The present invention relates to improvements in side break switches and the like, and particularly to an improved electrically conductive swivel connector for side break switches, which connector accommodates elimination of the braid conductor normally required between the blade and terminal pad of a side break switch.

A side break switch, in basic form, comprises a pair of spaced parallel insulator stacks, at least one of which is rotatable, a switch blade secured to the rotatable insulator stack for accurate movement in a plane generally normal to the stack axes, and contact means carried by the other insulator stack to be engaged by the blade to close the switch. To connect the blade and contact to the terminal ends of the line with which the switch is to be associated, terminal pads are provided, but separate supporting insulators are not provided for the pads, so that at least the terminal pad for the blade must be supported, directly or indirectly, by the rotatable insulator stack. Yet, the terminal pad cannot rotate with respect to the line, and thus, must be mounted for rotation with respect to the insulator stack. Moreover, the rotatable connection must not impose a substantial friction load between the pad and stack, for the line would then be required to support the load. Because of this latter requirement, known rotary electrical connectors for high capacity switches and the like have proven totally unsatisfactory for commercial use on side break switches. Accordingly, it has been customary heretofore to provide a low friction mechanical connection between the terminal pad and rotatable insulator and to utilize, despite the known objections thereto, a slack length of braid conductor electrically to connect the terminal pad and switch blade.

It is an object of the present invention to provide improved, and commercially practical, braidless side break switches. More specifically, it is an object of the invention to provide an improved electrically conductive swivel connector for side break switches and the like, which connector is particularly adapted for high capacity installations, to eliminate the necessity hereetofore existing for a braid conductor or the like between the terminal pad and switch blade.

Another object of the invention is to provide an improved electrically conductive swivel connector for side break switches and the like incorporating the known principles and advantages of high pressure-small area contact.

A further object of the invention is the provision of an improved electrically conductive swivel connector for two conductors in switches and the like including a novel combination of cooperative contact members and antifriction bearings therefor presenting exceedingly little frictional resistance to relative rotation of the two conductors.

A still further object of the invention is the provision of an improved electrically conductive swivel connector attaining the object set forth above, and at the same time, being of such sturdy construction as to constitute the sole connection between the two relatively movable conductors.

An additional object of the present invention is the provision of an improved swivel connector, and improved braidless side break switches, of compact, efficient and highly economical construction.

Other objects and advantages will become apparent in the following detailed description of preferred embodiments of the invention.

Now, in order to acquaint those skilled in the art with the present invention, I shall describe, in connection with the accompanying drawings, two preferred embodiments of side break switches formed in accordance with the present invention, and a preferred embodiment of the swivel connector of the invention.

In the drawings, wherein like reference numerals indicate like parts:

Figure 1 is a plan view of a braidless side break switch formed in accordance with the invention;

Figure 2 is a side elevation of the switch shown in Figure 1;

Figure 3 is a plan view of the braidless side break switch of the center break type, involving two rotatable insulators and switch blades, formed in accordance with the present invention;

Figure 4 is a side elevation of the switch shown in Figure 3;

Figure 5 is a plan view, on an enlarged scale, of a portion of a switch including my improved swivel connector; and

Figure 6 is a side view, partly in elevation and partly in section, of the apparatus shown in Figure 5, the view particularly showing my improved swivel connector in section.

