

[54] **ELECTRICAL CONNECTOR**

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[57] **ABSTRACT**

An electrical connector for connection to a lead wire comprising at least one terminal including a male or female contact portion at one end thereof, a resilient bellmouth-shaped portion interposed between the contact portion and the end of the terminal adapted for connection to the lead wire, and an engaging portion; and a connector body including a terminal-receiving aperture with its internal surface partly or wholly tapered and a portion for holding the terminal by engagement with the engaging portion of the terminal; the engaging portion of the terminal being inserted into the terminal-receiving aperture to such an extent as to engage with the holding portion, the bellmouth-shaped portion of the terminal being resiliently pressed against the internal surface of the tapered portion thereby to support the electrical connector.

5 Claims, 8 Drawing Figures

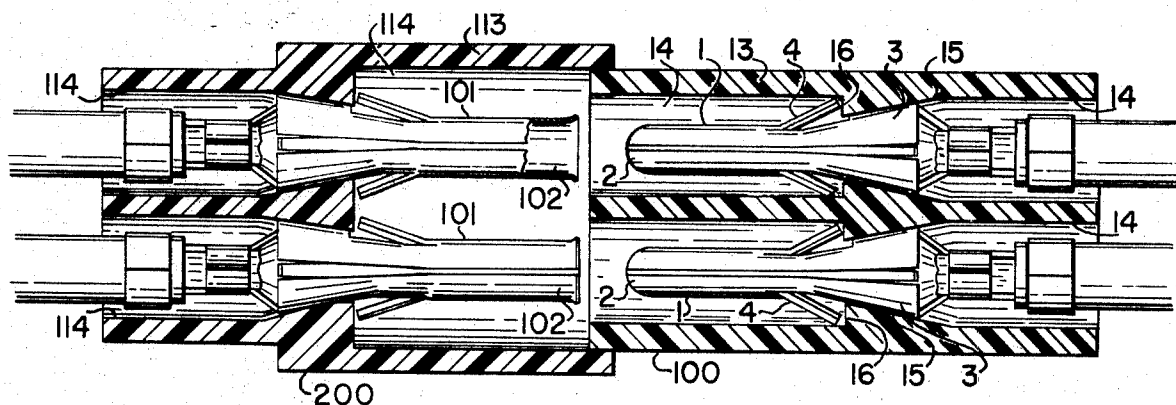


FIG. 1

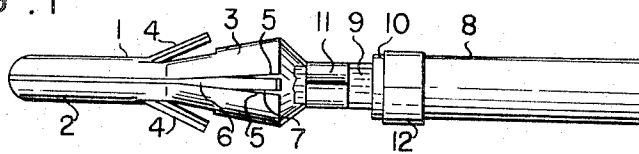


FIG. 2

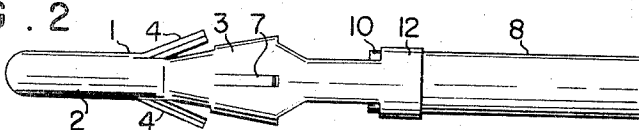


FIG. 3

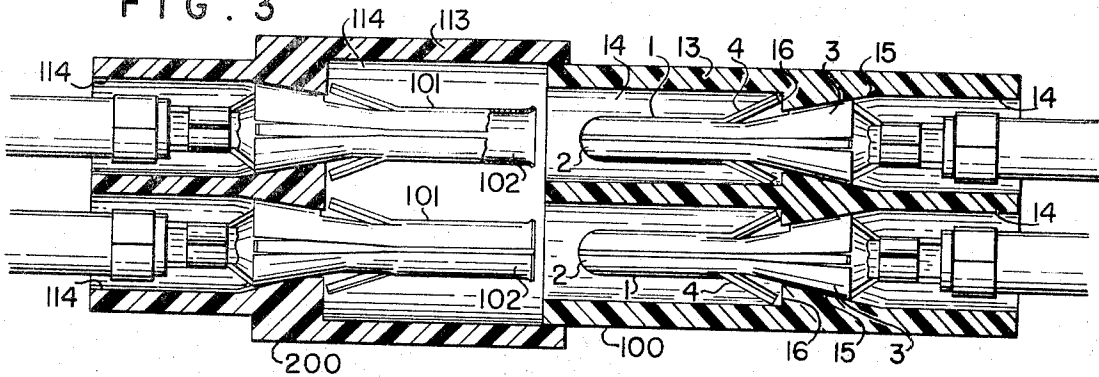


FIG. 4

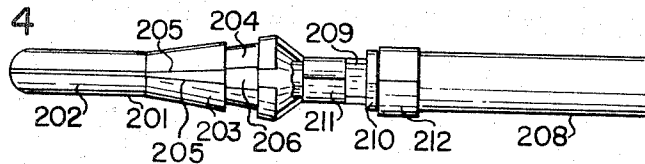


FIG. 5

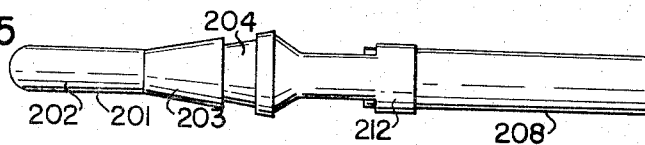


FIG. 6

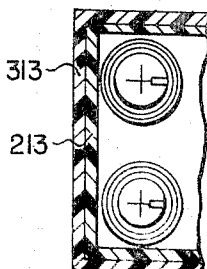
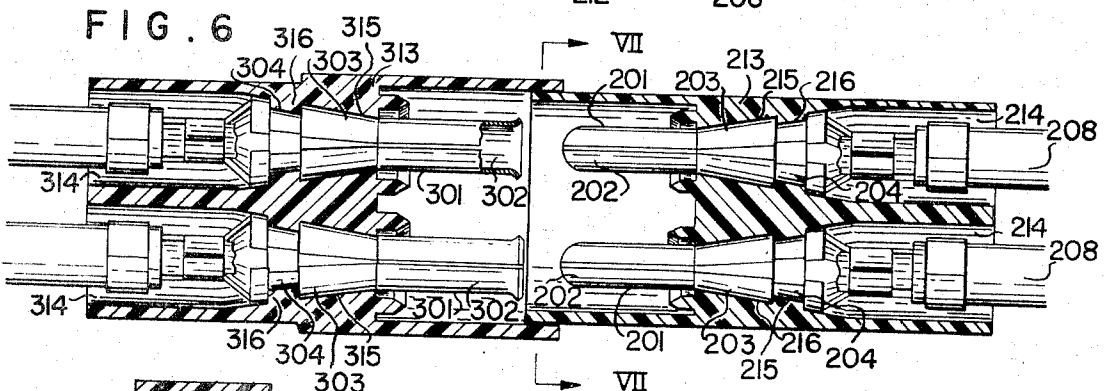
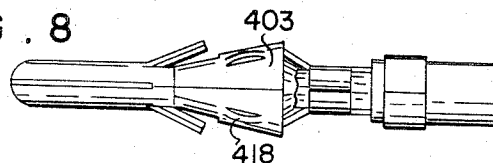


FIG. 7 FIG. 8



ELECTRICAL CONNECTOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an advantageous electrical connector used as an internal wiring connecting means for automotive vehicles or the like.

2. Description of the Prior Art

The distribution lines called a wire harness for automotive electric systems generally consist of a multiplicity of lead wires each with a terminal, which are divided into a plurality of batches each including about 5 to 10 lead wires. The terminals of each batch of lead wires are contained in a single connector. Such connectors are adapted for male and female type of engagement to accomplish the connection not only