United States Patent

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[54] **CONNECTOR RECEPTACLE WITH WIRE DEFORMING MEANS**
8 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** ..... **339/256 R,** 287/77, 339/276 R
[51] **Int. Cl.** **H01r 11/08**
[50] **Field of Search** ..... 339/252, 256, 276 T; 287/75, 77, 78, 104, 114

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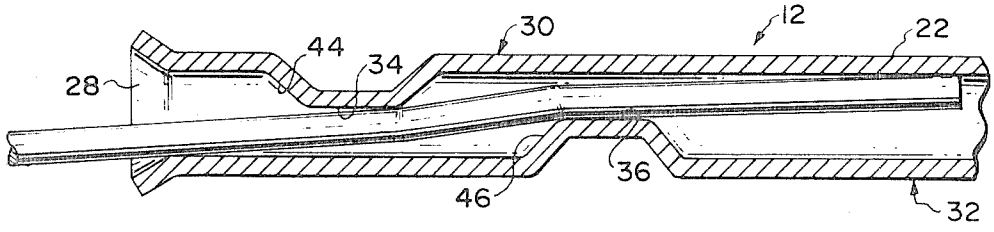
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Attorney—Mason, Kolehmainen, Rathburn & Wyss

ABSTRACT: A connector receptacle for establishing a strong mechanical connection and a reliable low resistance electrical connection with a metal wire such as the lead wire of a miniature lamp or other wire is formed from an elongated tubular member. Offset sections of the wall of the tube adjacent an open end provide obstructions to insertion of the wire forcing the wire to be deformed beyond its elastic limit as the wire is inserted into the tube. The tube inwardly of the obstructions includes an unobstructed portion of substantial length so that a substantial length of the wire is successively deformed as the wire is inserted. In order to withdraw the wire from the tubular receptacle, the wire must once again be deformed and the elastic limit overcome. Consequently, the wire is securely held in place and a low resistance electrical connection is obtained due to firm engagement between the wire and portions of the tube wall including the obstructions.



