

[54] ELECTRICAL CONNECTORS

[72] Inventors: Marvin E. Hartz, Grosse Pointe Farms; Anthony J. Taormina, Detroit; Stephen J. Grebik, Roseville, all of Mich.

[73] Assignee: Essex International, Inc., Fort Wayne, Ind.

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[56] References Cited

UNITED STATES PATENTS

1,520,485	12/1924	Singleton.....	339/14 L
3,183,030	5/1965	Schlvetter.....	292/303
3,178,674	4/1965	Scheller.....	339/217
2,972,728	2/1961	Cole.....	339/64
606,914	7/1898	Bragger.....	287/87

3,312,931	4/1967	Keller.....	339/258
1,014,148	1/1912	Heller.....	24/230 SL
937,052	10/1909	Cuno.....	339/100
1,039,392	9/1912	Heinze.....	339/252
1,789,935	1/1931	Cadieux.....	339/253
1,975,999	10/1934	Young.....	339/253
2,752,726	7/1956	Calverley.....	46/22

Primary Examiner—James A. Leppink

Assistant Examiner—Robert A. Hafer

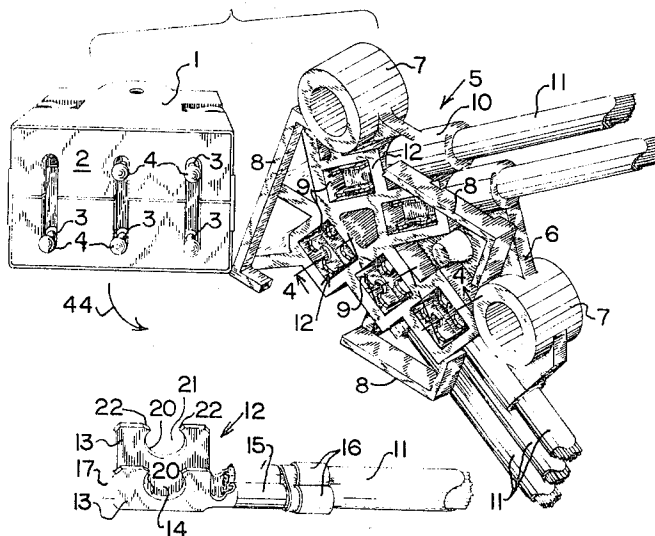
Attorney—Learman & McCulloch

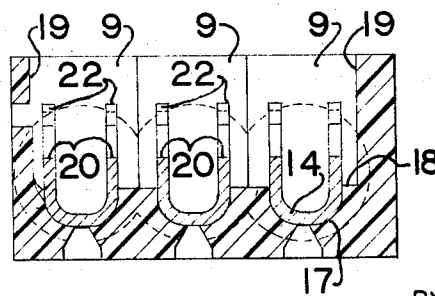
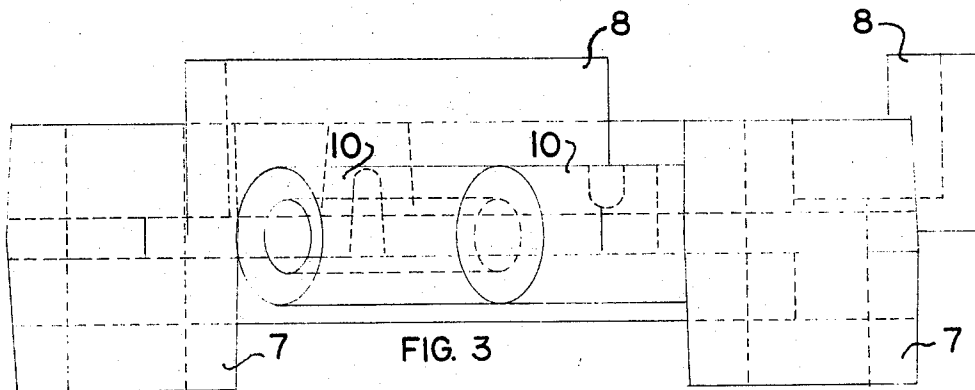
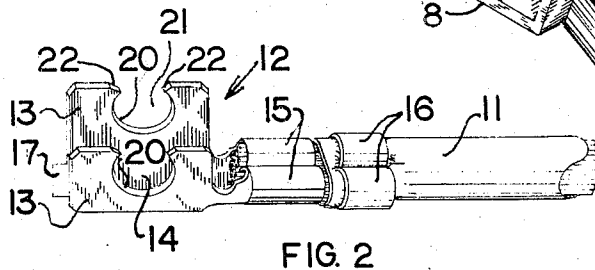
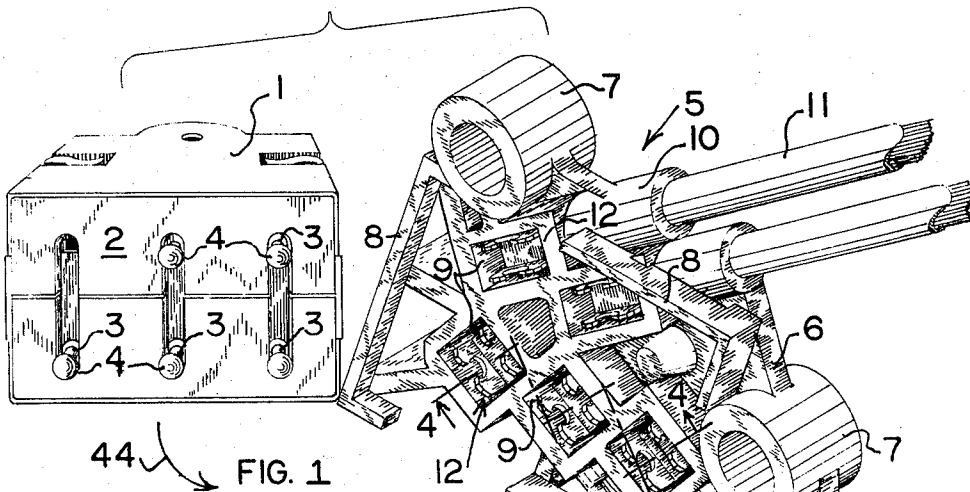
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ABSTRACT

