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ELECTRICAL SOCKET MEMBER HAVING INTERMEDIATE RESILIENT STRIPS AND PROCESS FOR MAKING SAME

Filed Nov. 14, 1966 3 Sheets-Sheet 1

Fig. 1.

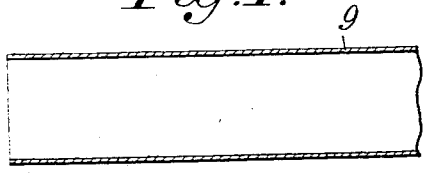


Fig. 2.

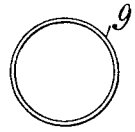


Fig. 3.

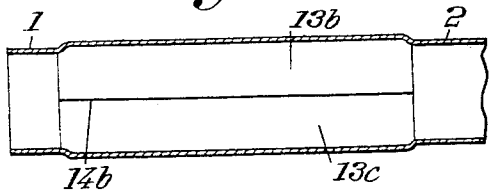


Fig. 4.

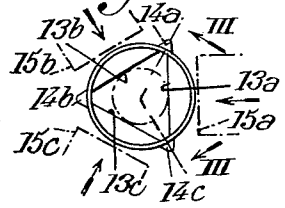


Fig. 5.

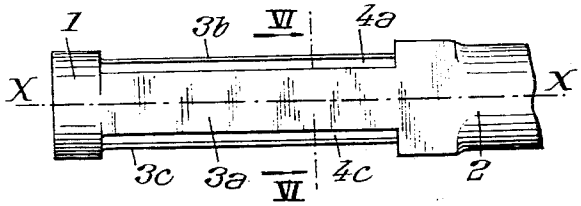


Fig. 6.

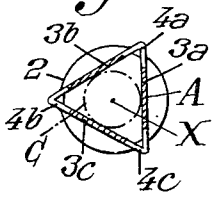


Fig. 7.

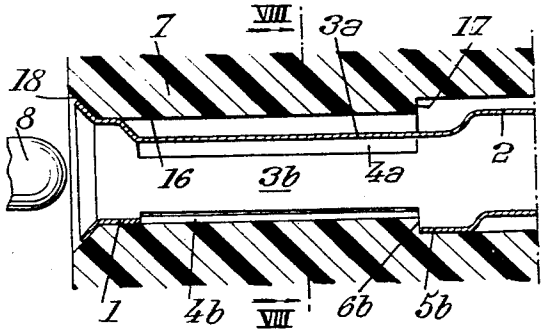


Fig. 8.

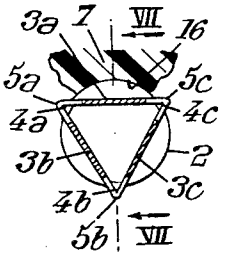


Fig. 9.

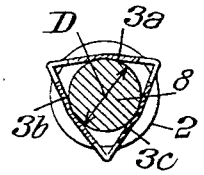


Fig. 10

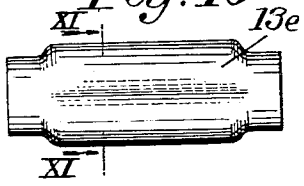


Fig. 11

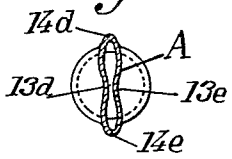


Fig. 12

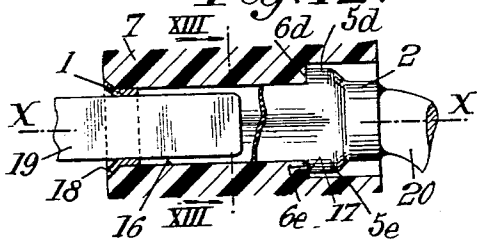


Fig. 13

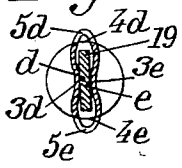


Fig. 14.

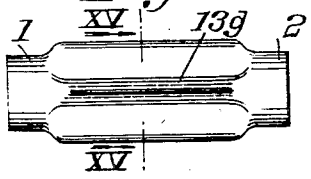


Fig. 15.