Referring now to the drawings, and particularly to Figures 1 and 2, I have shown a side break switch of a generally standard type as formed in accordance with the present invention. As shown, the switch comprises a pair of spaced parallel insulator stacks 10 and 12 mounted on a common base 14. The insulator stack 10 is fixed to the base 14 and at its upper end carries a laterally open stationary contact 16 including vertically opposed contact members 18, and a fixed terminal pad 20. The contact members 18 extend at an inclination to the longitudinal axis of the switch, and the contact 16 includes a stop 21 aligned with the axis of the switch to limit insertion of a switch blade between the contact members. The insulator stack 12 is mounted on the base 14 for rotation about its own axis and includes a downwardly depending extension 22 for attachment of an operating crank or the like. At its upper end, the stack 10 carries a bracket 24 which extends angularly away from the axis of the stack 12 toward the stack 10. The bracket 24, at its outer end, fixedly carries a main switch blade 26, the blade extending perpendicular to the axis of rotation of the insulator 12 and including an end portion 28 projecting rearwardly over the stack 12. Adjacent its rearward end, the blade 26 pivotally supports a terminal pad 30, and adjacent its opposite end, pivotally supports a knee blade 32, which pivotal supports or swivel connectors, as indicated generally at 34 and 36, respectively, will be explained in greater detail hereinafter. The knee blade 32 is mounted on the blade 26 for pivotal movement in a predetermined arc from a position in longitudinal alignment with 46, as is shown in solid lines in Figure 1, to a position wherein the knee blade is inclined in the direction of the contact 16 from the axis of the blade 26 at an angle of approximately 45°, as is shown in dotted lines in Figure 1. At its outer end, the knee blade 32 includes an enlarged portion 38 to be received between the contact members 18 to close the switch.
The switch blade of the side break switch shown in Figures 1 and 2 is thus comprised of the blade members 26 and 32, and is secured to the rotatable insulator 12 for arcing or movement in a plane at right angles to the insulator stacks 10 and 12. Specifically, the blade 26 is movable in an arc of substantially 90° from the switch closed position shown in solid lines in Figure 1, to the switch open position shown in dotted lines. As the movement in the switch opening direction commences, the blade 26 is moved rearwardly from the contact 16, but the knee blade 32 is held by the contact members 18, whereupon the knee blade 32 pivots within the contact and about its pivotal support 36 on the blade 26, until the knee blade attains substantially its maximum degree of inclination to the blade 26. In such position, the blade 32 is substantially aligned with the contact members 18, so that further rotation of the stack 12 results in longitudinal withdrawal of the contacting portion 38 of the knee blade from the contacts 18, with the advantageous results known in the art. Thereafter, as the stack 12 is rotated to complete a 90° arc of movement, the knee blade 32 is swung away from the contact 16, with the blade 26, to open the switch. Upon rotation of the stack 12 in the opposite direction to close the switch, the movement of the blade parts occur generally in reverse sequence, with the additional factor that the stop 21 on the contact 16 limits insertion of the knee blade 32 into the contact members, defines the position generally at which relative movement between the blades 26 and 32 commences, and defines the fully closed position of the switch, as is shown in Figure 1.

In use of the switch, the terminal pads 20 and 30 are fixed to line terminals to connect the switch in series with the line to be controlled thereby. As shown, the pad 20 is fixed to the contact 16 and stack 10, so that no particular problem arises with respect thereto. However, the pad 30 has no fixed point of support, and to provide a separate stack to support the same would be exceedingly wasteful. Yet, the pad 30 must maintain a substantially fixed position for proper line connection, despite the fact that the only anchor for the pad is the line itself. In view of the facts that the line must be maintained substantially stationary, and that substantial force must not be transmitted to the line, since it would normally result in line movement or undue stress thereon, it is apparent that the pivotal support or swivel connection 34 must not transmit any substantial degree of force to the pad 30 upon rotation of the stack 12 and switch blade. In fact, the swivel connection 34 must be substantially frictionless to avoid transmission of force to the pad 30 upon arcing movement of the blade. Yet, as pointed out heretofore, this same connection, according to the present invention, constitutes the point of electrical connection between the blade and pad and the connection must be capable of carrying the electrical load on the line. The pivotal support or swivel connection 36 between the blades 26 and 32 must also meet these conflicting requirements, although this connection is not quite so critical as the connection 34.

The same problems as outlined above in regard to the swivel connection 34 exist in center break switches, with the further requirement that two such connections be provided. In Figures 3 and 4, I have shown a center break type of side break switch formed in accordance with the present invention, the switch comprising a pair of rotatable insulator stacks 50 and 52 mounted on a common base 54 in a parallel relation. The stacks include a downwardly depending extension for abutment of an operating crank or the like. At its upper end, the insulator stack 50 carries a contact blade 56 including a blade portion 57 and vertically opposed spring biased contact members secured to the outer end of the blade portion. The blade is secured to the stack 50 by an inclined bracket 59, similar to the bracket 24, and includes a portion 61 projecting rearwardly over the stack. Adjacent its rearward end, the blade 56 pivotally supports a terminal pad 60, the pivotal support or swivel connection of the pad to the blade being indicated generally at 76. The insulator stack 52, at its upper end, carries a bracket 64 similar to the bracket 24, but reversed in its installation into the axial stack 52 to fix the stack 52 and the insulator stack 52, and adjacent its rearward end pivotally supports a terminal pad 70. The pivot 74, the swivel connection of the pad to the blade being indicated at 74. Adjacent its opposite end, the blade 66 is curved outwardly to define a portion 78 to be inserted between the contact members 58 to close the switch, the contact members 58 being disposed at an inclination to the longitudinal axis of the switch to cooperate with the portion 78 of the blade 66.