between lead wires themselves but also between lead wires and external equipment. It is essential to this type of connector that terminals are easily contained in the connector body, that the contained terminals do not come off the connector body at the time of connector engagement and disengagement, and that the center line of each terminal is aligned with that of the mating terminal. The third requirement arises because it is usual that a plurality of terminals are connected in a batch to a plurality of the mating terminals.

Especially, the above-mentioned second and third requirements are closely related to the workability of connector engagement and disengagement, and any connector which cannot meet these requirements has little commercial value.

SUMMARY OF THE INVENTION

An object of the invention is to provide an electrical connector in which terminals are easily contained in the connector body.

Another object of the invention is to provide an electrical connector in which the contained terminals are combined strongly with the connector body and maintain their center lines aligned.

The electrical connector according to the present invention which is intended to achieve the above-mentioned objects comprises at least one terminal and a connector body, the terminal including a male or female contact portion at one end thereof, a resilient bellmouth portion in midway thereof and an resilient hook extending sideway from the small-diameter side of the bellmouth portion, said connector body including at least one terminal-receiving aperture with an internal surface partially or wholly tapered and a holding portion at the smallest-diameter side of said tapered portion; in which the terminal is inserted into the terminal-receiving aperture to such an extent that the hook which enters the aperture from the large-diameter side thereof passes the smallest-diameter portion thereof, so that not only the hook is held by the holding-portion but also the bellmouth portion is resiliently pressed against the internal surface of the tapered portion.