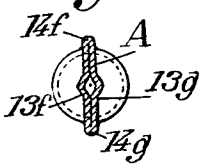


Fig. 16.

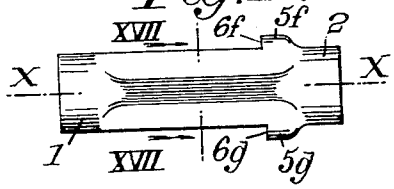
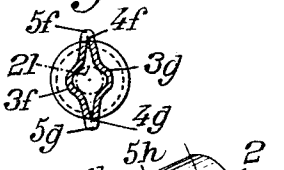


Fig. 17.



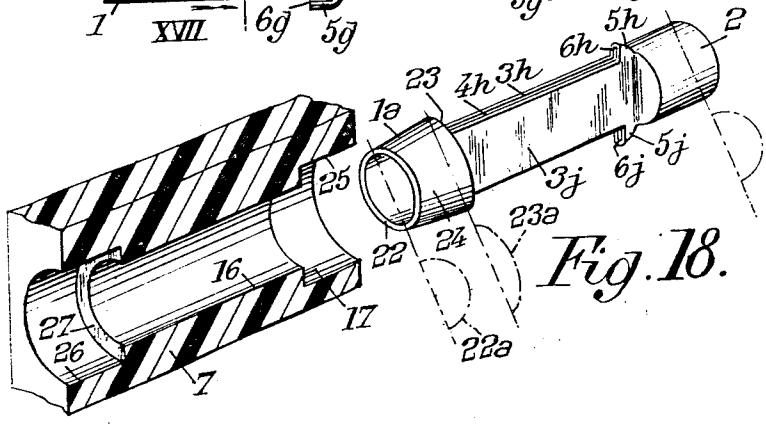


Fig. 18.

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Fig. 19.

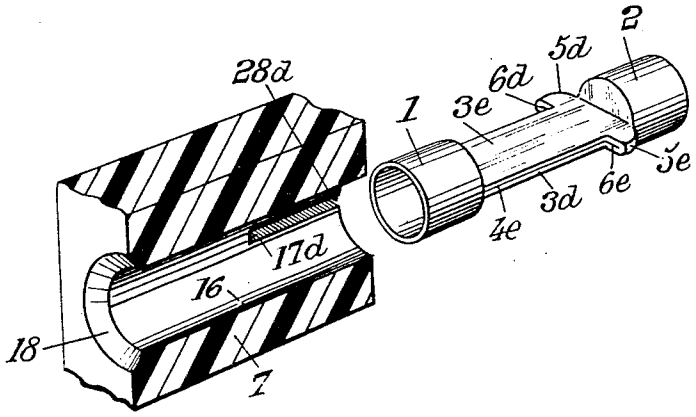
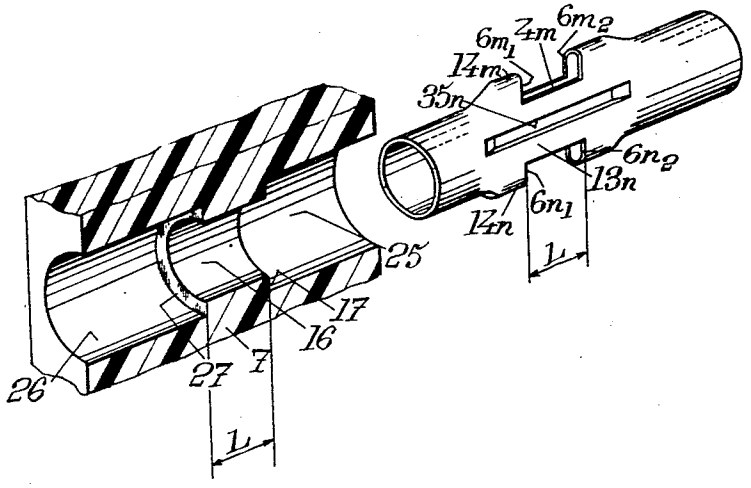


Fig. 20.