In use, the terminal pads 60 and 70 are connected to the line terminals, and both stacks 50 and 52 are simultaneously rotatable to open and close the switch. Specifically, the blades 56 and 66 are arcuately movable in a common plane normal to the stack axes in opposite directions and through arcs of substantially 90°, from the closed position shown in solid lines to the open position shown in dotted lines in Figure 3. To effect simultaneous rotation of the two stacks in opposite directions, and yet to require only a single operating crank on the depending extension of one or the other of the two stacks, the stacks are interconnected by means of crank and link means indicated generally at 89. As shown, the means 80 comprises a crank 82 secured to the shaft of the insulator stack 52 and extending to one side of the switch, a similar crank 84 secured to the shaft of the insulator stack 52 and extending to the opposite side of the switch, and a cross link 86 pivotally connected to said cranks at its ends, so that rotation of one stack in one direction automatically effects rotation of the other stack in the opposite direction.

As will be appreciated from the foregoing discussion of the swivel connector 34, the swivel connections 74 and 76 of the center break switch are both required to support the terminal pads 60 and 70 in such manner that very little force is transmitted to the pads upon rotation of the blades 56 and 66, and yet, are both required to constitute an efficient, load carrying electrical connection between the respective pads and blades.

Referring now to Figures 5 and 6, I have shown in detail a preferred embodiment of the swivel connector of the present invention, which connector is particularly adapted to comprise the connections or pivotal supports 34, 74 and 76 referred to hereinafter, and the pivotal support or connection 36 as well. By way of example, the connection 36 as described in connection with the pivotal support 34 of the switch shown in Figures 1 and 2, wherein the switch includes the bracket 24, the switch blade 26 having an end portion 28, and the terminal pad 30.

As shown, the swivel blade comprises a tubular conductor 100 provided at its rearward end with portions 102 of increased wall thickness, which portions are provided with opposed slots within which a solid reinforcing bar 104 is intimately fitted, the bar being secured in the blade by a bolt 106 or the like, and the bracket 24 being secured to the reinforced portion of the blade by a bolt 108 or the like. Directly above the insulator stack, or the portion of the bracket to be secured to the stack, the portions 102 of the blade are provided with aligned cylindrical bores 110 which are aligned with the axis of rotation of the insulator stack, the bracket and the blade. The bar 104 is not bored, so that the resultant effect is the provision of opposed bores in opposite sides of the switch blade. In the bottom of each bore, i.e., in the opposite sides of the bar 104 in alignment with the bores, a silver coated inlay 112 is provided to insure optimum electrical interchange, as will become apparent as the description proceeds.
end of the knee blade in the case of the connector 36) is bifurcated, the bifurcations 114 thereof extending in spaced parallel relation to one another perpendicular to the axis of rotation of the insulator and the bracket. As shown, the switch blade extends between the bifurcations 114, in parallel relation thereto, and terminates within the same. Each bifurcation of the terminal pad for knee blade) is provided with an aperture therethrough, the apertures being aligned with one another, with the bores 110 and with the axis of rotation of the insulator and the bracket. A cylindrical contact 116 is secured within, suitably threaded into, each aperture and includes a portion extending into and forming the adjacent bore 110 of each blade. Each contact 116 is provided with a convex outer end to engage substantially solely at a point in the bottom of the respective bore 110 with the respective silver contact 112, which points of contact are aligned axially with the said bores and apertures, and thus with the axis of rotation of the insulator and the bracket. Each contact 116 is also provided with a circumferential groove 118 in the portion thereof received within the respective bore 110, and a plurality of ball bearings 120 are positioned in each groove 118 to bear against the contact and the wall of the cylindrical bore 110 thus to mount the contacts 116 in the bores in the blade for rotation, and also for such axial movement as may be necessary. The cylindrical bores 110, and the circumferential grooves 118, may be formed and finished in any suitable manner to afford a smooth bearing surface engageable with the ball bearings 120. To shield the bores, the bearings and the contacts from entry of dust, moisture and other contaminants, seals 122 are provided, the seals being in the form of dished spring washers having a relatively weak spring characteristic. The springs are confined, respectively, between the inner surface of the respective bifurcation 114 and the adjacent surface of the switch blade. Specifically, each spring engages at its convex surface, adjacent its inner edge, against the adjacent bifurcation and around the contact 116 and at its outer edge engages the portions of the blade around the bore 110, thus to seal the bore.