In the electrical connector with the construction as described above, when the hook of the terminal is inserted into the terminal-receiving aperture from the large-diameter side of the tapered portion thereof reaches the position past the smallest-diameter portion of the aperture, the hook automatically engages with the holding portion by restitution, and at the same time the bellmouth-shaped portion presses itself against the internal surface of the small-diameter tapered portion,

thereby making possible very easy and speedy assemblage.

Further, the electrical connector according to the present invention comprises at least one terminal including a male or female contact at one end thereof, a resilient bellmouth portion in the midway thereof, and at least one protrusion or groove formed along the periphery of the bellmouth portion; and a connector body including at least one terminal-receiving aperture with an internal surface partially or wholly tapered, the tapered portion having at least one groove or protrusion adapted to engage with the protrusion or groove on the periphery of the bellmouth portion. The terminal is inserted into the tapered portion from its large-diameter side to such an extent that the protrusion or groove on the terminal comes to engage with the groove or protrusion on the tapered portion, whereby the protrusion or groove formed on the periphery of the terminal is held by the groove or protrusion on the tapered portion, at the same time the bellmouth portion being resiliently pressed against the internal surface of the tapered portion.

For the electrical connector according to the invention to work, it is enough to insert the terminal into the terminal-receiving aperture from the large-diameter side of the tapered portion to such an extent that the groove or protrusion on the bellmouth-shaped portion of the terminal comes to engage with the protrusion or groove formed on the internal surface of the tapered portion, and therefore the electrical connector according to the invention can be assembled very easily and quickly.

In order to achieve the second object of the invention, namely, to provide an electrical connector in which the inserted terminal is combined firmly with the connector body in such a manner as to always maintain its center line aligned with that of the mating terminal, the electrical connector according to the invention has an almost tubular body with a narrow gap which is extended longitudinally from end to end and the resilient hook is formed sideway from the bellmouth-shaped portion of the terminal. Further, at least two longitudinal cuts are provided on the bellmouth-shaped portion of the terminal and at least one resilient protrusion is formed by pushing sideway the portion between the cuts.

The terminal is generally made of such materials as copper, copper alloys, aluminum or aluminum alloys, and the connector body of such materials as hard rubber or plastics. But it is needless to say that the materials employed are not limited to the above-mentioned ones. In other words, any material with a desired electrical conductivity and mechanical strength may be used for the terminal, and as to the material of the connector body, the only conditions to be met are satisfactory degree of electrical insulation and mechanical strength.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a diagram showing an example of the male terminal employed in the electrical connector according to the present invention.

FIG. 2 is a diagram for explaining the back side of the male terminal shown in FIG. 1.

FIG. 3 is a partially exploded view showing an example of the electrical connector according to the present

invention assembled employing the male terminals shown in FIGS. 1 and 2.

FIG. 4 is a diagram showing another embodiment of the male terminal employed in the electrical connector according to the invention.

FIG. 5 is a rear view showing the male terminal of FIG. 4.

FIG. 6 is a partially exploded sectional view showing another embodiment of the electrical connector according to the invention which has been assembled using the male terminal shown in FIGS. 4 and 5.

FIG. 7 is a sectional view taken in the line VII — VII in FIG. 6.

FIG. 8 is a diagram showing still another embodiment of the male terminal used in the electrical connector according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiments of the invention will be now explained with reference to the attached drawings.

Referring to FIGS. 1 to 3, a male terminal 1 is formed by press-molding a sheet of tin-coated copper alloy plate. More in detail, the male terminal is provided with a contact portion of the male type at one end thereof, a resilient bellmouth-shaped portion 3 in the midway thereof, and at least one resilient hook 4 extending sideways from the small-diameter side or the front side of the bellmouth-shaped portion.

In the embodiment shown above, resiliency of the bellmouth-shaped portion is provided by the gap 6 between the edges 5, the resilient material of the terminal and at least one resilient finger 7 cut up toward the reader as shown in FIG. 2. The hook 4 is also cut up in same way as the finger 7.

The terminal has also clamps 11 and 12 formed on it to hold the conductor 9 of an insulated lead wire 8 and an insulating covering 10.