United States Patent Office 3,396,364 Patented Aug. 6, 1968

3,396,364

ELECTRICAL SOCKET MEMBER HAVING INTERMEDIATE RESILIENT STRIPS AND PROCESS FOR MAKING SAME

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Filed Nov. 14, 1966, Ser. No. 593,766
Claims priority, application France, Nov. 15, 1965, 54,895; Nov. 8, 1966, 38,406
14 Claims. (Cl. 339—217)

ABSTRACT OF THE DISCLOSURE

The process comprises the steps of deforming a middle portion of a cylindrical metal tube in a manner symmetrical with respect to the axis of the tube to form plug-engaging strips joined by edges projecting beyond the periphery of the undeformed tube end portions, and cutting out the said edges to form slots which separate the strips, the strips lying wholly within the periphery of the undeformed tube portions.

The socket principally comprises plug-engaging strips separated by longitudinal slots defining the longitudinal edges of these strips. These strips engage the plug along their middle portion between their longitudinal edges, these edges remaining clear of the plug.

The present invention relates to sockets for electrical plug and socket connectors and to the manufacture of the same.

It is an object of the invention to simplify and cheapen the manufacture of such sockets while providing a socket which ensures good contact with the plug or pin but involves negligible wear of the latter during their insertion and removal.

In accordance with the invention there is provided a process for the production of a socket for an electrical plug and socket connector comprising the steps of deforming a middle section of a cylindrical metal tube in a manner symmetrical with respect to the axis of the tube to form plug-engaging strips joined by corners projecting beyond the periphery of the undeformed tube, and cutting out the said corners to form slots which separate the strips, the strips lying wholly within the periphery of the undeformed tube.

Preferably the deformation is effected by inwardly-directed pressure in the regions of the strips.

In one embodiment the number of strips is three, arranged in a triangular formation to engage a plug which has a diameter sufficient to bow the strips outwards upon insertion in the socket.

For engagement with flat surfaces of a plug, particularly a plug in the form of a plate, the plug-engaging strips can be given a form which is curved in cross-section to present a convex engagement surface towards the interior of the tube.

For engagement with a plug of relatively small diameter each strip may be formed to present an inward-facing groove, the groove walls being tangential to a cylindrical surface coaxial with the tube to form two lines of contact of each strip with the plug.

The tube may be disposed in a holder and various methods of shaping the tube to ensure its retention in the holder will be described below.

The invention will now be described in more detail with the aid of examples illustrated by the accompanying drawings, in which:

FIGURES 1 and 2 show in axial and transverse section respectively a metal tube serving for the production of a socket in accordance with the invention;

FIGURES 3 and 4 show respectively in longitudinal section on the line III—III in FIGURE 4 and in end view, the tube of FIGURES 1 and 2 after the first phase of the process of manufacture;

FIGURES 5 and 6 show respectively in elevation and in transverse section on the line VI—VI in FIGURE 5, the tube of FIGURES 1 to 4 after the second phase of the process of manufacture;

FIGURES 7 and 8 show respectively in longitudinal section on the line VII—VII in FIGURE 8 and in transverse section on the line VIII—VIII in FIGURE 7 the tube of FIGURES 5 and 6 mounted in an insulating holder;

FIGURE 9 shows similarly to FIGURE 8 the tube after insertion of the pin;

FIGURE 10 is a side elevation of a deformed tube after the first stage of manufacture of a socket for engagement with a flat plug;

FIGURE 11 is a section on the line XI—XI of FIGURE 10;

FIGURE 12 is a longitudinal section of the tube of FIGURES 10 and 11 after the second stage of manufacture together with the holder in which it is inserted and the flat plug;

FIGURE 13 is a section on the line XIII—XIII of FIGURE 12;

FIGURE 14 is a side view and FIGURE 15 is a section on the line XV—XV of FIGURE 14 of a deformed tube after the first stage of manufacture of a socket for engagement with a pin of small diameter;

FIGURE 16 is a side view and FIGURE 17 is a section on the line XVII—XVII of FIGURE 16 of the tube on FIGURES 14 and 15 after the second stage of manufacture;

FIGURES 18 and 19 are perspective views of tubes with corresponding holders shown in longitudinal section, illustrating two methods of securing a tube in a holder, and

FIG. 20 is a perspective view of still another modification.

