Feb. 19, 1963 J. M. SHEESLEY 3,078,433

SELF-RETAINING ELECTRICAL CABLE CONNECTOR

Filed May 7, 1959 3 Sheets-Sheet 1

Fig. 1

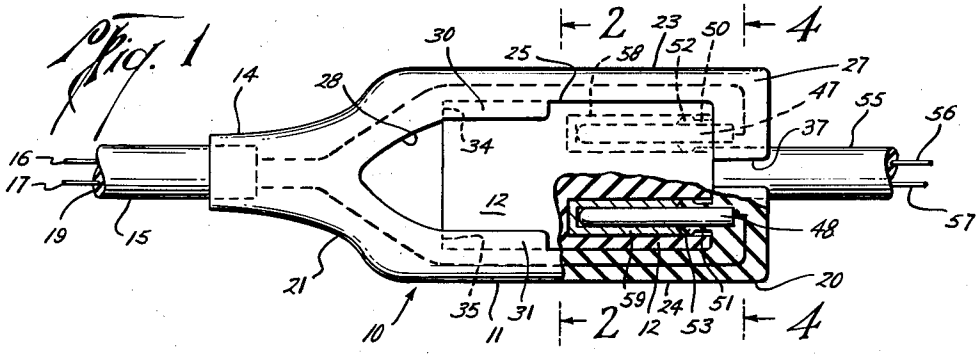


Fig. 2

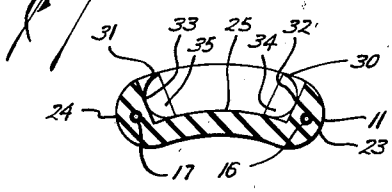


Fig. 3

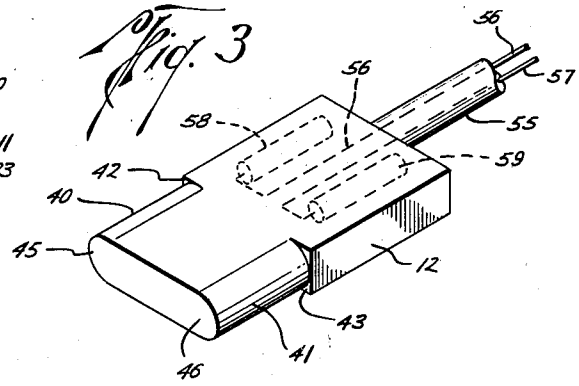


Fig. 4

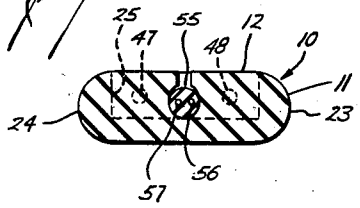
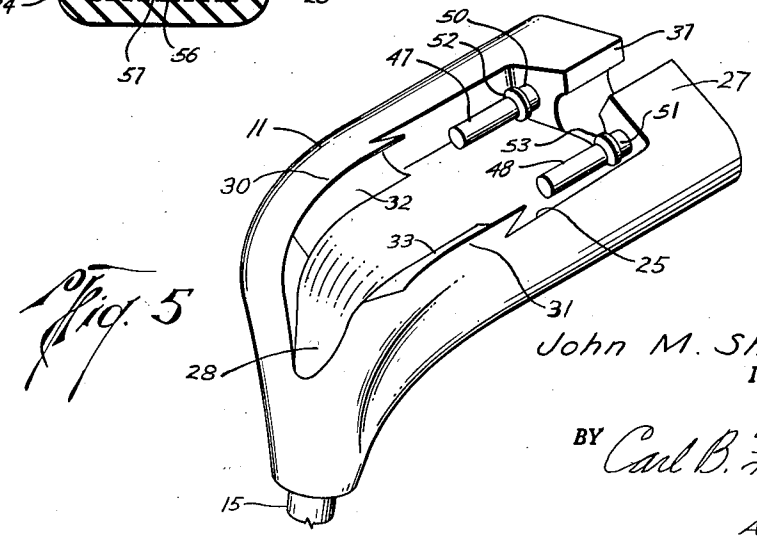


Fig. 5



John M. Sheesley
INVENTOR.