The terminal pad (or knee blade) also includes spring means for forcibly biasing the bifurcations 114 toward one another, thus to exert a substantial compressive force on the contacts. To this end, a headed tie rod 124, suitably formed of bolt and nut, is extended between and through the bifurcations 114 in spaced parallel relation to the axis of the bores 110 and apertures, and in spaced relation to the rearward end of the switch blade, and a spring 126 is confined between each head of the tie rod and the extended end face of the adjacent bifurcation. Preferably, each spring 126 comprises a pair of opposed spring cup washers, suitably formed of Phosphor bronze. Rearwardly of the springs and bifurcations, a lug pad 128 is formed integrally with the bifurcations to accommodate attachment to the pad of a line terminal.

To insure optimum conductivity, the terminal pad, switch blade and reinforcing bar 104 are preferably formed of copper or other metals or alloys having high conductivity characteristics. The contact inlays 112 are preferably formed of silver, and the contacts 116 may be formed of copper, silver, or a copper base having a silver tip portion. The springs 126 force the contacts 116 into high pressure engagement with the contact inlays 112 on the blade, so that efficient electrical connection, capable of carrying line load, is effected between the blade and contacts even though contact area comprises only two points of contact in said assembly, but not only affords the known advantages of high pressure-small area contacts, but also offers exceedingly little resistance to relative rotation of the contacts and the blade. The anti-friction ball bearing means serve, in conjunction with the point contacts, rotatably and slidably to support the contacts in the blade, likewise with exceedingly little resistance to relative rotation.

Due to the disposition of the contacts and bearings in axially alignment with the axis of rotation of the insulator, bracket and blade, movement of the terminal pad with respect to the remainder of the structure is purely rotational, and the contacts constitute the axis of rotational movement. Thus, the contact assembly comprises both the electrical and the mechanical connection between the blade and terminal pad, in which connection mechanical resistance to relative rotation is exceedingly low, thereby to meet the requirements of the art and satisfy the objects set forth hereinbefore.

Moreover, the construction of the swivelled connector is so sturdy as to eliminate any necessity for mechanical connection of the terminal pad to the insulator stock, so that the contacts and bearings engaging in the bores in the blade constitute the sole connection of the blade and terminal pad.

As is to be appreciated from the foregoing, the swivel connection at 34 in the switch shown in Figures 1 and 2, and the swivel connection at 74 and 76 in the switch shown in Figures 3 and 4, are effected exactly in the manner shown in Figures 5 and 6, while the swivel connection at 36 in the switch shown in Figures 1 and 2 is effected with exactly like construction and assembly, as shown in Figures 5 and 6, of the blade end, the contacts, the bearings and the bifurcations of the end portion of the knee blade 32. Other similar electrical connections may likewise be effected with the said assembly.

While I have shown and described what I regard to be preferred embodiments of my invention, it will be appreciated that various changes, rearrangements and modifications may be made therein without departing from the scope of the present invention, as defined by the appended claims.

I claim:

1. An electrically conductive swivel connector for side break switches and the like, comprising a first conductor having a bifurcated end portion, the bifurcations of said first conductor having aligned apertures therein, a second conductor including an end portion projecting between the bifurcations of said first conductor, said end portion of said second conductor having aligned apertures in the opposite sides thereof aligned with the apertures in the bifurcations of said first conductor, a contact mounted in the aperture in each bifurcation of said first conductor, said contacts extending axially into said bores in said second conductor and having clearance relative to the side walls of said bores, said contacts each having an outer end engaging said second conductor at the bottom of the respective bore solely at a point aligned with the axis of said bores and said apertures, an anti-friction bearing positioned in each bore and rotatably mounting the respective contact therein for rotation about the axis of said bores and said apertures, and spring means biasing said bifurcations of said first conductor toward one another thus to exert a compressive force on said contacts to maintain high pressure, low friction, point contact between said second conductor and said contacts, said point contacts and said bearings rotatably mounted said first conductor on said second conductor, said contacts and said bearings comprising the sole connection between said conductors and connecting said conductors both mechanically and electrically.