An electrical connector assembly comprises a spherical or ball terminal and a socket adapted to receive the ball and having a substantially U-shaped configuration including a pair of opposed sides or arms spaced apart a distance less than the diameter of the ball, each of the arms having an opening therein of smaller diameter than that of the ball. Preferably, each of the arms of the socket has a slot which communicates with its associated opening, each slot including an inwardly tapering throat portion which functions to guide the ball terminal into the openings.

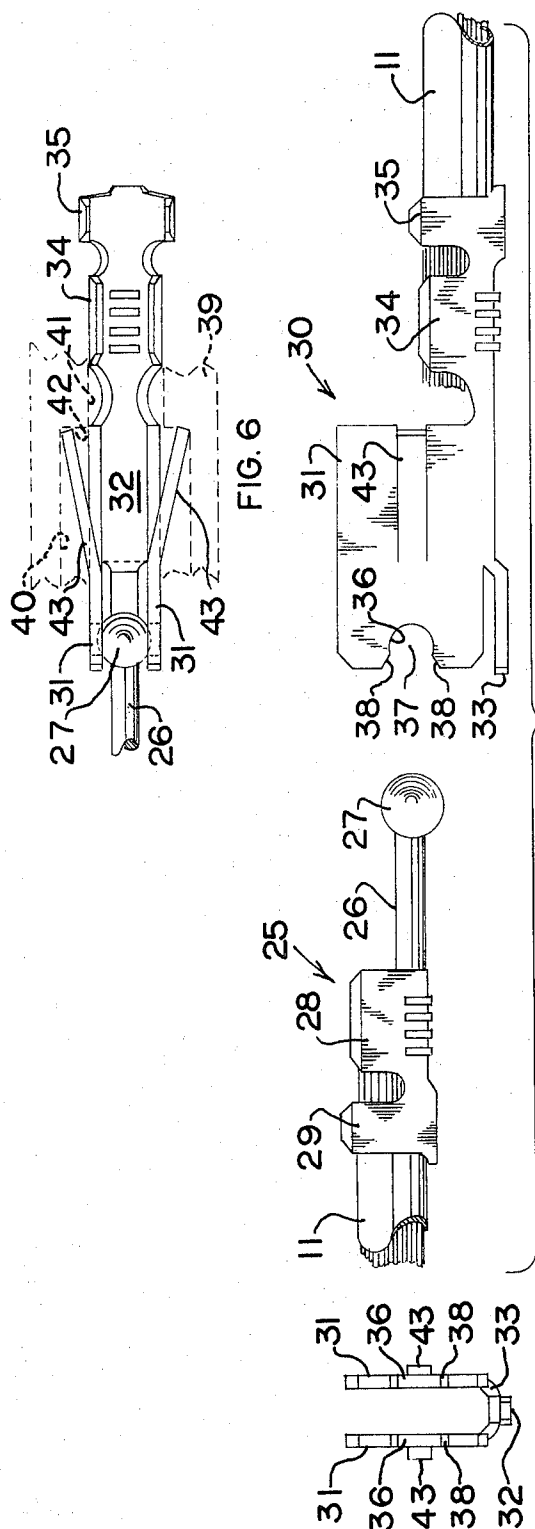
8 Claims, 7 Drawing Figures





INVENTORS
MARVIN E. HARTZ
ANTHONY J. TAORMINA
STEPHEN J. GREBIK

BY *Harman & Cullloch*



INVENTORS
MARVIN E. HARTZ
ANTHONY J. TAORMINA
STEPHEN J. GREBIK

BY *Herbert W. Schuch*

ELECTRICAL CONNECTORS

The invention disclosed herein relates to plug and socket type connectors wherein the plug or pin has one or more round-head terminals adapted to be accommodated in substantially U-shaped sockets each of which includes a pair of resilient, spaced apart spring arms between which the round head of a terminal may be accommodated. Connectors of the kind disclosed are especially adapted for the connection of switches to a circuit and for in-line terminal connections, but have other uses as well.

Connector assemblies of the general class to which the invention relates have been proposed heretofore, but not all of them have been satisfactory for a number of reasons. For example, it is possible with conventional pin and socket connector assemblies to obtain a false or insecure coupling with the result that the pin and socket separate in use. This problem is aggravated in those instances in which the pin terminal must be engaged forcibly with its socket, and particularly if the pin or the socket is somewhat malformed or has burrs which prevent proper seating of the parts without the application of excessive force. Even in those instances in which pin type terminals fit perfectly within their sockets, considerable care must be exercised to assure that the pins are aligned axially with the sockets so as to avoid bending of the pins or of the sockets. Conversely, it is equally important that conventional pin and socket connectors be disassembled in such manner as to avoid bending of the pins and sockets. As a consequence, it frequently is impossible to connect or disconnect the connectors of conventional design without rendering them unsuitable for further use.

