This invention relates to an electrical swivel connector.

In general, said connectors are of two kinds, one being the so-called "ball" type which is occasionally referred to hereinafter as an "unrestricted" connector, and the other the so-called "restricted" connector. The fundamental difference between these is that in an unrestricted, i.e., ball, connector, one member can experience rotational movement with respect to another member about any one of three intersecting rectangular axes, that is to say, true "swiveling" movement, whereas in the restricted connector, one member can experience rotational movement with respect to the other about only a single transverse axis, an additional mode of rotation being provided by a second joint that permits rotation about an axis running longitudinally of the connector. Because of the compound movement permitted by the two joints, a restricted connector has come to be known as a "swivel" connector.

For various reasons, although ball connectors are less expensive, simpler and more compact, the trade prefers restricted, i.e., "swivel" connectors. However, a certain basic difficulty arises in connection with the latter. The members which experience mutual relative movement about the single axis have connecting bores for passage of a wire, so that when the angle of rotation approaches 90°, the end of the bore in one of the members will be exposed. Since this is unsightly and otherwise undesirable, heretofore various elaborate mechanical arrangements have been devised to permit the requisite 90° mutual rotation to be experienced without exposing said bore. Despite the comparatively complex and cumbersome structure that ensued, such restricted connectors have found favor in the public eye.

It is an object of my invention to provide an improved and simplified restricted (swivel) connector which permits the desired 90° rotation to take place without the provision of any additional mechanical part for concealing the aforesaid bore.

As noted above, in previous restricted (swivel) connectors, it has been customary to provide the needed second mode of rotation by a second joint at an end of the connector remote from the restricted joint. It is another object of my invention to modify the aforesaid second joint whereby to allow a restricted (swivel) connector to experience 90° rotation without the utilization of any extra part at the restricted joint.

It is a further object of my invention to provide an electric swivel connector of the character described, which is durable and inexpensive, and which lends itself to mass production.

Other objects of my invention in part will be obvious and in part will be pointed out hereinafter.

My invention accordingly consists in the features of construction, combinations of elements and arrangements of parts, which will be exemplified in the electric fitting hereinafter described, and of which the scope of application will be indicated in the appended claims.

In the accompanying drawings in which is shown one of the various possible embodiments of my invention,

FIG. 1 is a side elevational view in partial section of an electric swivel connector constructed in accordance with my present invention and having the parts thereof arranged in alignment;

FIG. 2 is a side view of said connector, showing in full lines the parts rearranged to swing 90° to the left, and in dot-and-dash lines the parts rearranged to swing 90° to the right;

FIG. 3 is a top view of said connector, showing in full lines the parts rearranged to swing 90° to the left, and in dot-and-dash lines the parts similarly arranged but displaced approximately 30° in azimuth;

FIG. 4 is a front elevational view to a reduced scale of said swivel connector; and

FIG. 5 is an exploded perspective view of the swivel connector.

Referring now in detail to the drawings, the reference numeral 19 denotes my new electric swivel connector. Said connector includes an elongated casing 12 of tubular, i.e., hollow, open-ended, contour. More particularly, the casing is formed adjacent its lower end to the shape of a cylindrical portion 14, the axis of symmetry of which is coincident with the longitudinal axis of the casing. The lower edge of the cylindrical portion is inturnd to provide a flange 16 that defines a large constricted bottom opening 18 of somewhat smaller diameter than that of the cylindrical portion.

Above the cylindrical portion 14 the casing 12 flares outwardly at a comparatively small angle, e.g., in the neighborhood of 8°, providing thereby a conoidal part 20. The top of the conoidal part runs smoothly into an upper mutilated cylindrical portion 22. Said portion 22 includes two curved sections 24 (see FIG. 5) joined by parallel flats 26. The curved sections are parts of a true cylinder and would conjointly define a single true cylinder except for the interruption, i.e., mutilation, of the parallel flats 26. For design appearance, the flats may be continued down the conoidal portion 20, tapering in width as they approach the lower cylindrical portion 14.

The upper cylindrical portion 22 mounts at its top end an upper spherical segment 28. Said spherical segment is a smooth continuation of both the curved sections 24 and the flats 26. The spherical segment 28 terminates at a constricted top opening 30 of lesser diameter than the upper cylindrical portion 22, so that both the top and bottom ends of the casing 12 are constricted and thereby will capitally retain therein objects of slightly larger diameter than said ends.