The reference numeral 13 shows a connector body of molded hard plastics, which is internally provided with a terminal-receiving aperture 14 with a tapered small-diameter portion 15.

As is apparent from the drawings, the terminal is inserted into the terminal-receiving aperture 14 of the connector body 13 from its righthand side, as shown in FIG. 3, to such an extent that the hook 4 of the terminal 1 which enters the aperture 14 from the large-diameter side of the tapered portion 15 reaches beyond the smallest-diameter side thereof.

The hook 4 is arranged to the axial line of the terminal 1 in accordance with the contour of the internal surface of the tapered portion 15 as passing through it, and after having passed the tapered portion 15, the hook 4 of the terminal 1 is restored to its original position by its own resiliency thereby to engage with the holding portion 16 around the smallest-diameter side of the tapered portion 15.

The resilient bellmouth-shaped portion 3 is deformed by being pressed against the internal surface of the tapered portion 15 of the connector body 13 by the excessive insertion of the terminal 1, thereby applying restitutory force to the internal surface of the tapered portion 15.

Although only the male terminal has been taken up by way of example for explanation in the preceding embodiment, female terminals are also constructed almost in the same way. FIG. 3 also shows an embodiment of

the electrical connector according to the present invention involving female terminals. As can be seen from the figure, the female terminals are constructed the same way as the already-mentioned male terminals excepting the contact of female type 102 formed at one end of the terminal 101. It is also needless to say that the female terminal 101 is inserted from the lefthand side of the terminal-receiving aperture 114 of a connector body 113 made of the same plastic material as the connector body 13 by molding.

When the male and female connectors 100 and 200 respectively of the above-described construction are connected with each other by inserting the male electrical connector 100 into the receiving aperture 114 of the female electrical connector 200, as shown in FIG. 3, the male contact 2 is at the same time inserted with pressure into the female contact 102, thereby accomplishing electrical connection between them.

It will be understood from the above description that the present invention uses the hook 4 which engages with the holding portion 16 formed inside the connector body 13 and the portion 3 of the terminal 1 is pressed against the internal surface of the tapered portion 15, resulting in the terminal 1 and the connector body 13 being connected or engaged with each other very strongly in the axial direction. As a result, it is absolutely impossible that the terminals come off from the connector body 13 at the time of connection or disconnection of the electrical connector 13. In addition, since the bellmouth-shaped portion 3 of the terminal 1 is maintained pressed against the tapered portion 15 resiliently, the axial line of the terminal is always maintained in the same position, thereby eliminating the inability of the terminal 1 to engage with the mating terminal 101 which otherwise might occur at the time of insertion due to the out-of-alignment condition of the axial lines of the terminals.

In assembling the electrical connector according to the invention, the terminal 1 is inserted into the terminal-receiving aperture 14 from the large-diameter side of the tapered portion 15 to such an extent that the hook 4 of the terminal 1 go past the smallest-diameter side of the tapered portion 15, whereupon the hook returns to its original position by its resiliency and automatically engages with the holding portion 16, while the bellmouth-shaped portion 3 is pressed against the tapered internal surface of the connector body, making the assembly work very simple and speedy.

Referring now to FIGS. 4 to 7 showing another embodiment of the electrical connector according to the invention, a male terminal 201, like the one shown in the preceding embodiment, is formed by press-molding a sheet of tin-coated copper alloy plate. More in detail, the present embodiment comprises a male contact 202 at one end thereof, a resilient bellmouth-shaped portion 203 in the midway thereof and at least one groove 204 formed along the periphery of the bellmouth-shaped portion 203.

In this embodiment, like the preceding one, the resiliency of the bellmouth-shaped portion 203 is supplied by the presence of the gap 206 between a pair of the edges 205 and the resilient material of the terminal. Also, the terminal 201 is the same as the one in the preceding embodiment in that the clamps 211 and 212 support the conductor 209 of an insulated lead wire 208 and an insulating covering 210.

The connector body 213 which is made of the same plastic material as the connector body 13 of the preceding embodiment by molding has a tapered internal surface and a terminal-receiving aperture 214 having in the midway thereof a tapered portion 215 provided with at least one integral protrusion 216 occupying a peripheral portion of the internal surface.

As will be understood from the drawing, the terminal 201 is inserted into the terminal-receiving aperture 214 of the connector body 213 from the right-hand side thereof to such a depth that the protrusion 216 on the internal peripheral surface of the tapered portion 215 engages with the groove 204 along the periphery of the bellmouth-shaped portion 203 of the terminal 201.