An object of this invention is to provide a pin and socket electrical connector construction which overcomes the disadvantages of prior constructions referred to above.

Another object of the invention is to provide pin and socket type terminal connectors which fit together with a snap action which may be felt by the assembler so as to avoid false or imperfect connections.

A further object of the invention is to provide a connector assembly of the character referred to wherein small imperfections in the terminal parts have no effect on their assembly.

Another object of the invention is to provide a pin and socket connector assembly wherein the pins may be seated in the sockets without necessitating axial alignment thereof.

Another object of the invention is to provide a connector assembly of the kind described which is simpler and more economical in manufacture than similar constructions presently in use.

Other objects and advantages of the invention will be pointed out specifically or will become apparent from the following description when it is considered in conjunction with the appended claims and the accompanying drawings, in which:

FIG. 1 is an isometric view of a switch casing provided with pin terminals adapted to be seated in sockets carried by a base member;

FIG. 2 is an enlarged, isometric view of a socket formed in accordance with one embodiment of the invention;

FIG. 3 is a fragmentary, enlarged, side elevational view of the base shown in FIG. 1, but with the wires omitted;

FIG. 4 is an enlarged, sectional view taken on the line 4—4 of FIG. 1;

FIG. 5 is an exploded view of a pin terminal and socket member constructed in accordance with another embodiment of the invention;

FIG. 6 is a top plan view, on a reduced scale, of the apparatus shown in FIG. 5 and in assembled relation, but with the wires removed from the socket member; and

FIG. 7 is an end elevational view of the socket member shown in FIG. 6.

The apparatus disclosed in FIG. 1 includes a switch casing 1 of known construction have a non-conductive bottom 2 through which projects a plurality of conductive pins 3 each of which terminates at its free end in a round head or spherical ball 4 of uniform diameter. Associated with the switch casing

1 is a base member 5 having a body 6 formed of electrically insulating material and which is adapted to be secured to a support by means of screws (not shown) which may pass through mounting ears 7. The body may be provided with upstanding rails 8 between which the switch casing 1 may be accommodated.