BY Carl B. Fox, Jr.

ATTORNEY

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SELF-RETAINING ELECTRICAL CABLE CONNECTOR

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Fig. 6

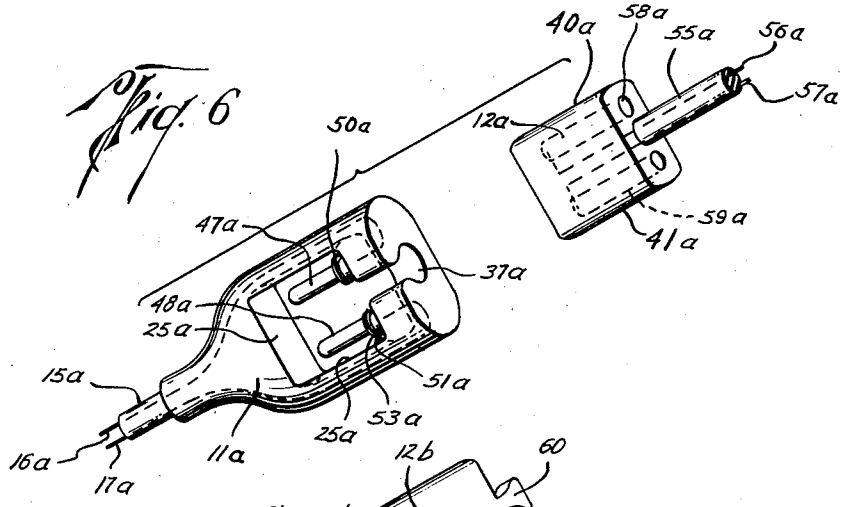


Fig. 8

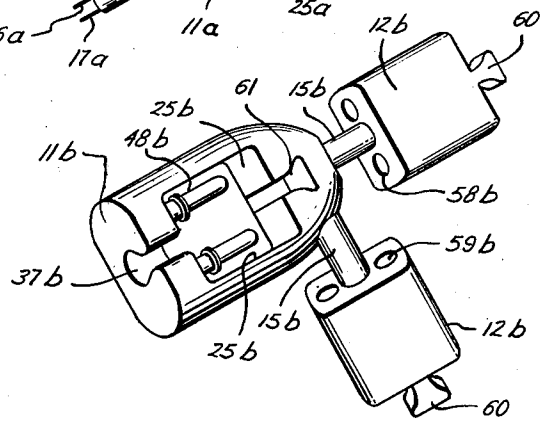
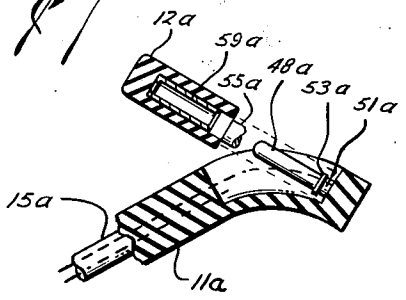


Fig. 7



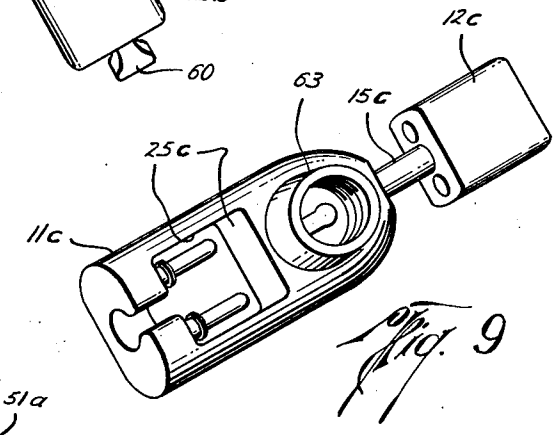


Fig. 9

John M. Sheesley
INVENTOR.

BY Carl B. Fox, Jr.