It will be appreciated that all of the sundry parts of the casing jointly comprise a simple piece, the casing preferably constituting a one-piece tub of sheet metal which has been appropriately shaped by suitable dies to assume the configuration described. It also should be mentioned at this point that such configuration is not entirely imparted until the last stage in the assembly of the electric swivel connector. More particularly, the flange 16 is provided before assembly and the spherical segment 28 is spun to its final form as the last stage in assembly, having theretofores constituted simply an extension of the cylindrical portions 22. This operation will be described in somewhat greater detail hereinafter.

The electric swivel connector 10 further includes a ball 32 which may, if desired, constitute, as illustrated, a die-casting, although it is within the scope of my invention to manufacture the same by turning or from sheet metal by a series of forming operations. Said ball includes a hollow spherical portion 34 from one side of which extends, preferably thereto as a single piece, a threaded tubular shank 36, a flange 38 being provided at the base of the shank where it joins the spherical portion. The flange is formed with a pair of diametrically opposed parallel flats 40 to assist in coupling the shank to a threaded female part. The bottom of the spherical portion is formed with a large opening 42 for passage of a wire extending through the connector. The spherical portion 34 includes a pair of diametrically opposed flats 44 at the ends of a major diameter of the ball perpen-
dicular to the longitudinal axis of the shank 35. Said ball has a diameter substantially equal to the diameter of the internal surface of the upper spherical segment 28.

The ball is located within the casing 12 at the upper end thereof, and is seated in the spherical segment 28 with the threaded shank 36, the flange 38, and the adjacent portion of 34 protruding from the top opening 30 of the casing, and with the flats 44 rotatably resting against the inner surfaces of the flats 25. It will be observed that at diametrically opposite edges of the upper opening 30, the upper spherical segment 28 is deeply notched at 46. The location of these notches with respect to the center of the spherical portion 34 is such that the neck 48 between the flange 38 and the spherical portion will abut said notches to confine the extremes of movements of the shank 36 with respect to the casing to an angular range less than 180°. More particularly, this range is sufficiently below 180°, e.g. about 90°, to prevent the opening 42 from being exposed as the ball turns. It further will be observed that the cooperation between the flats 25 and 44 restricts rotation of the ball with respect to the casing to turning movement about a single axis that is perpendicular to the longitudinal axis of the shank 36, and is perpendicular to the flats 25, 44, is coincident with a major axis of the spherical portion 34, and is substantially centered in the flats 44. As soon will be seen, the ball 32 is biased against the upper end of the casing, so that it can turn, subject to stop limits, in the manner aforesaid.

The portion of the ball 32 located within the casing 12 rests on an open-ended thimble 50. Said thimble is in the form of a sheet metal cup, the major portion of which constitutes a cylindrical side wall 52 having an out-turned annular spherically segmented flange 54 at its upper end. Preferably the flange is shaped to match the curvature of the spherical portion 34, so that there is a nice fit between these parts. Adjacent its base the thimble is provided with an in-turned shoulder 56 running into a short tubular projection 58 co-axial with the side wall 52.

The biasing action above described is furnished by an open-ended helical compression spring 60, the upper end of which telescopically receives the short tubular projection 58. It is apparent from the drawings that the thimble 50 is located within the casing 12, and that the spring 60 which biases the thimble against the ball, and the ball in turn against the constricted upper end of the casing, likewise is located internally of the casing.

I further provide an open-ended ferrule 62 constituting a tubular sleeve 64 having a frusto-conical outwards extending flange 66 at its lower end. The sleeve 64 is of proper diameter to telescopically fit within the lower end of the spring 60. The flange 66 terminates in a large diameter short tube 68. The lower end of the spring 60 telescopically receives the tubular sleeve 64 and bears against the flange 66.

Pursuant to my invention, I provide an unrestricted type joint 70 at the lower end of the casing, that is to say, a joint which permits rotation about three intersecting rectangular axes, in other words, a true swivel joint. This joint does have a different kind of restriction, which I will refer to hereinafter as a "limitation," in that rotation about two of these axes is limited to approximately 45° to either side of center, i.e., about 90° through center, and about the third axis to less than 360°.