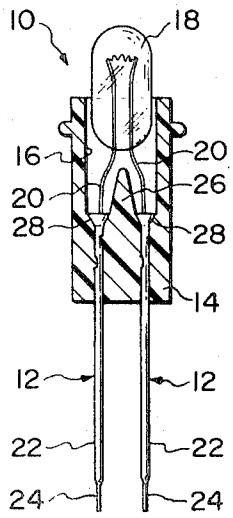


FIG. 1

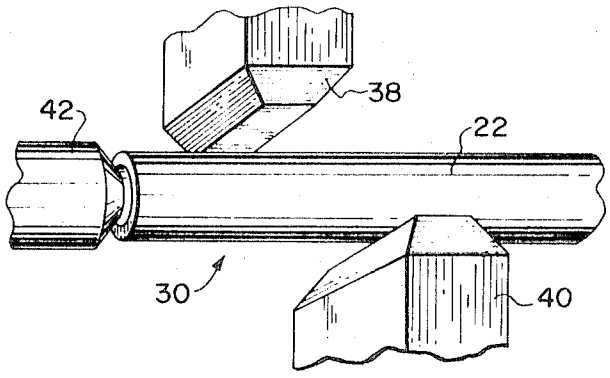


FIG. 2

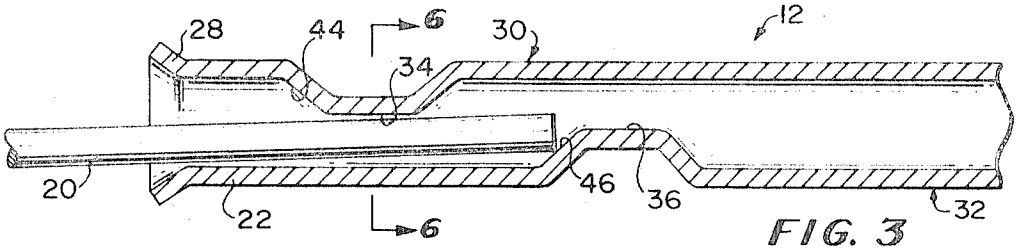


FIG. 3

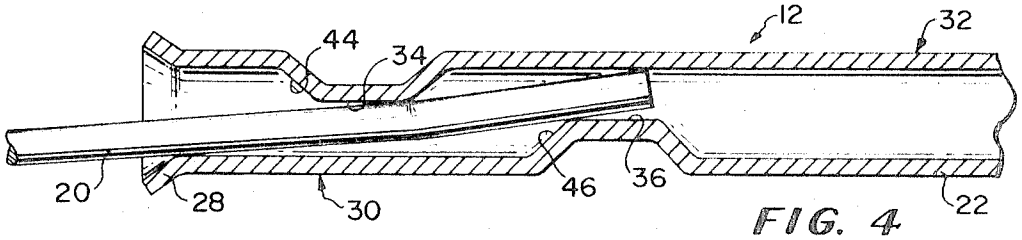


FIG. 4

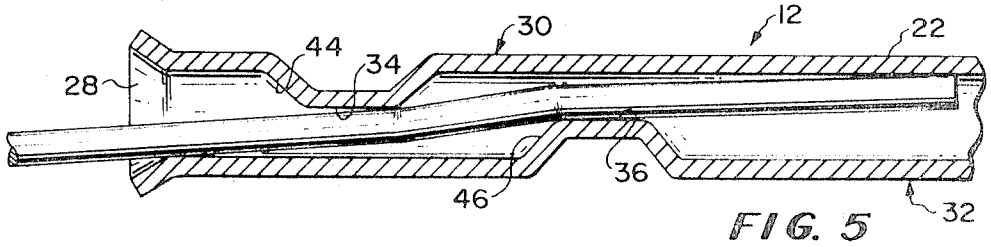


FIG. 5

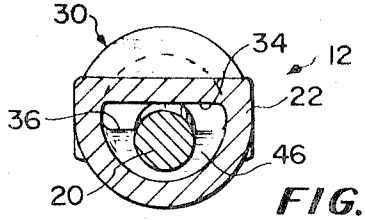


FIG. 6

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CONNECTOR RECEPTACLE WITH WIRE DEFORMING MEANS

The present invention relates to a connector receptacle for receiving a miniature lamp lead wire or other wire.

Many types of sockets or receptacles for establishing an electrical connection with a wire inserted therein are known. However most known receptacles rely upon the characteristic of resilience to provide a frictional engagement or an interference fit between the wire and the receptacle for holding the wire and for establishing electrical contact with the wire. The resilience may be associated either with the wire or with the receptacle, but in either case problems have been encountered in the past in establishing convenient and reliable connections with certain types of wires such as the small, soft, highly flexible lead wires used with miniature lamps.

In accordance with the present invention there is provided an improved connector receptacle for wire capable of providing both a strong mechanical connection with an inserted wire and also of providing a lasting low resistance electrical connection with the wire. In addition, the receptacle of the present invention provides a connection which is not subject to weakening or loosening caused by jarring, vibration or the like. Furthermore, the improved receptacle of the present invention may be used to mount a miniature lamp securely in any orientation.

In brief, the above and other objects of the present invention are achieved through the provision of a novel connector receptacle in the form of a tubular member having an open end and having a segment inward of the open end defining a tortuous path through which the wire is inserted. The tortuous path is such that upon insertion of a metal wire through the receptacle, the elastic limit of the wire is exceeded and the wire is deformed. As the wire is forced through the tortuous segment, successive portions of the wire are deformed. The wire must again be deformed beyond its elastic limit in order to remove the wire from the receptacle. Consequently, the wire is firmly held within the receptacle, and in addition a low resistance electrical contact is made due to firm engagement at several regions between the wire and the receptacle.

The invention together with the above and other objects and advantages may be better understood in connection with the following detailed description of one embodiment of the invention illustrated in the accompanying drawings wherein:

FIG. 1 is a sectional view of part of a miniature lamp assembly provided with a pair of connector receptacles each embodying the principles of the present invention;

FIG. 2 is a fragmentary perspective view illustrating the operations carried out in forming the connector receptacle of the present invention;

FIGS. 3–5 are fragmentary longitudinal sectional views of the connector receptacle indicating successive steps in the operation of inserting a wire into the receptacle; and

FIG. 6 is a sectional view taken along the line 6—6 of FIG. 3.

Having reference now to the drawing and initially to FIG. 1, there is illustrated a portion of a miniature lamp assembly generally designated as 10 and provided with a pair of connector receptacles constructed in accordance with principles of the present invention, each designated as a whole by the reference numeral 12. Although described herein with reference to the miniature lamp assembly 10, it should be understood that the principles of the present invention may be applied to many other uses and environments as will readily be appreciated by those skilled in the art.

In general, the miniature lamp assembly 10 includes a molded housing 14 defining a recess 16 receiving a lamp including a bulb 18 and a pair of lead wires 20. The miniature lamp assembly 10 is of the so-called "baseless" or wire terminal variety in that the connector receptacles 12 serve directly to receive and make connections with the lead wires 20 and also serve to interconnect the assembly 10 with a suitable electrical circuit for operation of the lamp. Consequently, the need for a separate lamp base such as a bayonet base or a screw base is overcome.