ATTORNEY

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SELF-RETAINING ELECTRICAL CABLE CONNECTOR

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Fig. 10

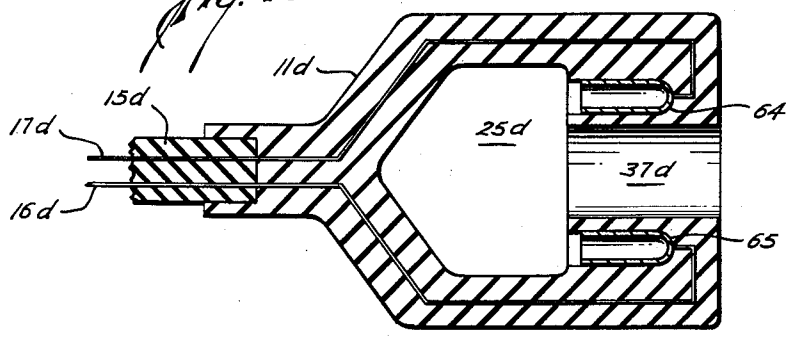


Fig. 11

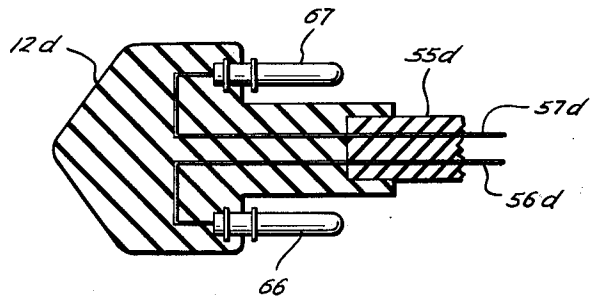
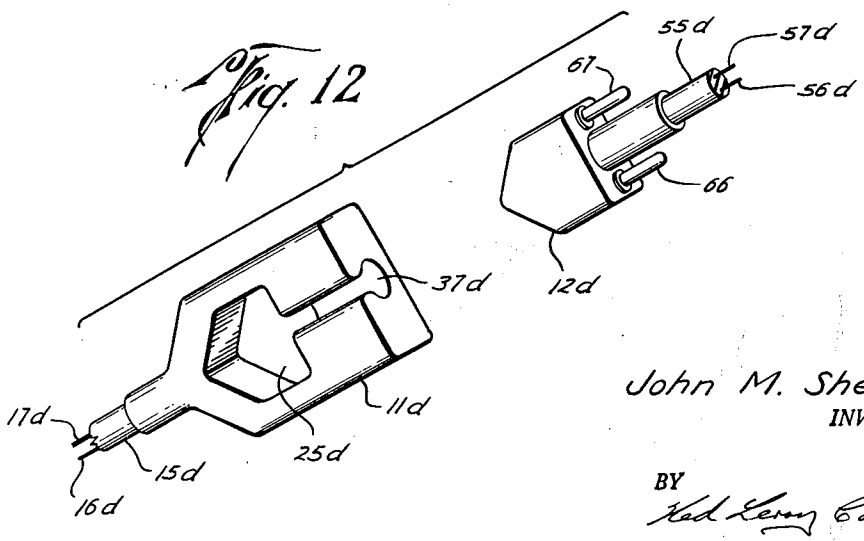


Fig. 12



John M. Sheesley
INVENTOR.

BY Kad Leroy Conley
ATTORNEY

United States Patent Office 3,078,433 Patented Feb. 19, 1963

3,078,433

SELF-RETAINING ELECTRICAL CABLE CONNECTOR

John M. Sheesley, % Research Engineering Co., P.O. Box 9011, Houston, Tex.

Filed May 7, 1959, Ser. No. 811,763
14 Claims. (Cl. 339—62)

This invention pertains to apparatus for connecting electrical cables or other elongate members of like form and properties. More particularly, the invention pertains to electrical cable connectors which are to be subjected to severe conditions of use, such as, for example, high longitudinal tensions, shock, crushing by motor vehicles, and the like.

This application is continuation-in-part of my copending application Serial No. 794,695, filed February 20, 1959, now abandoned.

A principal object of the invention is to provide a connector for elongate members which is strong, safe, and dependable.

Another object of the invention is to provide a connection for electrical conductor elements which is not subject to being damaged by water and other fluids, by crushing, by tensional strain, or by other forces likely to damage conventional electrical connection equipment.

Another object of the invention is to provide such a connection which is of low cost, of simple form, and yet which is entirely dependable in use even under the most damaging conditions.