2. An electrically conductive swivel connector for side break switches and the like, comprising a first conductor having a bifurcated end portion, the bifurcations of said first conductor having aligned apertures therein, a second conductor including an end portion projecting between the bifurcations of said first conductor, said end portion of said second conductor having aligned apertures in the opposite sides thereof aligned with the apertures in said bifurcations, a cylindrical contact mounted in the aperture in each bifurcation, said cylindrical contacts being freely positioned respectively in said bores in said second conductor and each having an outer end engaging...
the second conductor at the bottom of the respective bore solely at a point aligned with the axis of said bores and apertures, each of said cylindrical contacts having a circumferential groove in the portion thereof positioned in the respective bore, a plurality of ball bearings positioned in the groove of each cylindrical contact and bearing against the cylindrical wall of the respective bore rotateably to mount said cylindrical contacts in said bores, and spring means on said first conductor exerting a compressive force on said bifurcations and thus on said cylindrical contacts to maintain high pressure, low friction, point contact between said conductors, said point contacts and said bearings rotatably mounting said conductor and comprising the sole connection therebetween.

3. An electrically conductive swivel connector for side break switches and the like, comprising a first conductor having a bifurcated end portion, the bifurcations of said first conductor having aligned apertures therein, a second conductor including an end portion projecting between said bifurcations, said end portion of said second conductor having aligned apertures in the opposite sides thereof aligned with the apertures in said bifurcations, a contact mounted in the aperture in each bifurcation, said contact being securely positioned in said bifurcation and in said second conductor and each having an outer end engaging the second conductor at the bottom of the respective bore solely at a point aligned with the axis of said bores and apertures, anti-friction bearing means rotatably mounting said contacts in said bores, a headed tie rod extending between and through said bifurcations in spaced parallel relation to the axis of said bores and apertures and in spaced relation to the end of said second conductor, and a pair of opposed spring cup washers confined between the head at each end of said tie rod and the outer side of the adjacent bifurcation to exert a compressive force on said bifurcations and thus on said contacts to maintain high pressure, low friction, point contact between said conductors, said point contacts and said bearings rotatably connecting said conductors and comprising the sole connection therebetween.

4. In a side break switch having a rotatable insulator, a switch blade carried by the insulator and a terminal pad to be supported for rotation with respect to the insulator and blade and to be electrically connected to the blade, the improvement comprising providing the provision of a terminal pad having a bifurcated end portion, the bifurcations of said pad having aligned apertures therein aligned with the axis of rotation of the insulator, a switch blade including an end portion projecting over the insulator between and parallel to the bifurcations of said pad, a bracket secured to said blade in spaced relation to said end portion and connecting said blade to the insulator, said end portion of said switch blade having aligned cylindrical bores in the opposite sides thereof aligned with the axis of rotation of the insulator and the apertures in said bifurcations, a cylindrical contact mounted in the aperture in each bifurcation of said pad, said cylindrical contacts being freely positioned respectively in said bores in said blade and each having a convex outer end engaging the blade at the bottom of the respective bore solely at a point aligned with the axis of rotation of the insulator, each of said cylindrical contacts having a circumferential groove in the portion thereof positioned in the respective bore, a plurality of ball bearings positioned in the groove of each cylindrical contact and bearing against the cylindrical wall of the respective bore rotateably to mount said cylindrical contacts in said bores, a headed tie rod extending between and through said bifurcations in spaced parallel relation to the axis of rotation of the insulator and in spaced relation to the end of said terminal pad and the outer side of the adjacent bifurcation to exert a compressive force on said bifurcations and thus on said cylindrical contacts to maintain high pressure, low friction, point contact between said conductors, said point contacts and said bearings rotatably mounting said pad on said blade and comprising the sole connection of said pad to said blade and insulator.