As appears in greater detail below, the connector receptacles 12 include tubular bodies 22 which may be provided with flattened end portions 24 if desired in order to facilitate the interconnection of the connector receptacles 12 with other circuitry. To aid in inserting the lamp within the housing 14 the lower portion of the recess 16 is provided with a guiding projection 26 cooperating with flared, open end portions 28 of the connector receptacles 12 for guiding the ends of the lead wires 20 into the connector receptacles 12.

Referring to FIGS. 2–6, the construction and operation of the improved connector receptacle 12 are illustrated in greater detail. In accordance with important features of the present invention, the tubular body 22 is effective upon the insertion of a wire 20 through the flared open end 28 thereof to cause deformation of successive portions of the wire by causing the elastic limit of the wire to be exceeded. In accordance with the invention, this is accomplished by providing the tubular body 22 with a first segment generally designated as 30 defining a tortuous path through which the wire 20 may be inserted and a second segment generally designated as 32 providing an unobstructed path for travel of the wire inserted past the tortuous portion 30.

More specifically, the tubular body 22 in its initial state has an inside diameter well in excess of the diameter of the wire 20 to which a connection is to be made. Inwardly of the open end 28 of the body 22, the wall of the body is offset at two axially spaced locations to provide a pair of obstructions or protuberances 34 and 36. As illustrated somewhat diagrammatically in FIG. 2, these obstructions 34 and 36 may conveniently be in the form of indentations created by pressing the outside of the tubular body 22 with a pair of forming tools 38 and 40. If desired, the flared end portion 28 of the body 22 may be formed simultaneously with a suitable flaring tool 42.

As appears best in FIGS. 3–5, the obstructions or protuberances 34 and 36 each block off a substantial portion of the cross-sectional area of the inside of the tubular member 22. However, each protuberance leaves an opening or passage through the tubular member having a size somewhat greater than the size of the wire so that the wire may be inserted past the protuberance. Importantly, the obstructions or protuberances 34 and 36 are angularly offset or staggered with respect to one another so that the passage areas defined by the protuberances are offset and the wire 20 cannot be inserted along a straight path past both protuberances.

By way of example, in the illustrated embodiment of the invention the wire 20 has a diameter of about 0.010 inch, and the initial inside diameter of the tubular member 22 is about 0.025 inch and thus well in excess of the wire diameter. The protuberances 34 and 36 each extend about 0.010 inch at their highest point from the tubing wall, leaving a maximum distance of about 0.015 inch to the opposite wall of the tubular member 22. This distance is sufficient to permit passage of the wire 20 past the protuberance. However, the distance normal to the tubing axis between the protuberances is about 0.005 inch so that the wire cannot be inserted in a straight line into the receptacle 12.

Considering FIGS. 3–5 in sequence, when the wire 20 is inserted into the connector receptacle 12, the leading end of the wire is first guided into the receptacle by means of the flared open end portion 28. Upon reaching the protuberance or obstruction 34, the leading edge of the wire may conveniently be guide further inwardly by slanted guiding surface 44 preferably defined at the outermost edge of the protuberance 34. The wire upon further insertion then moves through the space between the protuberance 34 and the opposite wall of the tubular member 22 until it engages a similar slanting guiding edge 46 of the protuberance 36. The wire is illustrated in this position in FIG. 3. The guiding surfaces 44 and 46 may, for example, be at an angle of about 45 degrees with respect to the tubing axis.

As the wire is forced further inwardly of the receptacle connector 12, the leading end of the wire is cammed by the guiding surface 46 of the protuberance 36 causing the wire to be bent or deformed about the protuberance 34, as illustrated in

FIG. 4. The the tubular member 22 including the protuberances 34 and 36 is such that the bending of the wire 20 exceeds the elastic limit of the wire so that deformation of the wire takes place at the point where the wire engages the protuberance 34.

Once the end of the wire 20 clears the protuberance 36, the wire may be forced further inwardly through the space between the protuberance 36 and the opposite wall of the tubular member 22 and into the unobstructed segment 32 of the tubular member 22, as illustrated in FIG. 5. As the wire 20 engages the tubing wall, it is bent at the point of engagement with the protuberance 36 and the elastic limit of the wire is exceeded at this point as well. In the illustrated embodiment of the invention, for example, the distance between the points of engagement of the wire with the protuberances 34 and 36 may be in the neighborhood of 0.050 or 0.060 inch or so.

