closed position, constitutes an endwise extension of the inner arms of the U-shaped conductors and enters and leaves contact engagement therewith transversely of these inner arms; to provide contact surfaces on the inner arms extending transversely thereof; to provide for connecting a line conductor to the switch contact construction at a location which is substantially a straight line extension of the switch blade in switch closed position; to mount the U-shaped conductors in such manner that the path of the current from the line terminal to the switch blade is in the form of a double loop to each side of the switch blade; to obtain high current carrying capacity by employing a plurality of pairs of U-shaped conductors; to position the U-shaped conductors with the portions that engage the switch blade facing outwardly; to locate the U-shaped conductors with the contact portions facing outwardly such that the magnetic forces incident to current flow tend to hold the switch blade in the closed position; and to adapt the switch contact construction em-

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ploying the U-shaped conductors for use with a switch blade that is rotated about its longitudinal axis into high pressure contact engagement with the contact surfaces of the contact fingers.

Other objects of this invention will, in part, be obvious and in part appear hereinafter.

This invention is disclosed in the embodiment thereof shown in the accompanying drawings and it comprises the features of construction, combination of elements and arrangement of parts that will be exemplified in the construction hereinafter set forth and the scope of the application of which will be indicated in the appended claims.

For a more complete understanding of the nature and scope of this invention, reference can be had to the following detailed description, taken together with the accompanying drawings, in which:

Figure 1 is a view, in side elevation, of one pole of a high voltage switch in which this invention is embodied;

Figure 2 is a vertical sectional view, at an enlarged scale, taken generally along the line 2—2 of Figure 1;

Figure 3 is a view, similar to Figure 2, but showing only a portion thereof with the switch blade disengaged from the stationary contact assembly;

Figure 4 is a vertical sectional view, at an enlarged scale, taken generally along the line 4—4 of Figure 3;

Figure 5 is a horizontal sectional view taken generally along the line 5—5 of Figure 3;

Figure 6 is a horizontal sectional view taken generally along the line 6—6 of Figure 3;

Figure 7 is a view, in side elevation, of one of the contact fingers, the showing being at an enlarged scale;

Figure 8 is a view, in front elevation, of the contact finger shown in Figure 7;

Figure 9 is a cross sectional view taken generally along the line 9—9 of Figure 7;

Figure 10 is a sectional view taken generally along the line 10—10 of Figure 7;

Figure 11 is a view, in side elevation, of a modified form of switch construction employing a switch blade that is rotatable about one end into and out of sidewise engagement with the stationary contact of the present invention;

Figure 12 is a top plan view of the contact construction shown in Figure 11 with the switch blade in closed position;

Figure 13 is a vertical sectional view taken generally along the line 13—13 of Figure 12;

Figure 14 is a view, similar to Figure 13, but showing a modified arrangement of the line terminal connection to be located substantially in line with the switch blade when it is in closed position;

Figure 15 is a top plan view of a modified form of contact construction in which the arrangement is such that the current flow takes place through double loops;

Figure 16 is a vertical sectional view taken generally along the line 16—16 of Figure 15;

Figure 17 is a top plan view of a contact construction that is located within a switch blade comprising a pair of blade members the inner sides of which are arranged to engage the outwardly facing contact surfaces of the contact fingers;

Figure 18 is a vertical sectional view taken generally along line 18—18 of Figure 17;

Figure 19 is a view, similar to Figure 18, but showing the U-shaped conductors forming the contact fingers inverted with the arrangement being such that the magnetic forces incident to current flow tend to hold the switch blade in the closed position;

Figure 20 is a view, in end elevation, of a contact construction that can be employed in connection with a switch blade that is arranged to rotate about its longi-

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tudinal axis into high pressure contact engagement, the construction being that shown in copending application Serial No. 704,397, filed December 23, 1957;

Figure 21 is a view, in side elevation, of the contact construction shown in Figure 20;

Figure 22 is a top plan view of the contact construction shown in Figures 20 and 21;

Figure 23 is a view, in end elevation, of a modified form of contact construction that can be employed in conjunction with a switch blade which is arranged to rotate about its longitudinal axis into high pressure switch closed position; and

Figure 24 is a view, in side elevation, of the contact construction shown in Figure 23.

Referring now particularly to Figure 1 of the drawings, it will be observed that the reference character 10 designates, generally, a metallic base carrying an operating mechanism 11 for rotating an intermediate insulator 12 about a vertical axis. Near the ends of the base 10 stationary insulators 13 are mounted. While the base 10 is shown as being horizontally mounted with the insulators 12 and 13 extending upwardly therefrom, it will be understood that the base 10 can be vertically mounted and that it can also be mounted with the insulators 12 and 13 depending therefrom.

The stationary insulators 13 carry terminal brackets, shown generally at 14, which are provided with terminal pads 15 to which suitable connection can be made by high voltage conductors. The terminal brackets 14 include upright sections 16 to the upper ends of which load interrupter devices, shown generally at 17, are secured. Since a detailed description of the load interrupter device 17 is set forth in Patent No. 2,710,897, above referred to, no further description thereof will be set forth herein.

Contact engagement with the load interrupter devices 17 is provided by bow contacts 18 that are carried by the ends of a tubular switch member 19 which is mounted intermediate its ends on the insulator 12 and is rotatable therewith through 90° from the switch open to the switch closed position. Each load interrupter device 17 is provided with a depending operating arm, shown generally at 20, that is arranged to be engaged by an operator, shown generally at 21, at each end of the switch member 19, for effecting the operation of the respective load interrupter device 17 in the proper timed sequence. The operator 21 preferably is formed integrally with a switch fitting 22 that is secured to each end of the tubular switch member 19.

Also integrally formed with the switch fitting 22 is a switch blade 25. It will be understood that each switch fitting 22 is provided with a switch blade 25 and that they extend in opposite directions underneath the tubular switch member 19 when the switch construction is arranged as illustrated in Figures 1, 2 and 3 of the drawings. In order to provide a good contact surface, each of the switch blades 25 is provided with silver inserts 26 on opposite sides and each has a rounded leading edge portion 27 to facilitate engagement with a stationary contact assembly 28 which is carried by the respective upright sections 16 of the terminal brackets 14. The present invention is directed particularly to the construction of the stationary contact assembly 28.

It will be observed that the stationary contact assembly 28 includes a U-shaped contact support that is shown generally at 29 and has a central mounting ear 30 provided with apertures 31 for receiving bolts to secure it to the upright sections 16. The contact support 29 is formed preferably of brass and is relatively rigid so that its upstanding arms 32 are relatively inflexible.

Secured by rivets 33 to the upstanding arms 32 are outer branches 34 of flexible resilient U-shaped conductors that are indicated, generally, at 35 and formed preferably of copper. The inner branches 36 of the conductors 35 extend generally parallel to each other and, as shown in Figure 5, are split lengthwise as indicated at

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37 to provide two sections for independently supporting relatively massive contact fingers 40 that preferably are silver plated copper forgings. As shown more clearly in Figures 7 and 8 of the drawings, the contact fingers 40 are provided with apertures 41 for receiving rivets 42 to hold them securely to the inner sides of the respective portions of the inner branches 36. Each of the contact fingers 40 is provided with a raised portion 43 having a convex contact surface 44 that is relatively long and narrow. The radius, indicated at 45, of the longitudinal contact surface is several times the radius, indicated at 46 in Figure 9, of the transverse contact surface. For example, the radius 45 may be of the order of $2\frac{1}{2}$ " while the radius 46 may be of the order of $\frac{3}{32}$ ". This, together with an inclined approach surface 47, facilitates the entry of the rounded leading edge portion 27 of the switch blade 25 between the convex contact surfaces 44 of the four contact fingers 40. Should there be any foreign material on the silver inserts 26, the same is removed as the switch blade 25 moves into the switch closed position as shown in Figure 2 since the convex contact surfaces 44, being long and narrow, function like plows to clear away the foreign material and provide for good contact engagement between the contact surfaces 44 and the corresponding portions of the silver inserts 26.

The relationship between each convex contact surface 44 and the respective portion of the flat surface of the insert 26 carried by the switch blade 25 is illustrated more clearly in Figures 7 and 9. Because of the longitudinal curvature of the convex contact surface 44 some longitudinal and angular misalignment of the switch blade 25 and the contact fingers 40 can be tolerated without impairment of the contact efficiency. This is due to the fact that the actual contact area can shift longitudinally while still maintaining engagement with the respective surface portion of the insert 25. Another advantage resulting from this construction is that each contact area remains substantially centrally located with respect to its contact finger. On flow of short circuit current there is a more uniform distribution of current flow and of the resultant heat generated. The relatively long and narrow convex contact surface 44 wipes into what approaches a limited line contact engagement with the respective flat contact surface of the insert 26 which facilitates high unit pressure contact engagement and efficient current transfer over an extended contact area.