As a consequence, the bellmouth-shaped portion 203 which had been deformed toward the axial line of the terminal by the protrusion 216 on the internal peripheral surface of the tapered portion 215 is pressed against the internal surface of the tapered portion 215 at the same time that the protrusion 216 engages with the groove 204.

The above explanation was made employing the male terminal, but the construction of the female terminal is almost the same as that of the male terminal. FIG. 6 also shows an example of the female terminal, the female terminal is constructed the same way as the male terminal except the fact that a female contact 302 is formed at one end of the terminal 301.

In the electrical connector of the above construction, the protrusion 216 formed on the internal surface of the tapered portion 215 of the connector body 213 engages with the groove 204 on the periphery of the bellmouth-shaped portion 203 of the terminal 201, while at the same time the bellmouth-shaped portion 203 is pressed against the internal wall of the tapered portion 215 by means of resilient force applied in the radial direction. Therefore, the terminal 201 and the connector body 213 are engaged or combined with each other very strongly in the axial direction, with the result that it never happens that the terminal comes off from the connector body 213 when the electrical connectors are connected or disconnected. Further, the fact that the bellmouth-shaped portion 203 of the terminal 201 is resiliently maintained pressed in contact with the internal surface of the tapered portions 215 results in the axial line of the terminal 201 being maintained in position, thus eliminating the case in which the terminal is incapable of engaging with the mating terminal due to the out-of-alignment condition of the axial lines of the terminals.

Also, the assembly work of the electrical connector is easily performed simply by inserting the terminal 201 into the terminal-receiving aperture 214 from the large-diameter side of the tapered portions 215 until the protrusion 216 formed on the internal wall of the tapered portion 215 engages with the groove 204 in the bellmouth-shaped portion 203 of the terminal 201.

In the above explanation in connection with FIGS. 4 to 7, it is described that the terminal has the groove in its bellmouth-shaped portion and the protrusion is provided on the internal wall of the tapered portion of the terminal-receiving aperture. On the contrary, however,

the terminal may have such a protrusion in its bellmouth-shaped portion and the internal wall of the tapered portion may be provided with such a groove. It is clear that such an alternative construction delivers the same effect as that shown in FIGS. 4 to 7.

Still another embodiment of the male terminal is shown in FIG. 8. This embodiment has the same construction as that shown in FIGS. 1 to 3, the only difference being that in the embodiment of FIG. 8 the resiliency of the bellmouth-shaped portion 403 is derived solely by a cut-up protrusion 418.

As is clear from the above explanation, the present invention provides an electrical connector with a very high industrial and commercial value in which the terminal is fitted in the connector body very easily and the terminal, once fitted, engages strongly with the connector body in such a manner as to maintain the axial line thereof in position for mutual engagement with the mating terminal.

We claim:

1. An electrical connector comprising at least one terminal having a substantially tubular shape with a narrow gap extending longitudinally from one end to the other end thereof, said at least one terminal including a contact portion at one end, a resilient bellmouth-shaped portion formed at a middle portion and at least one resilient hook positioned at a smaller-diameter side of said bellmouth-shaped portion, said at least one hook projecting radially from said bellmouth-shaped portion; and a connector body including at least one internal bore for receiving said terminal, said at least one bore having a tapered portion with a circular cross-section on at least a part of the internal surface of the bore, said tapered portion decreasing in diameter uniformly in the radial direction along its axis from a larger-diameter end and a holding portion disposed at a smaller-diameter end of said tapered portion, said terminal being inserted into said bore from the larger-diameter end of said tapered portion to such an extent that said hook passes said smaller-diameter end of said tapered portion, such that said hook is held by said holding portion and said bellmouth shaped portion is resiliently pressed in a surface contact against the internal surface of said tapered portion.

2. An electrical connector according to claim 1, wherein said contact portion includes one of a male contact portion and a female contact portion.

3. An electrical connector according to claim 1, wherein said at least one resilient hook is formed of a resilient finger having one end extending outwardly from said bellmouth-shaped portion.

4. An electrical connector according to claim 1, wherein at least one resilient finger extending outwardly from a larger-diameter side of said bellmouth-shaped portion is provided to obtain resilient contact with the internal surface of said tapered portion.

5. An electrical connector according to claim 1, wherein at least one protrusion is formed on said bellmouth-shaped portion to provide resilient contact with the internal surface of said tapered portion.

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