As the wire is inserted, successive portions of the wire pass through the portion 30 including the protuberances 34 and 36 defining a tortuous path effective to deform the wire beyond its elastic limit. As a result, when the wire reaches a fully inserted position such as the position illustrated in FIG. 5, firm contact between the connector and the wire is established at various points including the end of the wire, the portions of the wire engaging the protuberances 34 and 36, and the portion of the wire engaging the tubular member 22 adjacent the flared open end 28 thereof. The wire is firmly held in position because in order to withdraw the wire it is necessary once again to successively overcome the elastic limit of the wire. In addition, due to the firm engagement of the wire at several regions with the connector 12, the electrical contact between the wire and the receptacle is highly reliable.

Advantageously, the firm mechanical and electrical connection created between the wire 20 and the receptacle connector 12 is such that the parts may be mounted in any desired orientation since the force of gravity is not relied upon to create or maintain the connection. In addition, shocks and vibration and other stresses which might be encountered by the wire and/or the receptacle connector do not interfere with either the mechanical or the electrical connection. Fatigue of resiliently movable metal structure does not decrease the effectiveness of the connection over a period of time as is commonly the case in connecting assemblies making use of flexible resilient properties of either the wire or of the connector.

The illustrated receptacle connector 12 is designed for use with a wire formed of an extremely soft character having a relatively low yield point, such as soft copper, "dumet" or the like. However, the connector receptacle can readily be designed for use with wires of other materials.

In a device constructed in accordance with the teachings of the present invention, the dimensions referred to above were found to produce highly satisfactory results. These specific figures are given by way of illustration of one embodiment of the invention only and are not intended to limit the scope of the invention.

What is claimed and desired to be secured by Letters Patent of the United States is:

1. A conductor and receptacle apparatus for establishing a releasable mechanical and electrical connection comprising in combination a unitary unstranded conductor wire having an elastic limit, and a tubular member having an open end capable of generally axially receiving said wire and having a segment spaced from said open end and defining a tortuous path for said wire extending inwardly of said open end, said segment being constructed and arranged relative to said elastic limit of said wire to be effective upon insertion and removal of the wire into and out of said tubular member to cause the elastic limit of the wire to be exceeded, thereby to produce sequential deformation of successive portions of the wire, said segment including a plurality of axially spaced protuberances defined on the inner wall of the tubular member, said protuberances being offset from one another around the periphery of the tubular member to form said tortuous path.

2. The apparatus of claim 1, said protuberances being integral portions of the tubing wall.

3. The apparatus of claim 2, each said protuberance including an inclined guiding surface for guiding the inserted wire over the protuberance.

4. The apparatus of claim 3, said open end of the tubular member being flared outwardly to guide the wire into the tubular member.

5. In combination, an elongated receptacle having an open end, and an unstranded metal wire having a relatively low elastic limit insertable into and withdrawable from said receptacle through said open end, said receptacle comprising a generally cylindrical straight tube having an inner diameter throughout most of its length substantially greater than the diameter of the wire, the wall of said tube spaced from said end being offset inwardly at least at two spaced regions to define at least a pair of obstructions, each said obstruction blocking a portion of the tube and leaving open a passage larger than the cross-sectional area of the wire, said passages being angularly offset from one another an amount such that the wire is deformed beyond its elastic limit as it is inserted and as it is withdrawn past said protuberances, and an obstruction-free segment of the tube of substantial length relative to the distance between said protuberances extending inwardly of said protuberances for permitting a substantial length of wire to be successively deformed as it is inserted past said protuberances into said segment and as it is withdrawn past said protuberances.

6. The combination of claim 5, said protuberances comprising a pair of indentations at opposite sides of the tube spaced axially from one another.

7. The combination of claim 6, the distance between the obstructions normal to the tube axis being substantially less than the wire diameter.

8. A readily attachable and releasable conductor and connector receptacle combination comprising:

a single wire conductor having a predetermined elastic limit;

and a tubular member having a wall substantially in the form of a tube and having at least one open end;

said wall throughout a substantial portion of the length of said tubular member having an inside diameter substantially larger than the wire diameter freely to receive said wire upon generally axial insertion and withdrawal of said wire into and out of said open end;

the wall of said tubular member including means for deforming successive portions of the wire beyond said elastic limit of the wire during both said insertion and said withdrawal;

said deforming means including protuberance means in said wall spaced from both ends of said tubular member;

said protuberance means including a pair of protuberances spaced from one another both axially and radially in the tube wall.