It is desirable to prestress the contact fingers 40 toward each other. Since the U-shaped conductors 35 inherently are resilient and since the ends of the outer branches 34 are held stationary by the upstanding arms 32, the inner branches 36 tend to move toward each other when they are biased or spring loaded as described hereinafter. Such movement is limited by a spacer sleeve 50 and a loading pin 63, to be described, which are interposed between the facing sides of the inner branches 36 as shown more clearly in Figures 2 and 3 of the drawings. The lengths of the spacer sleeve 50 and loading pin 63 are such that the distance 51 between the convex contact surfaces 44 is slightly less than the distance 52 between the outwardly facing surfaces of the silver inserts 26. Thus, when the switch blade 25 is moved from the position shown in Figure 3 to the switch closed position shown in Figure 2, it is only necessary to exert sufficient effort to overcome the spring bias and spread the contact fingers 40 apart a slight distance which is sufficient to space the opposed faces of the inner branches 36 from the adjacent ends of the spacer sleeves 50 as indicated at 53. The entire spring force transmitted to and tending to urge the contact fingers 40 toward each other then is immediately available for urging the convex contact surfaces 44 into small area high pressure contact engagement with the surface of the silver inserts 26.

With a view to applying a spring biasing action to the

contact fingers 40 and for individually biasing them toward the switch blade 25, a floating spring arrangement is employed. For this purpose an equalizer bar 54 extends through a spacer sleeve 50 and through the inner branches 36. As shown in Figures 2 and 3, the equalizer bar 54 projects into the spaces between the branches 34 and 36 of the U-shaped conductors 35 where transversely extending pins 55 are provided having reduced central sections 56 which interfit with the equalizer bar 54 and prevent disengagement of the loading pins 55. Underlying each loading pin 55 is a spring leaf 57 the outer ends of which are bifurcated and the extreme outer ends 58 turned inwardly to have small area high pressure engagement with the bottoms of slots 59 that are formed in the rear sides of the contact fingers 40. At the inner ends of the spring leaves 57 they have contact engagement with convex surfaces 60, Figure 4, of collars 61 which bear against the outer sides of the inner branches 36 and are held in place in an articulated arrangement by reduced end portions 62 of the loading pin 63, above referred to, which is positioned between the inner branches 36 near the curved outer ends thereof joining the outer branches 34. Each end of the loading pin 63 has a stepped section 64 interfitting with an aperture 65 in each of the inner branches 36 at the base of the slot 37 therein. Since the outer branches 34 are resilient, the sides of the inner branches 36 facing each other bear against shoulders 66 on the loading pin 63 and thus they are spaced apart a definite distance.

Preferably the U-shaped conductors 35 are made sufficiently resilient to be flexed by a relatively low force and the spring leaves 57 are stressed sufficiently to apply the required biasing action and the major portion of the pressure against the inserts 26. In effect a three point application of force is provided by the arrangement of the spring leaves 57 reacting against the loading pins 55. One point of support is applied against the collar 61 at each end of the loading pin 63 while the other two points are provided by the small area inturned ends 58 reacting against the back of each contact finger 40. In this manner a limited degree of flexibility is provided for each of the contact fingers 40 and for each of the arms of the bifurcated end portion of each spring leaf 57.

The equalizer bar 54 and loading pin 63 provide an articulated loading mechanism for the spring leaves 57. Since this mechanism interconnects the spring leaves 57 through the loading pins 55, the forces exerted thereby are equalized. It is then possible for the spring forces to be applied equally to the contact fingers 40 even when the switch blade 25, within limits, is out of alignment with the switch contact assembly 28.

Thus a limited degree of misalignment, for example as much as $\frac{1}{8}$ ", can be accommodated between the switch blade 25 and the contact fingers 40. The reason for this is that the outer branches 34 of the U-shaped conductors 35 have relatively great flexibility within the elastic limit of the material used and the inner branches 36 also have limited degrees of independent flexibility and because the equalizer bar 54 is unattached to them and permits their movement relative to it. Moreover, the equalizer bar 54 transmits the displacement of one of the contact fingers 40 or the displacement of two of them on one of the inner branches 36 to the other inner branch 36 and thereby to the contact fingers 40 carried thereby. Within the limits specified misalignment of the switch blade 25 can be accommodated without reduction in the sum of the individual contact pressures and without increasing the total effort required to move the switch blade 25 to and from the switch closed position. Even though the flexing of the U-shaped conductors 35 away from the centered position adds somewhat to the pressure on one side of the blade 25, an equal reduction takes place on the other side.

It will be observed that the contact fingers 40 are located at the outer ends of the inner branches 36 and that the overlap of the switch blade 25 with these contact fingers is relatively short. Since provision is made for moving the switch blade 25 endwise into engagement with the contact fingers 40, only a minimum movement of the switch blade 25 is required after it has entered the contact assembly 28 to effect complete closing of the switch in contra-distinction of the movement that would be required if the switch blade 25 were moved into switch closed engagement from the opposite ends of the inner branches 36. Likewise, only a minimum of movement toward the open position is required to disengage the contact assembly 28 and to establish the required gap before actuation of the load interrupter devices 17 and the length of the switch blade 25 can be a minimum.

It will be observed that a current flow through the inner branches 36 is in the same direction. As a result, the magnetic fields generated by the current flow through these branches are such as to urge the inner branches 36 toward each other. This is particularly true under short circuit conditions on flow of relatively heavy current. The current flow in the outer branches 34 is in a direction opposite to the current flow in the inner branches 36. As a result, the magnetic forces produced thereby act in such manner as to urge the inner branches 36 away from the outer branches 34. Since the outer ends of the latter are held stationary by the relatively rigid arms 32 of the contact support 29, a still further force is provided for increasing the contact pressure applied by the contact fingers 40 to the contact surfaces of the switch blade 25, more particularly to the surfaces of the silver inserts 26. These forces also momentarily deform the surfaces of the inserts 26 to enlarge the area of contact engagement during short circuit conditions.

As pointed out, the shoulders 66 of the loading pin 63 space the left hand ends of the inner branches 36 a fixed distance apart. Under short circuit conditions these shoulders provide relatively fixed fulcrums about which the inner branches 36 pivot. Thus maximum force is exerted against the inserts 26 on opposite sides of the switch blade 52 under these conditions.

The contact fingers 40 are subject to substantial mechanical shock when the switch blade 25 is moved rapidly to switch closed position, particularly when it enters in misaligned position. Where their contact surfaces are in engagement with the inserts 26, they may be subject to a high rate of heat generation during short circuit conditions. Because of their relatively massive construction and because of the other stated features of contact construction, the contact fingers 40 are capable of withstanding such shock and heat generation.

With a view to reducing mechanical shock in closing of the switch, resilient bumpers 70 of rubber or the like are carried by each of the switch fittings 22. They are arranged to engage one of the arms 32 of the contact supports 29, as shown in Figure 2, and prevent metal to metal contact. The bumpers 70 also function to determine the final positions of the inserts 26 relative to the contact surfaces 44 of the contact fingers 40.

Because of the prestressed arrangement of the contact fingers 40 through the agency of the spacer sleeve 50 and due to the particular convex curvature of the contact surface 44 with the radius 45 in the longitudinal direction being substantially greater than the radius 46 in the transverse direction, the drag is reduced and a minimum of effort is required to move the switch blade 25 into and out of the switch closed position. When it is recalled that the construction at each end of the tubular switch member 19 is identical and that ordinarily three poles of a construction similar to that shown in Figure 1 are employed and all three are operated simultaneously, the advantage of such an arrangement is obvious.

While the convex contact surfaces 44 are shown and

described as being located on the contact fingers 40 for engagement with flat contact surfaces on the inserts 26, it will be understood that the flat surfaces can be transposed to the contact fingers 40 and the convex surfaces to the inserts 26.

Referring now particularly to Figures 11, 12 and 13 of the drawings, it will be observed that the reference character 71 designates, generally, a disconnecting switch of the knife blade type which is provided with insulators 72 having metal caps 73 at their upper ends. Any suitable base can be provided for supporting the insulators 72 and it will be understood that the switch 71 can be located in various positions as may be required. Secured by bolts 74 and 75 to the caps 73 are base members 76 and 77 from which terminal pads 78 and 79 extend to permit connection of line conductors thereto.