The methods illustrated in the drawings are particularly adapted to the formation of miniature sockets, that is to say those capable of receiving a pin of not more than 2 mm. diameter.

FIGURES 5 to 8 show a socket formed from a single metallic part comprising two coaxial tubular end sections 1 and 2, of continuous contour, and a middle part formed by three strips 3 (3*a*, 3*b*, 3*c*) which are separated two by two by longitudinal slots 4 (4*a*, 4*b*, 4*c*), which are tangential internally to a cylindrical surface C (FIGURE 6) having the same axis X—X (FIGURE 5) as the tubular sections 1 and 2 and which, in transverse section, are together located on a continuous curve A (which is the overall contour of the strips 3 and slots 4 of FIGURES 6 and 8) whose perimeter is equal to that of the tubular sections 1 and 2. The internal edges of the slots 4 are located outside the cylinder C.

Advantageously, the said curve A presents towards the exterior local projections 5 (5*a*, 5*b*, 5*c*) with respect to the tubular sections 1 and 2 in such a manner that the deformed surface between the tubular end sections 2 and the middle section (strips 3) which is left without slots, forms abutments such as 6*b* for location in a socket holder 7.

As shown particularly in FIGURES 6 and 8 the said curve has preferably a polygonal outline (that is to say triangular in the case of three strips 3) with slightly rounded corners, the strips 3 being flat or slightly concave or convex towards the exterior, at least in the absence of a pin such as 8.

The slots 4 are straight and substantially parallel to the axis X—X but they might possibly be helical with

a very small inclination with the respect to the said axis.

To produce such a socket one can start with a cylindrical metal tube **9** (FIGURES 1 and 2). As shown in FIGURES 3 and 4, the middle section of the tube **9** is deformed in such a manner as to form three faces **13** (**13***a*, **13***b*, **13***c*) tangential internally to the cylindrical surface C defined above, this cylindrical surface having obviously a diameter less than the internal diameter of the cylindrical end sections **1** and **2** of the tube **9** which remain. Then the corners **14** (**14***a*, **14***b*, **14***c*) joining the faces **13** are cut out in such a manner as to form the slots **4** visible in FIGURES 5 and 6 and thus to separate the strips **3**. The size of these slots is chosen in such a manner that the edges of the strips are located within the external contour of the tubular sections **1** and **2**.

The said deformation is preferably effected by pressure directed from the exterior towards the interior of the original tube **9** in the region of the faces **13**, for example with the aid of three flattened punches or dies **15** (**15***a*, **15***b*, **15***c*) capable of being advanced towards the axis X—X along lines separated by 120°, as shown by the arrows in FIGURE 4. It will be understood that in the case where the number of strips **3** differs from three an equal number of dies will be used.

To mount such a socket in the holder **7**, which is of electrically insulating material, a cylindrical passage **16** is provided in this holder (FIGURES 7 and 8) of a diameter substantially equal to the external diameter of the tube **9**, depressions are formed at the level of the projections **5** in order to give the projections a free transverse surface which will form the abutment **6**.

It is sufficient then to provide at the end of the passage **16** a shoulder **17**, to introduce the socket (from the right of FIGURE 7) until the abutments **6** engage the shoulder **17** and to expand the end of the tubular section **1** against the flared surface **18** provided at the end of the passage **16** remote from that which comprises the shoulder **17**.

There is thus obtained a socket into which a pin **8** can be introduced whose effective diameter D has a value between the diameter of the cylinder C (FIGURE 6) and the internal diameter of the tube **9**, or which comes to the same thing, the tubular sections **1** and **2**, the pin **8** having a filed away or rounded off end (see FIGURE 7) to facilitate its introduction. As a result of this operation, the strips **3** deform as shown in FIGURE 9, this deformation being permitted by the play existing between these strips and the wall of the passage **16** and taking place by bending at the ends of the strips and/or by modification of the course of the curve A. FIGURE 9 also shows that, contrary to the majority of known sockets, the edges formed by the corners of the strips **3**, which are generally produced by fraising and thus likely to have cutting edges, cannot come into contact with the pin, which diminishes considerably the risks of wear or notching of the pin, and more particularly of the superficial protective layer of the latter.