A further object of the invention is to provide such a connection which will not become inadvertently disconnected under strain of rough usage.

Another principal object of the invention is to provide a connection which is not unsightly and which is of universal application.

Another object of the invention is to provide such a connection which is safe.

The connection apparatus according to this invention includes two interfitting parts, one part of which forms a receptacle for the other part. When engaged, the carriers of electricity within the apparatus are sealed against invasion by water or other damaging fluids, the engaged parts of the apparatus are secured one to the other and not subject to accidental disengagement, and the carriers of electricity are not subject to mechanical or to electrical failure under severe conditions of use. A noteworthy advantage of the connector afforded by this invention is that it is capable of supporting relatively great weights imposed across the connection, so that an electrical or other cable may be drawn to or suspended from an elevated structure and the connections thereof hereby provided will support both the weight of the cable itself as well as other tensions imposed thereon.

Other objects and advantages of the invention will appear from the following description of preferred embodiments thereof, reference being made to the accompanying drawings, of which:

FIGURE 1 is a plan view, partly in horizontal section, of a preferred form of connector according to the invention, shown engaged or connected to provide electrical connection between two two-element electrical cables or wires;

FIGURE 2 is a vertical section of the outer element shown in FIGURE 1, the inner element shown in FIGURE 1 being removed, and the outer element being elastomerically distended for a purpose to be described, the vertical section of the outer element being taken as indicated by line 2—2 of FIGURE 1;

FIGURE 3 is an enlarged upper perspective view of the inner element shown in FIGURE 1;

FIGURE 4 is a vertical section taken at line 4—4 of FIGURE 1;

FIGURE 5 is an enlarged upper perspective view of the outer element shown in FIGURE 1, the inner element being removed as in FIGURE 2, the outer element being shown in FIGURE 5 elastomerically distended to provide for insertion of the inner element, as will be further described;

FIGURE 6 is an upper perspective view of a modified form of apparatus according to the invention, same being shown broken apart or "disconnected";

FIGURE 7 is a vertical section taken at the longitudinal center-line of the apparatus shown in FIGURE 6, the apparatus being shown disconnected with an element thereof elastomerically distended to permit assembly of the elements;

FIGURE 8 is an upper perspective view of still another modified form of the apparatus, only a part thereof being shown in the drawing;

FIGURE 9 is an upper perspective view of still another modification of the invention;

FIGURE 10 is a cross-sectional view of another modified form of the outer element of the apparatus according to the invention;

FIGURE 11 is a cross-sectional view of a modified form of the inner element of the apparatus which fits into the outer element of FIGURE 10; and

FIGURE 12 is a perspective view of the elements of FIGURES 10 and 11.

Referring now to the drawings in detail, and first to FIGURES 1–5, a connector apparatus, generally indicated by reference numeral 10, includes an outer body element 11 and an inner body element 12. Bodies 11 and 12 are formed, for example by molding, of an elastomeric insulating material such as rubber or plastic. Body 11 has at one end a tubular socket formation 14 into which is received the end of an electrical cable 15, or conductor, having two electrical conductor elements 16, 17 disposed longitudinally therethrough. The inserted end of cable 15 is secured within socket 14, for example by bonding the elastomeric electrical insulating portion 19 thereof to the elastomeric material of body 11, so that the structure becomes substantially integral.

At its end opposite socket 14, body 11 is enlarged as at 20, there being a smooth flared enlargement area 21 between socket 14 and enlarged end 20. Body end 20 is of relatively flat form as shown in FIGURES 2, 4, the narrower sides 23, 25 thereof being smoothly convexly curved. A recess 25 is provided in one of the wider sides 27 of body 11, providing a receptacle for the body 12. Recess 25 is of generally rectangular cross-section, but has, at its end toward socket 14, a generally V-shaped end portion 28, and two opposite inwardly protruding formations 30, 31 at opposite sides of the recess. The formations 30, 31 are concave, providing the curved seats 32, 33, respectively, therewithin facing recess 25, the upper sides of each of which overhang portions of the interior of recess 25. Shoulders 34, 35 are provided at the respective ends of seats 32, 33 toward V-shaped recess end 28.