The base member 76 is provided with a pair of upstanding hinge members 80 to which at 81 are pivoted the bifurcated ends of a switch blade that is shown, generally, at 82. A pull ring 83 is secured to the switch blade 82 near its swinging end for receiving the prong of a switch stick to permit opening and closing of the switch blade 82. It will be understood that the switch blade 82 can be swung through 90° to the position shown by the broken lines or through 180° if desired. Conventional locking mechanism can be employed for holding the switch blade 82 in the switch closed position. Also suitable stops can be provided for limiting the opening movement thereof. Since these features form no part of the present invention, they are not illustrated or described.

Mounted on the base member 77 for engagement by the swinging end of the switch blade 82 is a contact assembly that is shown, generally, at 84. The contact assembly 84 includes a pair of spaced apart upstanding arms 85 that are substantially of rectangular cross section and are relatively rigid. They are formed preferably integrally with the base member 77.

Secured to the upstanding arms 85 by rivets 86 are outer branches 87 of flexible resilient U-shaped conductors that are indicated, generally, at 88. It will be noted that a pair of U-shaped conductors 88 is employed, one U-shaped conductor 88 being mounted on each of the upstanding arms 85. Inner branches 89 of the U-shaped conductors 88 are longitudinally slotted at their ends as indicated at 90 to provide a bifurcated end portion through which rivets 91 extend for securing contact fingers 92 thereto. The contact fingers 92 have convex contact surfaces 93 that extend transversely of the inner branches 89 of the U-shaped conductors 88 rather than longitudinally thereof as is the case for the convex contact surfaces 44 of the contact fingers 40 which are shown more clearly in Figures 5-8 of the drawings. The reason for the transverse positioning of the convex contact surfaces 93 for contact engagement with inserts 94 in an end portion 95 of the switch blade 82 therebetween is to provide for receiving this end portion 95 as it swings in the direction indicated by the double headed arrow 96 into and out of engagement with the contact assembly 84. Here the end portion 95 of the switch blade 82 engages the contact assembly 84 sidewise rather than endwise as is the case in the switch construction illustrated in Figures 1-10 of the drawings. Except for the transverse positioning of the convex contact surfaces 93, they are of the proportions described hereinbefore for the convex contact surfaces 44 of the contact fingers 40.

In order to urge the convex contact surfaces 93 into high pressure contact engagement with the inserts 94 in the end portion 95 of the switch blade 82 leaf springs 97 are employed. One end 98 of each leaf spring 97 is turned inwardly and bear against the rear side of the respective contact finger 92. The other end 99 of each leaf spring 97 bears against the respective end 100 of a loading pin 101 which extends between the inner branches 89 and is located adjacent the bottom of the U-shaped

conductors 88. The central portion of the loading pin 101 is enlarged and is provided with shoulders 102 at the ends which bear against the facing surfaces of the inner branches 89 in the absence of the end portion 95 of the switch blade 82. In part this construction limits the movement of the contact fingers 92 toward each other to provide a prestressed arrangement for the leaf springs 97.

It is desirable to mechanically interconnect the U-shaped conductors 88 in order to distribute stress therebetween. For this purpose intermediate portions 103 of the leaf springs 97 are engaged by loading pins 104 which extend transversely through an equalizer bar 105. The equalizer bar 105 is located in a position parallel to the loading pin 101 and extends through the slots 90 in the inner branches 89 and its ends project through suitable clearance openings in the outer branches 87 to limit the lateral deflection of the inner branches 89 when the end portion 95 of the switch blade 82 enters the contact assembly 84.

With a view to further limiting the movement of the inner branches 89 toward each other under the influence of the leaf springs 97 when the switch blade 82 is out of engagement with the contact assembly 84, a spacer sleeve 106 is telescoped over the central portion of the equalizer bar 105. The ends of the spacer sleeve 106 and the shoulders 102 of the loading pin 101 are spaced apart such that the convex contact surfaces 93 are permitted to move toward each other to a distance apart slightly past the locations of the respective contact surface of the inserts 94 when the end portion 95 of the switch blade 82 is in the switch closed position. This provides a prestressed construction which requires only a small amount of movement apart of the contact fingers 92 when the switch blade 82 is closed in order to develop the full spring pressure of the leaf springs 97.

The spacer sleeve 106 can be held in position against endwise movement on the equalizer bar 105 by transversely extending pin 107. A slotted guide 108 extends upwardly from the base member 77 and is provided with beveled edges 109 for guiding the end portion 95 of the switch blade 82 into the contact assembly 84.

Figure 14 shows a contact assembly that is indicated, generally, at 111 which can be employed in lieu of the contact assembly 84 which is shown in Figures 11-13. The contact assembly 111 has a base member 112 which corresponds to the base member 77. It is provided with the slotted guide 108 previously described. At the other end the base member 112 has an integrally formed upstanding wall 113 from which arms 114 laterally extend. The arms 114 correspond to the upstanding arms 85 of the contact assembly 84. To the outer ends of the laterally extending arms 114 the flexible resilient U-shaped conductors 88 are secured by rivets 86 as described previously.

It is desirable that the tendency for the switch blade 82 to move or to be thrown open as the result of magnetic forces generated by flow of current be minimized. Even when the switch blade 82 is latched in the closed position, it is desirable that it remain stationary. When it is recalled that these magnetic forces may become relatively great on flow of heavy current, such as the flow of short circuit current involving many thousands of amperes, it will be appreciated that provision should be made either for minimizing the effect of these forces or for mechanically locking the switch blade 82 in the switch closed position. In accordance with this invention provision is made for minimizing the effect of the magnetic forces by providing a terminal pad 115 intermediate the upper and lower edges of the upstanding wall 113 and generally in line with the switch blade 82 or end portion 95 thereof when it occupies the switch closed position. By connecting the line conductor to the terminal pad 115 located as illustrated in Figure 14, an in line relationship with the switch blade 82 is established and the magnetic forces incident to the flow of heavy current, such as short

circuit current, do not tend to swing the switch blade to the open position.

Figures 15 and 16 show, generally, at 117 a contact assembly which can be employed where the normal flow of load current exceeds that for the switch construction 71, for example, shown in Figures 11-13 of the drawings. In Figures 15-16 a switch blade 82' is employed which is generally of the same construction as the switch blade 82, previously described, but is wider. It is provided with a pull ring 83. The switch blade 82' has an end portion 95' which is arranged to engage convex contact surfaces 93 of contact fingers 92 which are carried by flexible resilient U-shaped conductors 88, as previously described. However, in the construction here illustrated two pairs of U-shaped conductors 88 are employed in order to give increased current carrying capacity.

The contact assembly 117 includes a base member 118 which is provided with a slotted guide 119 on one side that corresponds to the slotted guide 108 previously described. On the other side the base member 118 has an integrally formed upstanding wall 120 which is provided with laterally extending arms 121 on which the U-shaped conductors 88 are mounted in the manner described for Figure 14. A terminal pad 122 extends laterally from the upstanding wall 120 and is located generally in line with the end portion 95' of the switch blade 82' when it is in the switch closed position. As previously described, this arrangement minimizes the effects of the magnetic forces incident to the flow of heavy current, such as short circuit current, in acting to swing the switch blade to the open position.

Referring to Figure 15 of the drawings, it will be observed that a double loop effect is provided with respect to the flow of current in the contact assembly 117. Here it will be observed that the current flows from the terminal pad 122 as indicated by the arrows 123 to the laterally extending arms 121. Then, as indicated by the arrows 124, the current flows in a reverse direction through the outer branches 87 of the U-shaped conductors 88. Finally the current flows to the contact fingers through the inner branches 89 as indicated by the arrows 125. The relationship of the magnetic fields thus generated is such as to urge the contact fingers 92 into engagement with the opposite sides of the end portion 95' of the switch blade 82' with even greater force and certainty than if this double loop construction is not employed, particularly if the loading pin 101 is not used. Thus, the contact pressure with the switch blade is increased, particularly under short circuit conditions, in proportion to the flow of current. The same relationship holds for the contact assembly 111 shown in Figure 14.

Figures 17 and 18 of the drawings show a switch construction which, in certain respects, is the reverse of that illustrated in the preceding figures. Here a switch blade is provided and is indicated generally at 127. The switch blade 127 can be pivoted in the manner described hereinbefore for the switch blade 82. As shown in Figures 17 and 18 the switch blade 127 comprises spaced-apart blade members 128 which are interconnected by spacer pins 129. The blade members 128 are arranged to straddle a contact assembly that is indicated, generally, at 130.