The process of manufacture is economical since the same deformation with the aid of the dies **15** (FIGURE 4) not only enables the contact strips **3** to be obtained but also the locating abutments **6**.

The embodiments of FIGURES 10 to 19 resemble those previously described in being formed in one piece having two coaxial tubular end sections **1** and **2** with a continuous contour, and a middle section composed of strips **3**, in these embodiments two strips only (**3***d*, **3***e* in FIGURE 13; **3***f*, **3***g* in FIGURE 17; **3***h*, **3***j* in FIGURE 18) which are separated by longitudinal slots **4** (**4***d*, **4***e* in FIGURE 13; **4***f*, **4***g* in FIGURE 17; **4***h* in FIGURE 18). The strips **3** are tangential internally to a cylindrical surface having the same axis X—X as the tubular sections **1** and **2**. In transverse section the strips lie on a closed curve A whose perimeter is equal to that of the tubular sections **1** and **2**. The inner edge of the slots **4** are outside the said cylindrical surface.

The curve A has local projections **5** (**5***d*, **5***e* in FIGURES 12 and 13; **5***f*, **5***g* in FIGURES 16 and 17; **5***h*, **5***j* in FIGURE 18) which extend outside the tubular sections **1** and **2** so that the deformed surface between the tubular end section **2** and the middle section (strips **3**), which is left unslotted, can form abutments **6** (**6***d*, **6***e* in FIGURE 12; **6***f*, **6***g* in FIGURE 16; **6***h*, **6***j* in FIGURE 18) for location of the tube in a socket holder **7**.

The slots **4** can again be either straight and parallel to the axis X—X or helical with a slight inclination with respect to that axis.

As before the socket is formed by deformation of a cylindrical tube to form two relatively flat faces **13** (**13***d*, **13***e* in FIGURES 10 and 11; **13***f*, **13***g* in FIGURES 14 and 15). The corners **14** (**14***d*, **14***e*, in FIGURE 11; **14***f*, **14***g* in FIGURE 15) joining the faces **13** are then cut out to form slots **4** dividing the strips **3**. The width of the slots is such that the edges of the strips are within the external contour of the tubular sections **1** and **2**.

FIGURE 12 shows the tube mounted in its holder **7** in the same manner as in FIGURE 7, with the abutments **6***d* and **6***e* engaging the step or shoulder **17** and the end **1** flared out against the flared end **18** of the passage **16** of the holder. A flat plug **19** is shown inserted in the socket and a conductor **20** received within the end section **2** of the socket.

In the embodiment of FIGURES 10 and 13 each of the faces **13***d* and **13***e* and hence each of the strips **3***d* and **3***e* is given a sinuous curvilinear shape such that it presents a convex region of contact *d* or *e* towards the corresponding flat face of the plug. As shown in FIGURE 12 the larger transverse dimension of the plug **19** has a value substantially equal to the internal diameter of the tubular end section **1** of the socket. To guide the flat plug **19** with greater accuracy the tubular section **1** can be squashed to a cross-section corresponding to that of the plug.

While the drawings show the preferred case of a flat plug having two flat surfaces, the invention is equally applicable to plugs of triangular section (three flat surfaces) or to plugs whose flats are slightly convex.

FIGURES 14 and 17 relate to an embodiment for use with a cylindrical pin **21** of small diameter which is shown in broken line in FIGURE 17. Each of the strips **3***f* and **3***g* is given a shape having an inwardly facing groove whose walls are tangential at two points to a cylindrical surface coaxial with the end sections **1** and **2** but remain outside the cylinder so that the socket presents to the pin **21** twice as many regions of contact as there are strips. As shown in FIGURE 15, in the absence of the plug each strip **3***f* and **3***g* is flat except for the central part of its profile which has a grooved or V-form. Better guiding of the plug is thus achieved and thorough contact along four lines of contact.