I obtain the desired action by utilizing a second ball 72 which, desirably, is manufactured in the same manner as the first ball 32, that is to say, preferably by die-casting, although optionally by any other mode of fabrication. The ball 72 includes a hollow spherical portion 74 from which there extends a threaded tubular shank 76 provided with the usual shoulder 78, the latter being connected to the spherical portion at a neck 80. The top of the spherical portion is formed with a large opening 82 for passage of a wire extending through the joint. For a purpose which soon will be apparent, I mutilate the surface of the spherical portion 74 along a great circle zone running in a general direction from the opening 82 toward the shank 76. This mutilation may take the form of a raised ridge, a flat or a groove, and herein constitutes a groove 84 lying on a great circle of the spherical portion 74. The upper end of the groove short of the opening 82. The lower end of the groove stops short of the neck 80.

The frictional conical flange 66 seats the spherical portion 75 of the ball 72 and said flange bears against said spherical portion under the force exerted by the spring 60. Another point is that said balls 32, 72 in opposite directions against the constricted opposite ends of the casing 12.

The tube 68 is of such dimension that it fits nicely around the spherical portion of the ball 72 and fits nicely into the cylindrical portion 14 of the casing said spherical portion also is seated, under the pressure of the spring 60 (transmitted through the ferrule 62), against the bottom opening in the casing. Thereby the ferrule is mounted to turn about the longitudinal axis of the casing and the ball is mounted to turn in like manner and also to swivel about a point on this axis at the spherical portion 74. The ferrule 62 includes an internally protruding lug 86 the surface whereof is shaped to ride smoothly in the groove 84. The lug is located on the tube 68 at any point in a plane perpendicular to the longitudinal axis of the casing and intersecting the spherical portion 74 so that it is disposed at an end of a major diameter of the spherical portion 74 of the lower ball. The ferrule 62 additionally is provided with an erect rotating stop arm 88 which rides along, i.e., adjacent, the inner surface of the cylindrical portion 14 of the casing part. Said portion has an inwardly protruberant boss 90 in the path swept by the arm 88.

Before assembly of the parts, the casing 12 has an unconstricted top end, that is to say, the upper spherical segment 28 has not yet been formed but the flange 16 already has been provided. At this time, the upper end of the casing constitutes an unmodified continuation of the upper cylindrical portion 22, including the curved sections 24 and the flats 26. The various parts are inserted into the casing in the order shown in FIG. 1, that is to say, the ball 72 is seated in the opening 18 with the shank 76, flange 78, neck 80 and the adjacent portion of the spherical portion 74 protruding from the lower open end of the casing.

Next, the ferrule 62 is placed atop the ball with the lug 56 riding in the groove 54 and the spring 60 is seated on the sleeve 64 of the ferrule. The tube 68 is located between the ball 72 and the cylindrical portion of the casing so that the ball is rotatably engaged between the ferrule 62 and the lower end of the casing. Next the thimble 50 is set on the spring 60, with the tubular projection 58 inside the spring. Finally, the ball 32 is seated on the thimble 50.

At this time, due to the lengths of the sundry parts in a direction parallel to the longitudinal axis of the casing, the ball 32 will be too high in the casing. Accordingly, the spring 60 is compressed by forcing the ball 32 downwardly until it is located at its proper position within the casing. Then, with suitable spinning machinery, the spherical segment 28 is formed, thereby constructing the upper end of the casing and captivating all of the parts therein. Spinning the upper segment 28 provides a spherical seat for the upper ball 32. The flange 16 furnishes a swivel seat for the lower ball 72.

When the two balls 32, 72 are angularly arranged so that their respective shanks 36, 76 are co-axial, as shown in FIG. 1, an electric wire can be threaded in a straight line through the connector 10. Thus, referring to FIG. 1, it will be seen, reading from top to bottom, that aligned straight openings are formed in the ball 32, the thimble 50, the spring 60, the ferrule 62, and the ball 72.
The upper ball 32 is capable of restricted movement, that is to say, movement about a single axis, perpendicular to the longitudinal axis of the casing between an in-line position (the position shown in FIG. 1) and two extreme angular positions (shown in FIG. 2), in one of which the neck 48 will abut one of the notches 46, in the other of which the neck will abut the opposite notch. As mentioned earlier, the notches are so arranged that in neither of these extreme positions will the opening 42 be exposed. However, because of this limitation of movement about a single peripheral axis, the upper ball 32 is not capable of swinging up to 90° to both sides with respect to the longitudinal axis of the casing, the actual extremes of movements being about 45° as indicated in FIG. 2. It is in order to compensate for this limitation that I have provided in connection with the restricted joint at the upper end of the casing, an unrestricted second joint, albeit of limited movement, at the lower end of the casing.