On the inner sides of the blade members 128 inserts 131 are provided for high pressure contact engagement with convex contact surfaces 132 which extend lengthwise of contact fingers 133. Generally the contact fingers 133 are constructed in a manner described hereinbefore for the contact fingers 40. The contact fingers 133 are secured by rivets 134 to outer bifurcated branches 135 of flexible resilient U-shaped conductors that are indicated, generally, at 136. The U-shaped conductors 136 have inner branches 137 which are secured by rivets 138 to opposite sides of an upper thicker portion 139 of an arm 140 that extends upwardly from a base member 141. It will be understood that the base member 141 can be secured by bolts 142 to a suitable insulator cap, correspond-

ing to the cap 73 previously described. Extending laterally from the base member 141 is a terminal pad 143 for receiving a line conductor.

In order to bias the convex contact surfaces 32 outwardly into high pressure contact engagement with the inserts 131 on the inner faces of the blade members 128, one end 146 of each of a pair of leaf springs 147 bears against the rear side of the respective contact finger 133. The other ends 148 of the leaf springs 146 bear against the lower portions of the outer branches 135 of the U-shaped conductors 136. Thus the leaf springs 147 overlie the outer branches 135 and are spaced slightly therefrom. The intermediate portions of the leaf springs 147 are engaged by loading pins 149 that extend transversely through an equalizer bar 150. It will be noted that the equalizer bar 150 extends through the arm 140, the inner branches 137 of the U-shaped conductors 136 and through the slotted openings in the bifurcated outer branches 135. At one end of the equalizer bar 150 there is a head 151 and a nut 152 is threaded on the other end. It will be understood that the equalizer bar 150 is loaded in compression against the loading pins 149 when the blade members 128 are in the switch closed position shown in Figure 18. The pressures applied by the leaf springs 147 to the contact fingers 133 are equalized since the equalizer bar 150 is free to shift longitudinally except as restrained by the loading pins 149 in engagement with the leaf springs 147. The head 151 and nut 152 limit the outward movement of the contact fingers 133 when the switch blade 127 is open to position the convex contact surfaces 132 at locations slightly past the respective contact surface of the inserts 131 when they are in the switch closed position and to prestress the leaf springs 147.

It will be observed that the arm 140 has a lower thinner portion 153 which is spaced from the facing sides of the inner branches 137. This affords some degree of flexibility to the U-shaped conductors 136 and permits advantage to be taken of the double loop effect previously described in connection with Figure 15.

Extending through the lower thinner portion 153 of the arm 140 and through the inner branches near the base of the U-shape there is a loading pin 154 which is provided with heads 155 at the ends in the form of stop rings that are suitably secured in position. The heads or stop rings 155 have shoulders 156 which engage the outer sides of the inner branches 137. This construction limits the movement apart of the inner branches 137 and thus assists in the preloading of the contact fingers 133 by the leaf springs 147. This construction serves to mechanically interconnect the U-shaped conductors 136 and effects conjoint movement thereof should the blade member 128 be slightly out of alignment with the contact assembly 130. Some clearance, as indicated at 157, is provided between shoulders 158 on the loading pin 154 and the inner faces of the inner branches 137. This permits some articulation in the interconnection between the U-shaped conductors 136. The inner branches 137 would tend to move inwardly as a result of the magnetic forces set up between them and the outer branches 135 but this tendency is opposed by the magnetic forces resulting from current flowing through the inner branches 137 and the portion 153 of the arm 140 thereby providing the double loop effect referred to above.

Since the current flow in the outer branches 135 is opposite to the direction of current flow through the inner branches 137, the magnetic forces generated thereby tend to cause these branches to move away from each other. Since the inner branches 137 are rigidly secured to the upper thicker portion 139 of the arm 140 the net result of this construction is to increase the contact pressure exerted against the blade member 128. Thus on flow of high current, such as short circuit current, there is increase in the contact pressure applied to the blade members 128. Under these circumstances the outer branches 135 tend to swing outwardly about the shoulders 158 as fulcrums.

It will be understood that suitable stops are provided for limiting the movement of the blade members 128 to the positions shown in Figure 18. Also, suitable latch mechanism is provided to prevent the blade members 128 from moving to the open position on flow of relatively heavy current, such as short circuit current.

Figure 19 shows a contact assembly 130' which is generally the reverse of the construction for the contact assembly 130. Here the blade members 128 are arranged to approach closer to the base member 141. To limit the movement of the blade members 128 stop bosses 161 can be formed integrally with the base member 141. In this construction an arm 162, corresponding to the arm 140, is carried by the base member 141. However, it has a lower thicker portion 163 to which the inner branches 137 of the U-shaped conductors 136 are secured by the rivets 138. It will be observed that the U-shaped conductors 136 have the U-shape opening in the direction of closing movement of the blade members 128 in contradistinction to the construction shown in Figure 18 where the openings of the U-shaped conductors 136 are in the direction of opening movement of the blade members 128. The arm 162 has an upper thinner portion 164 to permit a greater degree of flexibility for the U-shaped conductors 136 in the manner described hereinbefore.

The magnetic fields generated on flow of current through the switch construction illustrated in Figure 19 are such as to tend to cause the switch blade 127 to move toward the switch closed position or to hold it in the closed position. This is particularly true on flow of heavy current or short circuit current. In addition, on flow of such current, the reaction is such as to increase the contact pressure applied to the blade members 128.

Referring now particularly to Figures 20-22 of the drawings, a contact assembly or line contact member is shown, generally, at 170, which is particularly adapted for use with a disconnecting switch of the beaver tail type such as that disclosed in copending application Serial No. 704,397, filed December 23, 1957. Since the hinge end of the switch mechanism forms no part of the present invention, only a portion of the switch blade 171 is shown herein. It will be understood that the switch blade 171 is arranged to be swung about an axis transverse to its longitudinal axis and also that it is arranged to be rotated about its longitudinal axis to move laterally extending ears 172 into high pressure contact engagement with contact surfaces that may be provided by silver inlays 173 that are mounted on the inner sides of downturned bifurcated inner branches 174 of flexible resilient inverted U-shaped conductors that are shown, generally, at 175. The U-shaped conductors 175 include downturned outer branches 176 which are secured by bolts 177 to a contact housing 178. Extending upwardly along opposite sides of the outer branches 176 are arms 179 that may be formed integrally with the housing 178 and have transverse webs 180 normally in spaced relation to the outer sides of the outer branches 176. Transverse pins 181 at the upper ends of the arms 179 limit the movement of the outer branches 176 toward each other. The contact housing 178 extends upwardly from a contact base 182 that is suitably mounted on an insulator and is provided with a line terminal pad all as described in the application last referred to.

With a view to urging the contact surfaces provided by the silver inlays 173 on the downturned inner branches 174 into good contact engagement with the outer edges of the ears 172 upper bifurcated ends 183 of leaf springs 184 bear against the outer sides of the inner branches 174 generally in alignment with the ears 172 in the switch closed position. The lower bifurcated ends 185 of the leaf springs 184 bear against the lower ends of the inner branches 174 and are centered on projecting ends 186 of a loading pin 187 which extends between the lower ends of the inner branches 174 as shown. Central portions

188 of the leaf springs 184 bear against the outer branches 176.

The contact pressures applied by the leaf springs 184 are equalized by an equalizer bar 189 which extends through the slots in the bifurcated inner branches 174 and through the central portions 188 of the leaf springs 184 and project beyond the outer branches 176 where loading pins 190 serve to interconnect mechanically these outer branches 176.

It is desirable to space the contact surfaces of the silver inlays 173 apart in the absence of the ears 172 and for this purpose a spacer sleeve 191 is telescoped over the central portion of the equalizer bar 189 and is secured thereto by a pin 192. The central portion of the loading pin 187 and the spacer sleeve 191 serve to space the inner branches 174 apart the desired distance in the absence of the switch blade 171 and to preload the leaf springs 184.

The movement of the switch blade 171 toward the switch closed position is limited by a stop pin 193 which is carried by the contact housing 178 and extends upwardly from the lower portion thereof.