FIGURE 18 shows a method of securing the tube in its holder **7** which avoids the necessity for expanding the end section **1** against the flared end **18** of the passage **16**. The end section **1***a* of the tube has a forward edge **22** whose outline (half of which is shown in plan by the broken line **22***a*) corresponds to that of the passage **16** and a rear edge **23** whose outline (similarly shown by the broken line **23***a*) differs from that of the forward edge in being oval. The two edges are joined by a continuous surface **24** of generally conical form. The passage **16** has at one end a cavity **25** of larger diameter than the passage and forming the shoulder **17** and at the other end a second cavity **26** of larger diameter than the passage and separated from it by a step or shoulder **27**.

The engagement of the tube in the holder **16** from the position shown in FIGURE 18 progressively deforms the surface **24** to give it temporarily along its whole length the same contour as the forward edge **22**, until the rear edge **23** passes the shoulders **27** after which the end section **1***a* springs back to its original form and the rear edge **23** abuts against the shoulder **27**. Furthermore the pro-

jections **6***h* and **6***j* abut against the shoulder **17** as explained above.

To withdraw the tube a cylindrical plug can be inserted in the end section **1***a* to restore it temporarily to a cylindrical form.

FIGURE 19 shows a modification of FIGURE 12 in which the step or shoulder **17** is replaced by the ends **17***d* of longitudinal recesses or grooves such as **28***d* provided in the wall of the passage **16** to receive the projections **5***d* and **5***e*. The grooves **28***d* ensure a predetermined angular position for the tube in the holder which is particularly valuable when the plug should be introduced into the socket in a predetermined orientation, as in the case of the flat plug **19**.

In the case of the embodiment illustrated by FIG. 20, the intermediate portion of the tube **9** is provided with non-contiguous faces **13** (only the face **13***n* is shown) and the corners **14** (**14***m* and **14***n*) are cut out over a length L in such manner as to form slots **4***m* and **4***n* (only slot **4***m* is visible). In this manner two pairs of abutments **6** (**6***m*$_1$, **6***m*$_2$ and **6***n*$_1$, **6***n*$_2$) are obtained at the level of each slot, the two abutments of each pair being located at a distance equal to L from each other. Each of the faces **13***m* and **13***n* includes a longitudinal slot (**35***m* and **35***n*, the second one only being visible), which is parallel to the axis of the tube **9**. The holder **7** is analogous to that of FIG. 18 with the difference that the shoulders **17** and **27** are at a distance of each other equal to L.

In this way, and in view of the resiliency of the structure that is obtained, in particular owing to the slots **35***m* and **35***n*, there is produced, when the socket is inserted in the holder, by contact with the shoulder **17**, a retraction of the portions of the corners **14** remaining at the level of the abutments **6***m*$_1$ and **6***n*$_1$, thus permitting the passage of the socket.

When the socket has been inserted to a sufficient depth so that the abutments **6***m*$_1$ and **6***n*$_1$ have moved past the shoulder **27**, the above indicated portions of the corners **14** return to their initial shape, the socket being thus locked inside the holder **7** owing to the cooperation of the abutments **6** and the shoulders **17** and **27**.

In order to disengage the socket, a method analogous to that indicated above with reference to FIG. 18 may be used.

In a further modification, not shown in the drawings, to prevent removal of the tube in the sense which separates the abutments **6** from the shoulders **17** and **17***d*, each strip has local deformations projecting outwardly and adapted to engage in recesses or against transverse engagement surfaces provided for the purpose in the holder **7** after being eased into position during insertion of the tube in the holder.

What I claim is:

1. A process for the production of a socket for an electrical plug and socket connector comprising the steps of deforming a middle portion of a cylindrical metal tube in a manner symmetrical with respect to the axis of the tube to form plug-engaging strips joined by edges projecting beyond the periphery of the undeformed tube end portions, and cutting out the said edges to form slots which separate the strips, the strips lying wholly within the periphery of the undeformed tube portions.

2. A process as claimed in claim **1** in which the deformation is effected by inwardly-directed pressure in the region of the strips.

3. A process as claimed in claim **1** in which the cutting out is effected in such a way that the slots do not extend the full length of the deformed portion but leave an unslotted part between the slotted portion and one of the end portions, and the tube is placed in a holder of an insulating material having abutments against which the projecting edges of the unslotted part of the deformed portion rest.