5. An electrically conductive swivel connector for side break switches and the like, comprising a first conductor having a bifurcated end portion, the bifurcations of said first conductor having aligned apertures therein, a second conductor including an end portion projecting between and parallel to the bifurcations of said first conductor, said end portion of said second conductor having aligned cylindrical bores in the opposite sides thereof aligned with the apertures in the bifurcations of said first conductor, a silver contact on said first conductor in the bottom of each of said bores, a cylindrical contact of a diameter less than that of said bores mounted in the aperture in each bifurcation of said first conductor, said cylindrical contacts being freely positioned respectively in said bores in said second conductor and each having a convex outer end engaging the respective silver contact solely at a point aligned with the axis of said bores and said apertures, each of said cylindrical contacts having a circumferential groove in the portion thereof positioned in the respective bore, a plurality of ball bearings positioned in the groove of each cylindrical contact and bearing against the cylindrical wall of the respective bore rotateably and slidably to mount said cylindrical contacts in said bores, a seal for each of said bores including an annular spring disposed between the respective bifurcation of said first conductor and the cylindrical contact mounted therein and the adjacent surface of said second conductor surrounding the adjacent bore to close the bore and seal the cylindrical contact and the ball bearings therein, a headed tie rod extending between and through said bifurcations of said first conductor in spaced parallel relation to the axis of rotation of the insulator and said apertures and in spaced relation to the end of said second conductor, and a pair of opposed spring cup washers confined between the head at each end of said tie rod and the outer side of the adjacent bifurcation to exert a compressive force on said bifurcations and thus on said contacts to maintain high pressure, low friction, point contact between said conductors and said contacts, said point contacts and said bearings rotatable mounting said first conductor on said second conductor and comprising the sole connection of said conductors.

6. In a side break switch having a rotatable insulator, a switch blade carried by the insulator and a terminal pad to be supported for rotation with respect to the insulator and blade and to be electrically connected to the blade, the improvement comprising providing the provision of a terminal pad having a bifurcated end portion, the bifurcations of said pad extending generally perpendicular to the axis of rotation of the insulator and having aligned apertures therethrough aligned with the axis of rotation of the insulator, said terminal pad including a pad lug formed integrally with said bifurcated end portion for direct connection to a line, a tubular switch blade extending perpendicular to the axis of rotation of the insulator and including an end portion projecting over the insulator between and parallel to the bifurcations of said pad, a bracket secured to said blade in spaced relation to said end portion and connecting said blade to the insulator, said end portion of said switch blade being rotatably thick and having a bore therethrough aligned with the axis of rotation of the insulator and the apertures in the bifurcations of said pad, an imperfect bar secured in said end portion of said blade in the region of said bore to define thereby a pair of aligned bores in the opposite sides of said blade, a pair of silver contacts on opposite sides of said blade each disposed in the bottom of one of said pair of bores, a cylindrical contact mounted in the aperture in each bifurcation of said pad, said cylindrical contacts being freely positioned respectively in said bores in said blade and each having a convex outer end engaging the respective silver
contact solely at a point aligned with the axis of rotation of the insulator, each of said cylindrical contacts having a circumferential groove in the portion thereof positioned in the respective bore, a plurality of ball bearings positioned in the groove in each cylindrical contact and bearing against the cylindrical wall of the respective bore rotatably to mount said cylindrical contacts in said bores, a seal for each of said bores including an annular spring disposed between the respective bifurcation of said pad and the cylindrical contact mounted therein and the adjacent surface of said blade surrounding the adjacent bore to close the bore and seal the cylindrical contact and the ball bearings therein, a headed tie rod extending between and through said bifurcations of said pad in spaced parallel relation to the axis of rotation of the insulator and spaced relation to the end of said blade, and a pair of opposed spring cup washers confined between the head at each end of said tie rod and the outer side of the adjacent bifurcation to exert a compressive force on said bifurcations and thus on said cylindrical contacts to maintain high pressure, low friction point contact between said blade and said contacts, said point contacts and said bearings rotatably mounting said pad on said blade and comprising the safe connection of said pad to said blade and insulator.

References Cited in the file of this patent
UNITED STATES PATENTS
2,227,925 Cornell et al. ------------ Jan. 7, 1941