The construction of the contact assembly or line contact member 170 is such as to accommodate some misalignment between the switch blade 171 and the contact assembly 170. Also, as described, it provides for equalizing the contact pressure that is applied to the ears 172 on the switch blade 171. During heavy current flow, such as under short circuit conditions, the contact pressure between the ears 172 on the switch blade 171 and the inner branches 174 increases greatly because of the forces developed as a result of the U-shape of the conductors 175. Under these conditions the inner branches 174 tend to move away from the outer branches 176 which are mechanically interconnected by the equalizer bar 189. Ultimately the outer branches 176 engage the transverse webs 180 resulting in maximum pressure being exerted by the inner branches 174 through the silver inlays 173 against the outer edges of the ears 172. The force exerted against these ears is not changed by distortion of the inner branches 174.

At its swinging end the switch blade 171 is provided with an arcing tip 194 that is arranged to provide the initial and final contact engagement between the switch blade 171 and the contact assembly 170. The arcing tip 194 constitutes an endwise extension of the switch blade 171 and it can be readily removed and replaced should it become eroded due to arcing. It is arranged to engage and disengage flexible arcing horns 195 and 196 having circular cross sections which are secured in staggered relation by set screws 197 to the contact base 182 of the contact housing 178. The arcing horns 195 and 196 are spaced apart along the arcing tip 194 in the switch closed position for a distance several times the transverse dimension or diameter of the arcing horns 195 and 196. The reasons for positioning the arcing horns 195 and 196 in staggered relation are to facilitate the breaking of ice should they become so encased under certain adverse weather conditions and to insure that contact is always maintained on one side or the other of the arcing tip 194 despite strong lateral vibrations of the arcing horns 195 and 196 and the switch blade 171 incident to fast operation. Since the arcing horns 195 and 196 are likely to require replacement, they are detachably mounted, as indicated, on the contact base 182 by the set screws 197.

Figures 23 and 24 show, generally, at 200 a contact assembly which can be employed in lieu of the contact assembly shown in Figures 20-22 of the drawings. The contact assembly 200 is arranged for cooperation with the switch blade 171 that is operated as described hereinbefore and includes a contact base 201 that can be mounted on a suitable insulator. The contact base 201 is provided with a terminal pad 202 for connection to a line conductor. The switch blade 171 can be provided

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with the arcing tip 194, previously referred to, for engagement with an arcing horn 195 that extends upwardly from the contact base 201.

The upper portion of the contact base 201 is formed by a contact housing 203 which has arms 204 that extend outwardly and upwardly. To the intermediate portions of the arms 204 bolts 205 secure outer branches 206 of flexible resilient U-shaped conductors that are shown, generally, at 207. These U-shaped conductors 207 have inner branches 208 which carry contact fingers 209 at their upper ends. Rivets 210 secure the contact fingers 209 to the upper ends of the inner branches 208. It will be noted that the facing sides of the contact fingers 209 have elongated convex contact surfaces 211 for high pressure contact engagement with the ears 172 that extend laterally from the switch blade 171.

The contact fingers 209 are urged into high pressure contact engagement with the ears 172 by the upper ends 212 of leaf springs 213 the lower ends 214 of which bear against outer ends 215 of a loading pin 216 which extends between the inner branches 208 at the base portions of the U-shape.

It is desirable to provide for distributing the contact pressure applied by the leaf springs 213. For this purpose loading pins 217 bear against the central portions of the leaf springs 213 and extend transversely through an equalizer bar 218. It will be understood that the equalizer bar 218 extends through the inner branches 208 which are bifurcated and also through the leaf springs 213. Surrounding the equalizer bar 218 is a spacer sleeve 219. It, together with the loading pin 216, limits the movement of the contact fingers 209 toward each other under the influence of the leaf springs 213 in the absence of the switch blade 171 or more particularly when the ears 172 are not in engagement with the elongated convex contact surfaces 211.

As a further means for limiting the movement of the contact fingers 209 toward each other in the absence of the switch blade 171, stops 220 depend from the upper ends of the arms 204 into the paths of the upper ends 221 of the contact fingers 209. When the switch blade 171 is in the open position, the stops 220 are engaged by the upper ends 221 of the contact fingers 209 while the inner surfaces of the inner branches 208 bear against the ends of the loading pin 216 and the spacer sleeve 219.

It will be understood that the current flow through the arms 204 and U-shaped conductors 207 is generally of the character described hereinbefore for the contact assembly 117 shown in Figure 15. That is, there is a reverse loop effect since the current flows upwardly through the arms 204, then downwardly through the outer branches 206 and finally upwardly through the inner branches 208 to the switch blade 171. Increased contact pressure results from this arrangement in the manner previously described.

The movement of the switch blade 171 to the switch closed position is limited by a stop pin 224 which is carried by the contact housing 203 and extends upwardly therefrom.

Since certain further modifications and arrangements of the invention can be made without departing from the spirit and scope thereof, it is intended that all matters shown in the accompanying drawings and described hereinbefore shall be interpreted as illustrative and not in a limiting sense.

What is claimed as new is:

1. In a switch, in combination, a switch blade and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of U-shaped flexible resilient conductors having the ends of their outer branches rigidly supported in spaced relation and their inner branches facing each other with contact means extending lengthwise thereof at their outer ends for engaging opposite sides of said switch blade therebetween, means biasing said contact means

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into high pressure contact engagement with said switch blade, and means limiting the movement of said contact means toward each other to a distance apart slightly less than the distance between the opposite sides of said switch blade engaged by said contact means in switch closed position.

2. In a switch, in combination, a switch blade and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of U-shaped flexible resilient conductors having the ends of their outer branches rigidly supported in spaced relation and their inner branches facing each other with contact means extending lengthwise thereof at their outer ends for engaging opposite sides of said switch blade therebetween, each contact means having a convex contact surface with the radius of the longitudinal portion being substantially greater than the radius of the transverse portion, means biasing said contact means into high pressure contact engagement with said switch blade, and means limiting the movement of said contact means toward each other to a distance apart slightly less than the distance between the opposite sides of said switch blade engaged by said contact means in switch closed position.

3. In a switch, in combination, a switch blade and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of U-shaped flexible resilient conductors having their outer branches rigidly supported in spaced relation and their inner branches facing each other and split lengthwise to provide independently movable legs, a relatively massive contact finger carried by the outer end of each leg having a convex contact surface for small area contact engagement with opposite sides of said switch blade, the lengths of the current paths in said branches of said U-shaped conductor being substantially equal whereby the resulting magnetic forces acting to increase the contact pressure applied by said contact fingers to said switch blade attain a maximum for any given current flow there-through, means individually biasing said contact fingers into high pressure contact engagement with said switch blade, and means limiting the movement of said contact fingers toward each other to a distance apart slightly less than the distance between the opposite sides of said switch blade engaged thereby in switch closed position.

4. In a switch, in combination, a switch blade and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of U-shaped flexible resilient conductors having their outer branches rigidly supported in spaced relation and their inner branches facing each other and split lengthwise to provide independently movable legs, a relatively massive contact finger carried by the outer end of each leg having a convex contact surface with the radius of the longitudinal portion being substantially greater than the radius of the transverse portion for small area contact engagement with opposite sides of said switch blade, the lengths of the current paths in said branches of said U-shaped conductors being substantially equal whereby the resulting magnetic forces act to increase the contact pressure applied by said contact fingers to said switch blade in proportion to the current flow therethrough, means individually biasing said contact fingers into high pressure contact engagement with said switch blade, and means limiting the movement of said contact fingers toward each other to a distance apart slightly less than the distance between the opposite sides of said switch blade engaged thereby in switch closed position.

5. A switch comprising, in combination, a switch blade and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of spaced relatively inflexible contact support arms, a pair of relatively flexible resilient U-shaped conductors extending from said contact support arms and

having the outer branches overlying and secured to said arms and the inner branches extending between and spaced from the inner sides of said arms and from each other, relatively massive contact finger means secured to the outer end of each of said inner branches and extending lengthwise thereof and providing on their facing sides contact surfaces engaging the opposite sides of said switch blade, a spacer intermediate the facing sides of said inner branches and holding the opposite contact surfaces of said contact finger means apart in the switch open position a distance slightly less than the thickness of said switch blade where they are engaged thereby in the switch closed position, an equalizer bar extending through said inner branches with its ends projecting beyond the outer sides thereof and retaining means at each end, and a spring leaf overlying the outer sides of said inner branches with the inner ends reacting against the same, the intermediate portions of said spring leaves being located between the respective retaining means on said equalizer bar and said outer sides of said inner branches and reacting against the former, and the outer ends of said spring leaves reacting against the rear sides of the respective contact finger means.