4. A process as claimed in claim **3** in which the holder has a cylindrical passage in which the tube is disposed, the abutments being formed by a step in the passage, and the end portion of the tube remote from the unslotted part of the deformed portion is expanded into an enlargement of the passage to secure the tube in position.

5. A process as claimed in claim **3** in which the abutments are formed by the ends of slots in the holder into which the projecting edges are slid and which serve to locate the tube in a fixed angular position in the holder.

6. A process as claimed in claim **3** in which the end portion of the tube remote from the unslotted part of the deformed portion is shaped to have a circular cross section at its leading edge which changes progressively to a non-circular section at its trailing edge and which end portion is inserted first into a passage in the holder having a cross section corresponding to that of the leading edge so that the trailing edge is temporarily resiliently deformed to the same cross section, the inner end of the passage being defined by a retaining shoulder beyond which the trailing edge of the end portion of the tube takes up its original cross-section and thereby locks the tube in the holder.

7. An electrical socket member for a plug and socket type electrical connector, which socket member comprises, in combination:

a metal socket including two tubular end portions, a front one and a rear one, having a common axis and an intermediate portion integral with said end portions and extending between them and comprising at least two separate longitudinal resilient strips the generatrices of which are parallel to said axis, with, between said strips, longitudinal slots parallel to said axis, said slots defining longitudinal edges of said strips, each said strip being adapted to engage said plug, when said plug is introduced into said socket, along a middle portion of said strip between, but excluding, said longitudinal edges, said longitudinal edges remaining clear of said plug, the rear ends of said slots being at a distance from said rear tubular end portion, said strips being tangent to a cylindrical surface the generatrices of which are parallel to said axis,

the front edge of the part of said intermediate portion located between the rear ends of said slots and the rear tubular end portion forming abutments extending outside of the cylindrical surface of said rear tubular end portion, and

a socket holder made of an insulating material and surrounding said socket and forming a housing fitting on said front tubular end portion, said socket holder being provided with stopping means adapted to cooperate with said abutments.

8. An electrical socket member according to claim **7** wherein the front end of said front tubular end portion of said metal socket has a flaring shape and fits against the corresponding flared edge of said socket holder, whereby said metal socket is tightly held in said socket holder.

9. An electrical socket member according to claim **7** wherein said socket intermediate portion consists of three strips disposed, in cross section, along the three sides of an equilateral triangle circumscribing a circle which is the cross section of said cylindrical surface, said abutments being constituted by the apexes of the triangular cross section of the part of said intermediate portion located between said rear ends of said slots and the rear tubular end portion.

10. An electrical socket member according to claim **7** wherein said intermediate socket portion consists of two strips facing each other and having, in cross section, sinuous shapes with their respective middle points at the minimum distance from each other.

11. An electrical socket member according to claim **7** wherein said intermediate socket portion consists of two strips facing each other and forming, along their middle lines, rectlinear grooves facing each other.

12. An electrical socket member according to claim **7**

wherein said socket holder is provided with a cylindrical housing forming a shoulder at each end thereof and said socket front tubular end portion has its front edge in the shape of a circle of a diameter corresponding to that of said cylindrical housing and its rear edge in the shape of an elongated closed curve of a maximum diameter greater than that of said cylindrical housing, the perimeter of said curve being equal to that of said circle, the surface between said edges being of general conical shape to join them to each other, whereby, after deformation to permit the passage of said socket front tubular end portion through said housing, said rear edge is caught against the front shoulder of said holder housing.

13. An electrical socket member according to claim 7 wherein said socket holder housing is provided with longitudinal grooves adapted to accommodate said abutments of said socket.

14. An electrical socket member according to claim 7 wherein said socket holder is provided with a cylindrical housing forming a shoulder at each end thereof, and said socket front tubular portion is of circular cross section and adapted to slide through said holder cylindrical housing, said abutments of said socket being adapted to fit against said socket holder shoulders, said socket being provided with two longitudinal slots to permit deformation of said socket when it is to slide through said housing.

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