Formed in the body 6 is a plurality of chambers 9 having an open side or access opening. In communication with each chamber is a tubular fitting 10 for the accommodation of an insulated conductor 11. Joined to each conductor 11 and accommodated in the associated chamber 9 is a socket or terminal 12 formed of resilient, springy, conductive material. It will be understood that the member 5 is molded in place with the conductors 11 and the terminals 12 in accordance with conventional molding techniques.

Each terminal socket 12 is generally U-shaped and has a pair of substantially parallel arms 13 spaced apart from one another and joined by a web 14. At one end of the walls 13 are tabs 15 which may be rolled around the wire of the conductor 11 and additional tabs 16 which may grip the insulation of the conductor 11 in the conventional manner. At the opposite ends of the walls 13 the web 14 is extended to form a short tongue 17 which, in the molding of the body 5, extends under a wall forming the associated chamber 9 so as to retain the socket 12 snugly within the chamber.

As is best illustrated in FIG. 4, each chamber 9 has a base 17 in which the web 14 of the associated terminal 12 fits snugly and each base 17 has shoulders 18 from which extend side walls 19 of the chamber. Each of the terminal arms 13, therefore, is spaced from the associated side wall 19 of its chamber.

Each of the arms 13 of the terminal 12 is provided with an opening 20 of generally circular shape, the center of each opening being closer to the free edge of the arm than it is to the web 14. This construction provides for a substantial beam length between the web and the openings for a purpose presently to be explained. In communication with each opening 20 is a slot 21, the sides 22 of which converge in a direction inwardly from the free edge of the arm 13 to form an inwardly tapering throat communicating with the associated opening.

The spacing between the arms 13 of each terminal 12 is less than the diameter of the terminal balls 4, and the diameter of each opening 20 is less than the diameter of the balls 4. The difference between the diameter of a terminal ball 4 and the spacing between the terminal arms 13 need not be great, but the diameter of the ball should be sufficiently large as to flex the arms 13 away from one another to a noticeable extent in order to accommodate the ball 4 therebetween. The flexing of the arms 13 is possible because of the resilience of the material from which the member 12 is made and because of the spaces between the arms 13 and the sides 19 of the chamber 9. The difference between the diameters of the ball 4 and the openings 20 again need not be great, but the diameter of the openings 20 should be sufficiently smaller than the diameter of the ball 4 to assure gripping of the ball by the edges of the openings when the ball is accommodated in the openings.

Inasmuch as the diameter of the ball 4 is greater than the spacing between the terminal arms 13, the latter resists seating of the ball in the openings 20. Such resistance is lessened by the slots 22. The resilience of the arms is sufficient to enable them to seat on the ball with a snap action when the ball passes the narrowest portion of the inlet throat leading to the openings 20, and such snap action may be felt by the assembler.

When the ball is seated in the openings 20 any attempt to remove the ball from the socket 12 necessitates spreading apart of the arms 13. Although the ball terminal 4 may be removed from the socket 12, the resistance of the arms 13 to being spread apart requires the exertion of deliberate force on the terminals, thereby avoiding the likelihood of inadvertent separation of the terminals.

The embodiment of the invention disclosed in FIGS. 5-7 is similar to the earlier described embodiment, but constitutes as

in-line connector assembly. In this embodiment a pin-type terminal 25 has a shank 26 terminating at one end in a sphere or ball 27 and at its opposite end is provided with tabs 28 and 29 for connection to the component parts of an insulated conductor 11. The assembly also includes a socket member 30 having a pair of arms 31 spaced apart by a web 32 which terminates at its forward end in a locking tongue 33. At its opposite end the web 32 is provided with tabs 34 and 35 which may be secured to the component parts of another insulated conductor 11.

Those edges of the arms 31 adjacent the web 32 are free and are provided with generally coaxial, spherical openings 36. In communication with each opening 36 is a slot 37, the opposite sides 38 of which converge inwardly from the free edges of the arms 31 so as to provide an inwardly tapering throat leading to the openings 36. The diameter of the ball 27 is greater than the diameter of the openings 36 and also is greater than the spacing between the arms 31.

The terminal 30 is adapted to be accommodated in a non-conductive, tubular molded housing 39 provided with a chamber 40 in which the arms 31 and the web 32 are accommodated, the housing 30 having an opening 41 communicating with the chamber 40 for the accommodation of the conductor 11. A shoulder 42 is provided between the chamber 40 and the opening 41 and the arms 31 carry outwardly directed tangs or fingers 43 which seat against the shoulder 42 and thus maintain the terminal 30 in its assembled relation with the housing 39.