6. A switch comprising, in combination, a switch blade and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of spaced relatively inflexible contact support arms, a pair of relatively flexible resilient U-shaped conductors extending from said contact support arms and having the outer branches extending between and spaced from the inner sides of said arms and from each other with relatively massive contact means secured to the outer end of each of said inner branches and extending lengthwise thereof and providing on their facing sides contact surfaces engaging the opposite sides of said switch blade, a spacer sleeve intermediate the facing sides of said inner branches and holding the opposite contact surfaces of said contact finger means apart in the switch open position a distance slightly less than the thickness of said switch blade where they are engaged thereby in the switch closed position, an equalizer bar extending through said spacer sleeve with its ends projecting beyond the outer sides of said inner branches and retaining means at each end, a loading pin extending between said inner branches near their inner ends and having reduced end portions projecting beyond said outer sides thereof, and a spring leaf overlying the outer sides of said inner branches with its inner end portion guided by the respective end portion of said loading pin and reacting against said outer sides of said inner branches, the intermediate portions of said spring leaves being located between the respective retaining means on said equalizer bar and said outer sides of said inner branches and reacting against the former, and the outer ends of said spring leaves reacting against the rear sides of the respective contact finger means.

7. A switch comprising, in combination, a switch blade and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of spaced relatively inflexible contact support arms, a pair of relatively flexible resilient U-shaped conductors extending from said contact support arms and having the outer branches overlying and secured to said arms and the inner branches extending between and spaced from the inner sides of said arms and from each other, relatively massive contact finger means secured to the outer end of each of said inner branches and extending lengthwise thereof and providing on their facing sides contact surfaces engaging the opposite sides of said switch blade, each contact surface being convex with the radius of the longitudinal contact surface being substantially greater than the radius of the transverse contact surface, a spacer sleeve intermediate the facing sides of said inner branches and holding the opposite contact surfaces of said contact finger means apart in the switch open posi-

tion a distance slightly less than the thickness of said switch blade where they are engaged thereby in the switch closed position, an equalizer bar extending through said spacer sleeve with its ends projecting beyond the outer sides of said inner branches and retaining means at each end, a loading pin extending between said inner branches near their inner ends and having reduced end portions projecting beyond said outer sides thereof, and a spring leaf overlying the outer sides of said inner branches with its inner end portion guided by the respective end portion of said loading pin and reacting against said outer sides of said inner branches, the intermediate portions of said spring leaves being located between the respective retaining means on said equalizer bar and said outer sides of said inner branches and reacting against the former, and the outer ends of said spring leaves having limited area high pressure contact engagement with the rear sides of the respective contact finger means centrally of the respective contact surface.

8. A switch comprising, in combination, a switch blade and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a U-shaped relatively inflexible contact support, a pair of relatively flexible resilient U-shaped conductors extending from the arms of said contact support and having the outer branches secured to said arms and the inner branches split lengthwise and extending between and spaced from said arms and from each other, a relatively massive contact finger secured to the outer end of each of the legs of said inner branches and extending lengthwise thereof and therewith having limited movement relative to each other and providing on their front sides contact surfaces engaging the opposite sides of said switch blade, a spacer intermediate the facing sides of said inner branches and holding the opposite contact surfaces of said contact fingers apart in the switch open position a distance slightly less than the thickness of said switch blade where they are engaged thereby in the switch closed position, an equalizer bar extending through said inner branches with its ends projecting beyond the outer sides thereof and a pin extending transversely through each end, and a spring leaf overlying the outer sides of said inner branches with the inner ends reacting against said outer sides of said inner branches, the intermediate portions of said spring leaves being located between the respective transverse pins in said equalizer bar and said outer sides of said inner branches and reacting against the former, the outer ends of said spring leaves being bifurcated and reacting against the rear sides of the respective contact fingers.

9. A switch comprising, in combination, a switch blade and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a U-shaped relatively inflexible contact support, a pair of relatively flexible resilient U-shaped conductors extending laterally of the arms of said contact support and having the outer branches secured to said arms and the inner branches split lengthwise and extending between and spaced from said arms and from each other, a relatively massive contact finger secured to the outer end of each of the legs of said inner branches and extending lengthwise thereof and therewith having limited movement relative to each other and providing on their front sides contact surfaces engaging the opposite sides of said switch blade, each contact surface being convex with the radius of the longitudinal contact surface being substantially greater than the radius of the transverse contact surface, a spacer intermediate the facing sides of said inner branches and holding the opposite contact surfaces of said contact fingers apart in the switch open position a distance slightly less than the thickness of said switch blade where they are engaged thereby in the switch closed position, an equalizer bar extending through said inner branches with its ends projecting beyond the outer sides thereof and a pin extending transversely through each

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end, and a spring leaf overlying the outer sides of said inner branches with the inner ends reacting against said outer sides of said inner branches, the intermediate portions of said spring leaves being located between the respective transverse pins in said equalizer bar and said outer sides of said inner branches and reacting against the former, the outer ends of said spring leaves being bifurcated and having limited area high pressure contact engagement with the rear sides of the respective contact fingers centrally of the respective contact surface.

10. A switch comprising, in combination, a switch blade and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a U-shaped relatively inflexible contact support, a pair of relatively flexible resilient U-shaped conductors extending laterally of the arms of said contact support and having the outer branches secured to said arms and the inner branches split lengthwise and extending between and spaced from said arms and from each other, a relatively massive contact finger secured to the outer end of each of the legs of said inner branches and extending lengthwise thereof and therewith having limited movement relative to each other and providing on their front sides contact surfaces engaging the opposite sides of said switch blade, each contact surface being convex with the radius of the longitudinal contact surface being substantially greater than the radius of the transverse contact surface, a spacer sleeve intermediate the facing sides of said inner branches and holding the opposite contact surfaces of said contact fingers apart in the switch open position a distance slightly less than the thickness of said switch blade where they are engaged thereby in the switch closed position, an equalizer bar extending through said spacer sleeve with its ends projecting beyond the outer sides of said inner branches and a pin extending transversely through each end, and a spring leaf overlying the outer sides of said inner branches with the inner ends reacting against said outer sides of said inner branches, the intermediate portions of said spring leaves being located between the respective transverse pins in said equalizer bar and said outer sides of said inner branches and reacting against the former, the outer ends of said spring leaves being bifurcated and having limited area high pressure contact engagement with the rear sides of the respective contact fingers centrally of the respective contact surface.

11. A switch comprising, in combination, a switch blade and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a U-shaped relatively inflexible contact support, a pair of relatively flexible resilient U-shaped conductors extending laterally of the arms of said contact support and having the outer branches secured to said arms and the inner branches split lengthwise and extending between and spaced from said arms and from each other, a relatively massive contact finger secured to the outer end of each of the legs of said inner branches and extending lengthwise thereof and therewith having limited movement relative to each other and providing on their front sides contact surfaces engaging the opposite sides of said switch blade, each contact surface being convex with the radius of the longitudinal contact surface being substantially greater than the radius of the transverse contact surface, a spacer sleeve intermediate the facing sides of said inner branches and holding the opposite contact surfaces of said contact fingers apart in the switch open position a distance slightly less than the thickness of said switch blade where they are engaged thereby in the switch closed position, an equalizer bar extending through said spacer sleeve with its ends projecting beyond the outer sides of said inner branches and a pin extending transversely through each end, a loading pin extending between said inner branches at the base of the split in each and having reduced end portions projecting beyond said outer sides thereof, and a spring leaf at each end of said load-

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ing pin with its end portions guiding the respective inner ends of the spring leaves and the same bearing against spacing means reacting against said outer sides of said inner branches, the intermediate portions of said spring leaves being located between the respective transverse pins in said equalizer bar and said outer sides of said inner branches and bearing against the former, the outer ends of said spring leaves being bifurcated and having limited area high pressure contact engagement with the rear sides of the respective contact fingers centrally of the respective contact surface.