At the lower end of the casing, the ball 72 can experience several modes of movement, all of which are limited, that is to say, the ball has unrestricted (true swivelling) limited movement. Thus, said ball is able to turn about one horizontal axis (assuming the connector to have its longitudinal axis vertically oriented), this being the axis perpendicular to the plane of the diametrical groove 84. When this turning movement is experienced, the lug 86 rides in the groove 84. Additionally, the ball can turn about a second horizontal axis at right angles to and intersecting the foregoing axis, that is to say, about a horizontal axis running from the lug 86 to the longitudinal axis of the casing. Such movement is permissible because the lug 86 is located to lie approximately at the end of a major diameter of the ball 72. Furthermore, the ball can turn about an axis coincident with the longitudinal axis of the casing. This latter movement is accompanied by movement of the ferrule 62 to which the ball is keyed by the lug and groove. Such latter turning about the axis of the casing causes the stop arm 88 to swing about the inside of the casing.

It now will be apparent that movement of the lower ball 72 with respect to the casing can take place about three intersecting axes and therefore is of the so-called unrestricted type. Although the angular movement is unrestricted, it is limited in extent to prevent cutting of the wire which extends through the lower joint, twisting of said wire, or exposure of the opening 32. Movement of the ball 72 with respect to either of the two horizontal axes above described is limited by abutment of the neck 80 against the edge of the opening 18. Additionally, rotation of the ball about the horizontal axis perpendicular to the plane of the groove 84 is limited by abutment of the lug 86 against the shoulders at the ends of the groove. Rotation of the ball about the longitudinal axis of the casing is limited by abutment of the stop arm 88 against the boss 90.

The parts are so dimensioned that the upper ball 32 can swing about 45° to either side of the longitudinal axis of the casing, and so that the lower ball 72 likewise can turn about 45° to either side of the longitudinal axis of the casing. These two angles are complementary, i.e., add up to 90°, so that if both balls are turned in the same direction to their extreme limits, the longitudinal axis of the shank 36 will be perpendicular to the longitudinal axis of the shank 76, as illustrated in full lines in FIG. 2. If it is desired to swing the upper shank 36 to its diametrically opposed position, as shown in dot-and-dash lines in FIG. 2, the two balls are swung to their opposite extreme limits, or the casing is turned 180° about the vertical axis of the lower ball 72, this latter motion being illustrated in FIG. 3. It will be appreciated by those skilled in the art that the limitation upon the last-mentioned movement, by abutment of the stop arm and boss, will prevent the wire that passes through the connection from being twisted to the point of breaking.

It thus will be seen that I have provided an electric swivel connector which achieves the various objects of my invention, and is well adapted to meet the conditions of practical use. As various possible embodiments might be made of the above invention, and as various changes might be made in the embodiment above set forth, it is to be understood that all matter herein described or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense. Having thus described my invention, I claim as new and desire to secure by Letters Patent:

An electric swivel connector comprising an open-ended hollow elongated casing having seats at opposite ends thereof, said casing having a pair of diametrically opposed flats near one of the seats and a cylindrical portion near the other seat, the cylindrical portion having an axis coincident with the longitudinal axis of the casing, a first hollow open-ended ball having diametrically opposed flats engaging the flats in the casing, said ball being seated in the seat near the flats in the casing whereby said first ball is mounted in said casing for rotation relative thereto only about a single axis transverse to the length of the casing, said ball having a shank extending therefrom and protruding from said casing to limit such rotation of the ball about said single axis to an arc less than 180°, a second hollow open-ended ball, a tubular member rotatable in the cylindrical portion of the casing, the second ball being seated against the second seat of the casing, cooperating means in the second ball and tubular member for limiting rotation of the second ball relative to the tubular member to an axis transverse to the length of the casing, whereby said second ball is mounted in the casing for rotation about three rectangular axes one of which is parallel to the length of the casing, said second ball having a shank extending therefrom and protruding from said casing to limit such rotation of the second ball about two of said rectangular axes other than the parallel axis to an arc less than 180°, means to limit rotation of the tubular member with respect to the casing to an arc exceeding 180° and less than 360° whereby rotation of the second ball relative to the casing about the parallel axis is similarly limited, and hollow open-ended spring means forcing said balls apart.

References Cited in the file of this patent

UNITED STATES PATENTS

1,665,810 Gillick September 20, 1928
1,927,703 Glowacki September 19, 1933
2,882,730 Berger December 2, 1958
2,887,329 Blakely May 19, 1959
3,012,798 Berger December 12, 1961