The terminal 25 may be assembled with the terminal 30 by presenting the ball 27 to the slots 37, whereupon the arms 31 will be spread apart so as to permit the ball 27 to pass through the slots into the openings 36. As the ball passes the narrowest portion of the inlet throat, the arms 31 will spring back toward one another with a snap action which may be felt by the assembler. The edges of the openings 36 will grip the opposite sides of the ball 27 securely, thereby assuring good electrical connection and preventing inadvertent separation of the terminals 25 and 30.

A particularly advantageous characteristic of connectors constructed in accordance with the invention is that the pin terminals may be presented to their sockets without first being precisely aligned therewith. This characteristic is illustrated in FIG. 1 wherein the pin terminals 3 supported by the switch casing 1 may be coupled to the socket members 12 by rotary movement of the body 5 in the direction of the arrow 44. As the member 1 is rotated toward seating relation, the ball terminals 4 will be presented to their respective socket members 12, whereupon the slots 21, together with the converging edges 22, automatically will guide the balls 4 into proper seating relation with their respective terminals 12. In like manner, presentation of the ball terminal 27 to the housing 39 need not require precise alignment of the ball 27 with the terminal 30 inasmuch as the slots 37 and the tapering walls 38 will guide the ball 27 into proper seating relation between the arms 31.

Another advantage of the disclosed construction is that movement of the pin terminal into the socket terminal effects wiping of the parts, thereby assuring good electrical connection.

The location of the ball-accommodating openings of the socket terminals should be such that there is a substantial distance between the web of the socket and the closest edge of the openings. This provides a substantial beam length between the openings and the web so as to effect better distribution of flexing forces applied to the arms upon movement of the ball

terminal into and out of the socket terminal.

Inasmuch as the socket terminals of the disclosed construction basically are U-shaped in configuration, they can be manufactured by considerably simpler and less expensive dies than are utilized in the manufacture of cylindrical or other socket members.

The disclosed embodiments are representative of presently preferred forms of the invention, but are intended to be illustrative rather than definitive thereof. The invention is defined in the claims.

We claim:

1. An electrical connector comprising a generally U-shaped socket member adapted to receive a ball terminal and having a pair of substantially parallel, spaced apart arms formed of resilient, electrically conductive material joined by a web, each of said arms having an opening therein, said openings being coaxial, each of said arms having a slot extending inwardly of said arm and terminating at the associated opening, said slots being parallel to one another, each of said slots having confronting edges which converge in a direction toward said opening and form a tapered throat communicating with the associated opening, the spacing between said arms, the diametral dimension of each of said openings, and the width of each of said throats being less than the diameter of a ball terminal adapted to be received by said socket member.

2. The connector set forth in claim 1 wherein the opening in each of said arms is located closer to a free edge thereof than to said web.

3. The connector set forth in claim 2 wherein said web joins said arms at the ends thereof remote from said free edges.

4. The connector set forth in claim 2 wherein said web joins said arms at the sides thereof adjacent said free edges.

5. An electrical connector construction adapted to receive a ball terminal comprising a body having at least one chamber therein, said chamber having an access opening leading thereto; and a conductive socket member accommodated in said chamber, said socket member having a pair of substantially parallel, spaced apart arms formed of resilient, electrically conductive material joined by a web, each of said arms having an opening therein, said openings being coaxial, each of said arms having a slot extending inwardly of said arm and terminating at the associated opening, each of said slots having confronting edges which converge in a direction toward said opening and form a tapered throat communicating with the associated opening, the spacing between said arms, the diametral dimension of each of said openings, and the width of each of said throats being less than the diameter of a ball terminal adapted to be received by said socket member.

6. The construction set forth in claim 5 wherein said chamber has spaced apart, opposed side walls adjacent said arms, each of said arms being spaced from its adjacent side wall to permit flexing of said arms toward and away from the adjacent side walls.

7. The construction set forth in claim 5 including resilient fingers projecting from said arms toward and engaging said side walls.

8. The construction set forth in claim 5 wherein said chamber has a base snugly accommodating said web, said chamber having side walls upstanding from said base and being substantially parallel to but spaced from the adjacent arms to permit flexing of said arms toward and away from the adjacent side walls.

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