12. A switch comprising, in combination, a switch blade and a relatively endwise movable contact assembly mounted in insulated spaced relation, said contact assembly including a U-shaped relatively inflexible contact support with a central mounting ear extending laterally away from said switch blade in closed position, a pair of relatively flexible resilient U-shaped conductors parallel to said ear having the outer branches overlying and secured to the outer sides of the arms of said contact support and the inner branches split lengthwise and extending between and spaced from the inner sides of said arms and from each other with their ends spaced from the lateral edges of said arms away from said ear, a relatively massive contact finger secured to the inner facing side of each of the legs of said inner branches and extending to said lateral edges of said arms and having limited movement relative to each other and providing on their front sides contact surfaces engaging the opposite sides of said switch blade, each contact surface being convex with the radius of the longitudinal contact surface being substantially greater than the radius of the transverse contact surface, a spacer sleeve intermediate the facing sides of said inner branches and holding the opposite contact surfaces of said contact fingers apart in the switch open position a distance slightly less than the thickness of said switch blade where they are engaged thereby in the switch closed position, an equalizer bar extending through said spacer sleeve with its ends projecting beyond the outer sides of said inner branches and a pin extending transversely through each end, a loading pin extending between said inner branches at the base of the split in each and having reduced end portions projecting beyond said outer sides thereof, a collar on each of said end portions bearing against the outer side of the respective inner branch and having a convex outer end surface, and a spring leaf at each end of said loading pin with its end portions guiding the respective ends of the spring leaves and the same bearing against the respective convex end surface of each collar, the intermediate portions of said spring leaves being located between the respective transverse pins in said equalizer bar and said outer sides of said inner branches and bearing against the former, the other ends of said spring leaves being bifurcated and turned inwardly to overlie the respective ends of said legs of said inner branches and having limited area high pressure contact engagement with the rear sides of the respective contact fingers centrally of the respective contact surface.

13. In a switch, in combination, a switch blade and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of U-shaped flexible resilient conductors having the ends of their outer branches rigidly supported in spaced relation and their inner branches facing each other with contact means extending lengthwise thereof at their outer ends for engaging opposite sides of said switch blade therebetween, means biasing said contact means into high pressure contact engagement with said switch blade, articulated interconnecting means between said inner branches for distributing substantially equally the contact pressure applied by said contact means to said opposite sides of said switch blade, and means for effecting relative movement between said switch blade and contact assembly such that the former enters and

leaves the latter at said outer ends of said inner branches.

14. In a switch, in combination, a switch blade and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of U-shaped flexible resilient conductors having the ends of their outer branches rigidly supported in spaced relation and their inner branches facing each other with contact means extending lengthwise thereof at their outer ends for engaging opposite sides of said switch blade therebetween, means biasing said contact means into high pressure contact engagement with said switch blade, means limiting the movement of said contact means toward each other to a distance apart slightly less than the distance between the opposite sides of said switch blade engaged by said contact means in switch closed position, and means for effecting relative movement between said switch blade and contact assembly such that the former enters and leaves the latter at said outer ends of said inner branches.

15. In a switch, in combination, a switch blade having spaced contact surfaces and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of U-shaped flexible resilient conductors having the ends of a branch of each rigidly supported in spaced relation and their other branches facing said contact surfaces of said switch blade with contact means thereon for engaging said contact surfaces of said switch blade, means biasing said contact means into high pressure contact engagement with said contact surfaces of said switch blade, and an equalizer bar mechanically interconnecting said U-shaped conductors to distribute the contact pressures applied by said biasing means through said contact means to said contact surfaces.

16. In a switch, in combination, a switch blade having spaced contact surfaces and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of U-shaped flexible resilient conductors having the ends of a branch of each rigidly supported in spaced relation and their other branches facing said contact surfaces of said switch blade with contact means thereon for engaging said contact surfaces of said switch blade, means biasing said contact means into high pressure contact engagement with said contact surfaces of said switch blade, means limiting the movement of said contact means toward said contact surfaces to a distance slightly past the respective contact surface of said switch blade engaged by said contact means in switch closed position, and an equalizer bar mechanically interconnecting said U-shaped conductors to distribute the contact pressures applied by said biasing means through said contact means to said contact surfaces.

17. In a switch, in combination, a switch blade having spaced contact surfaces and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of U-shaped flexible resilient conductors having the ends of a branch of each rigidly supported in spaced relation and their other branches facing said contact surfaces of said switch blade with contact means thereon for engaging said contact surfaces of said switch blade, means individual to each contact means biasing the same into high pressure contact engagement with said contact surfaces of said switch blade, and an equalizer bar extending past adjacent branches of said U-shaped conductors and mechanically interconnecting said biasing means to distribute the contact pressures applied by said biasing means through said contact means to said contact surfaces.

18. In a switch, in combination, a switch blade having spaced contact surfaces and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of U-shaped flexible resilient conductors having the ends of a branch of each rigidly supported in spaced relation and their other

branches facing said contact surfaces of said switch blade, means limiting the movement of said contact means toward said contact surfaces to a distance slightly past the respective contact surface of said switch blade engaged by said contact means in switch closed position with contact means thereon for engaging said contact surfaces of said switch blade, means individual to each contact means biasing the same into high pressure contact engagement with said contact surfaces of said switch blade, and an equalizer bar extending past adjacent branches of said U-shaped conductors and mechanically interconnecting said biasing means to distribute the contact pressures applied by said biasing means through said contact means to said contact surfaces.

19. In a switch, in combination, a switch blade having spaced contact surfaces and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of U-shaped flexible resilient conductors having the ends of a branch of each rigidly supported in spaced relation and their other branches facing said contact surfaces of said switch blade with contact means thereon for engaging said contact surfaces of said switch blade, means biasing said contact means into high pressure contact engagement with said contact surfaces of said switch blade, an equalizer bar extending past adjacent branches of said U-shaped conductors and mechanically interconnecting said U-shaped conductors to distribute the contact pressures applied by said biasing means through said contact means to said contact surfaces, and a loading pin extending between said adjacent branches in spaced relation to said equalizer bar.

20. In a switch, in combination, a switch blade having spaced contact surfaces and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of U-shaped flexible resilient conductors having the ends of a branch of each rigidly supported in spaced relation and their other branches facing said contact surfaces of said switch blade with contact means thereon for engaging said contact surfaces of said switch blade, means biasing said contact means into high pressure contact engagement with said contact surfaces of said switch blade, means limiting the movement of said contact means toward said contact surfaces to a distance slightly past the respective contact surface of said switch blade engaged by said contact means in switch closed position, an equalizer bar extending past adjacent branches of said U-shaped conductors and mechanically interconnecting said U-shaped conductors to distribute the contact pressures applied by said biasing means through said contact means to said contact surfaces, and a loading pin extending between said adjacent branches in spaced relation to said equalizer bar.

21. In a switch, in combination, a switch blade having spaced contact surfaces and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of U-shaped flexible resilient conductors having the ends of a branch of each rigidly supported in spaced relation and their other branches facing said contact surfaces of said switch blade with contact means thereon for engaging said contact surfaces of said switch blade, means biasing said contact means into high pressure contact engagement with said contact surfaces of said switch blade, and articulated means mechanically interconnecting said U-shaped conductors for distributing the contact pressures applied by said biasing means through said contact means to said contact surfaces.

22. In a switch, in combination, a switch blade having spaced contact surfaces and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of U-shaped flexible resilient conductors having the ends of a branch of each rigidly supported in spaced relation and their other branches facing said contact surfaces of said switch blade with contact means thereon for engaging said contact sur-

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faces of said switch blade, means individual to each contact means biasing the same into high pressure contact engagement with said contact surfaces of said switch blade, means limiting the movement of said contact means toward said contact surfaces to a distance slightly past the respective contact surface of said switch blade engaged by said contact means in switch closed position, and articulated means mechanically interconnecting said U-shaped conductors for distributing the contact pressures applied by said biasing means through said contact means to said contact surfaces.

23. In a switch, in combination, a switch blade having spaced contact surfaces and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of U-shaped flexible resilient conductors having the ends of a branch of each rigidly supported in spaced relation and their other branches facing said contact surfaces of said switch blade with contact means thereon for engaging said contact surfaces of said switch blade, means individual to each contact means biasing the same into high pressure contact engagement with said contact surfaces of said switch blade, an equalizer bar extending past adjacent branches of said U-shaped conductors and mechanically interconnecting said biasing means to distribute the contact pressures applied by said biasing means through said contact means to said contact surfaces, and a loading pin extending between said adjacent branches near the bottom of the U-shape and in spaced relation to said equalizer bar.

24. In a switch, in combination, a switch blade having spaced contact surfaces and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of U-shaped flexible resilient conductors having the ends of a branch of each rigidly supported in spaced relation and their other branches facing said contact surfaces of said switch blade with contact means thereon for engaging said contact surfaces of said switch blade, means biasing said contact means into high pressure contact engagement with said contact surfaces of said switch blade, an equalizer bar mechanically interconnecting said U-shaped conductors to distribute the contact pressures applied by said biasing means through said contact means to said contact surfaces, and stop means carried by said equalizer bar limiting the movement of said contact means toward said contact surfaces to a distance slightly past the respective contact surfaces of said switch blade engaged by said contact means in switch closed position.

25. In a switch, in combination, a switch blade having spaced contact surfaces and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of U-shaped flexible resilient conductors having the ends of a branch of each rigidly supported in spaced relation and their other branches facing said contact surfaces of said switch blade with contact means thereon for engaging said contact surfaces of said switch blade, means biasing said contact means into high pressure contact engagement with said contact surfaces of said switch blade, an equalizer bar extending past adjacent branches of said U-shaped conductors and mechanically interconnecting said U-shaped conductors to distribute the contact pressures applied by said biasing means through said contact means to said contact surfaces, stop means carried by said equalizer bar limiting the movement of said contact means toward said contact surfaces to a distance slightly past the respective contact surface of said switch blade engaged by said contact means in switch closed position, and a loading pin extending between said adjacent branches in spaced relation to said equalizer bar.

26. In a switch, in combination, a switch blade having spaced contact surfaces and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of U-shaped flexible resilient conductors having the ends of a branch of each

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rigidly supported in spaced relation and their other branches facing said contact surfaces of said switch blade with contact means thereon for engaging said contact surfaces of said switch blade, means biasing said contact means toward each other into high pressure contact engagement with said contact surfaces of said switch blade therebetween, and an equalizer bar extending past adjacent branches of said U-shaped conductors and mechanically interconnecting said U-shaped conductors to distribute the contact pressures applied by said biasing means through said contact means to said contact surfaces.

27. The invention, as set forth in claim 26, wherein the stop means is a sleeve telescoped with the equalizer bar and is stressed in compression when the switch blade is out of engagement with the contact assembly.

28. In a switch, in combination, a switch blade having spaced contact surfaces and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of U-shaped flexible resilient conductors having the ends of a branch of each rigidly supported in spaced relation and the other branches facing said contact surfaces of said switch blade with contact means thereon for engaging said contact surfaces of said switch blade, a leaf spring overlying each of said other branches with one end of each acting thereagainst to bias the contact means carried thereby into high pressure contact engagement with the respective contact surface of said switch blade, an equalizer bar extending past adjacent branches of said U-shaped conductors and mechanically interconnecting the intermediate portions of said leaf springs, and a loading pin extending between said adjacent branches in spaced relation to said equalizer bar with the other ends of said leaf springs bearing thereagainst.

29. In a switch, in combination, a switch blade having spaced contact surfaces on opposite sides and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of U-shaped flexible resilient conductors having the ends of a branch of each rigidly supported in spaced relation and their other branches facing said contact surfaces of said switch blade with contact means extending transversely thereof at their outer ends for engaging opposite sides of said switch blade therebetween, each contact means having a convex contact surface with the radius of the transverse portion being substantially greater than the radius of the longitudinal portion, means biasing said contact means into high pressure contact engagement with said contact surfaces of said switch blade, an equalizer bar mechanically interconnecting said other branches to distribute the contact pressures applied by said biasing means through said contact means to said contact surfaces, and means mounting said switch blade to swing into and out of engagement with said contact assembly transversely of said other branches of said U-shaped conductors and longitudinally of said convex contact surfaces.

30. The invention, as set forth in claim 29, wherein the biasing means comprises leaf springs overlying the sides of the other branches away from the switch blade and the equalizer bar is connected to the intermediate portions of said leaf springs.

31. The invention, as set forth in claim 29, wherein a line terminal pad is connected to the contact assembly at a location where it constitutes a substantially symmetrical endwise extension of the switch blade in switch closed position whereby the magnetic forces incident to current flow have substantially no tendency to cause said switch blade to move toward open position.

32. The invention, as set forth in claim 29, wherein the contact assembly comprises two pairs of U-shaped flexible resilient conductors each arranged and constructed as aforesaid.

33. In a switch, in combination, a switch blade having a pair of spaced apart blade members provided with in-

wardly facing contact surfaces and a relatively movable contact assembly mounted in insulated spaced relation with the latter being straddled by the former, said contact assembly including a pair of U-shaped flexible resilient conductors with the ends of adjacent branches rigidly supported in spaced relation and their other branches having contact means thereon facing outwardly toward said contact surfaces on said blade members, spring means biasing said other branches outwardly and said contact means carried thereby into high pressure contact engagement with said contact surfaces of said switch blade, and an equalizer bar in compression between said spring means to distribute the contact pressures applied by said spring means through said contact means to said contact surfaces.

34. The invention, as set forth in claim 33, wherein the ends of the equalizer bar extend past the other branches and carry stop means limiting the outward movement of the contact means to positions slightly past the respective contact surface of the respective blade member engaged by said contact means in switch closed position.

35. The invention, as set forth in claim 33, wherein a loading pin extends through the adjacent branches near the bottom of the U-shape and the ends thereof limit the movement apart of said adjacent branches when the switch blade is disengaged from the contact assembly.

36. The invention, as set forth in claim 33, wherein the contact means is located near the outer ends of the other branches and the U-shapes open in the direction of opening movement of the switch blade.

37. The invention, as set forth in claim 33, wherein the contact means is located near the outer ends of the other branches and the U-shapes open in the direction of closing movement of the switch blade.

38. In a switch, in combination, a switch blade having spaced contact surfaces and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of U-shaped flexible resilient conductors having the ends of a branch of each rigidly supported in spaced relation and the other branches facing said contact surfaces of said switch blade with contact means thereon for engaging said contact surfaces of said switch blade, a leaf spring overlying each of said other branches with one end of each acting thereagainst to bias the contact means carried thereby into high pressure contact engagement with the respective contact surface of said switch blade, and the other end of each leaf spring bearing against the respective branch, an equalizer bar extending past adjacent branches of said U-shaped conductors and bearing against intermediate portions of said leaf springs, and a loading pin extending between said adjacent branches in spaced relation to said equalizer bar.

39. In a switch, in combination, a switch blade and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of U-shaped flexible resilient conductors having the ends of their outer branches rigidly supported in spaced relation and their inner branches facing each other for receiving said switch blade therebetween remote from the free ends thereof, spring means interposed between the branches of each U-shaped conductor and biasing said inner branches thereof toward each other, an equalizer bar extending transversely of said U-shaped conductors and connected at its ends to said outer branches, and spacer means carried by said equalizer bar and limiting the movement of said inner branches toward each other.

40. The invention, as set forth in claim 39, wherein the

switch blade has diametrically oppositely extending contact ears and is rotatable about its longitudinal axis to move the same into and out of engagement with the facing surfaces of the inner branches.

41. In a switch, in combination, a switch blade and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of U-shaped flexible resilient conductors having the ends of their outer branches rigidly supported in spaced relation and their inner branches facing each other for receiving said switch blade therebetween remote from the free ends thereof, a loading pin between said free ends of said inner branches limiting the movement thereof toward each other, spring means interposed between the branches of each U-shaped conductor and biasing said inner branches thereof toward each other, an equalizer bar extending transversely of said U-shaped conductors and connected at its ends to said outer branches, and spacer means carried by said equalizer bar and limiting the movement of said inner branches toward each other.

42. In a switch, in combination, a switch blade and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of U-shaped flexible resilient conductors having the ends of their outer branches rigidly supported in spaced relation and their inner branches facing each other for receiving said switch blade therebetween remote from the free ends thereof, a loading pin between said free ends of said inner branches limiting the movement thereof toward each other, a leaf spring interposed between the branches of each U-shaped conductor having the central portion reacting against the inner side of the respective outer branch and the ends reacting against the inner side of the respective inner branch, an equalizer bar extending transversely of said U-shaped conductors and said central portions of said leaf springs and connected at its ends to said outer branches, and a spacer sleeve carried by said equalizer bar and limiting the movement of said inner branches toward each other.

43. In a switch, in combination, a switch blade and a relatively movable contact assembly mounted in insulated spaced relation, said contact assembly including a pair of U-shaped flexible resilient conductors having the ends of their outer branches rigidly supported in spaced relation and their inner branches facing each other for receiving said switch blade between the free ends thereof, spring means interposed between the branches of each U-shaped conductor and biasing said inner branches toward each other, and an equalizer bar extending transversely of said inner branches and interconnecting said spring means, said switch blade having diametrically oppositely extending contact ears and being rotatable about its longitudinal axis to move the same into and out of engagement with the facing surfaces of said inner branches.

44. The invention, as set forth in claim 43, wherein the stop means cooperate with the free ends of the inner branches and limit the movement thereof toward each other when the contact ears of the switch blade are disengaged therefrom.

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