Opposite recess end 28, there is provided a concave-sided outlet 37 from recess 25. Body 12 (best shown in FIGURE 3), of generally flat rectangular disk shape, has convexly curved opposite side portions 40, 41 at its end. These side portions correspond in size, position and curvature with seats 32, 33 when body 12 is placed within recess 25 of body 11. The shoulders 34, 35 at the ends of the respective side portions abut the corresponding ends of formations 30, 31. Body 12 fits snugly within recess 25 at all of its areas engaged therewith. The length of body 12 is made such that the end surfaces 45, 46 within the curvature of side portions 40, 41, respectively, flushly fit against shoulders 34, 35 at the ends of seats 32, 33.

Body 11 has two electrical contact prongs 47, 48 within

recess 25 thereof and facing toward conductor 15, one end of each prong being imbedded in the elastomeric material of which body 11 is formed, one to each side of outlet or opening 37. The electrical conductor elements 16, 17 each extend through body 11, at the sides of recess 25 thereof, and element 16 is connected for electrical current flow to the imbedded end of prong 47 while element 17 is connected for electrical current flow to the imbedded end of prong 48. Elements 16, 17 are electrically insulated, one from the other and also from other objects, by the elastomeric insulating material of body 11 through which they are disposed. Each of the elements 16, 17, and their connections with the prongs, are completely surrounded and enclosed by the elastomeric material to be insulated thereby.

At the side of recess 25 from which prongs 47, 48 extend into recess 25, the recess wall is provided with two integral tubular members 50, 51 of the elastomeric material each of which surrounds a base part of a prong 47, 48 adjacent the recess wall. Members 50, 51 each have a ring portion 52, 53 at their ends of enlarged diameter.

Body 12 includes, at its end opposite the end of side portions 40, 41, a section 55 of electrical conductor cable or wire of the same type as cable 15. Conductor 55 has disposed therethrough two electrical conductor elements 56, 57. Conductor 55 is formed of elastomeric electrical insulating material (like or similar to that of body 12) and its end is received and bonded in place in a suitable recess in the end of body 12. In the same end of body 12, and facing conductor cable 55, there are imbedded in place two tubular contact elements 58, 59, bonded at their outside surfaces with the material of body 12, and terminating at beveled ends spaced from the end of body 12. The electrical conductor elements 56, 57 of cable 55 each continue through the elastomeric insulating material making up body 12, element 56 being connected for flow of electrical current to the inner end of tubular contact element 58, and element 57 being connected for flow of electrical current to the inner end of tubular contact element 59, as shown. Both elements are insulated apart and from other objects by the material of body 12 which completely encloses the elements and their connections. The openings of body 12 within which contact elements are disposed are cylindrical and continue full size beyond the beveled ends of contact elements 58, 59 to the end of body 12, leaving enlarged opening spaces at the ends of elements 58, 59 within which the elastomeric tubular members 50, 51 of body 11 are received when prongs 47, 48 are inserted into the tubular openings of contact elements 58, 59, respectively, to make electrical contact therewith. Tubular contact elements 58, 59 have tubular openings therethrough of a size to make a sliding pressure contact with prongs 47, 58 inserted thereinto. It is also contemplated that other means for insuring good electrical engagement between the prongs and tubular contact receptables such as are known in the art may be substituted for the prong-tube contacts shown, no detailed explanation of the other known forms being necessary.

Note, in FIGURES 1–4, that conductors 16, 17, 56, and 57 all lie in substantially the same plane. This is preferred, since tension applied to conductor cables 15 and 55 is thereby applied in a straight line through the connecting device.

Referring now particularly to FIGURES 2 and 5 of the drawings, but also still to FIGURES 1, 3 and 4, to insert body 12 within recess 25 of body 11, body 12 is laid against the upper surface of body 11, its receptacle end having cable 55 extending therefrom and having tubular contacts 58, 59 opening therefrom being placed adjacent the ends of prongs 47, 48. Cable 55 is then pressed until it snaps or slides into opening 37, the concavely curved sides of opening 37 resiliently engaging the sides of the cable and holding it down and in place. Next, one hand holding down on body 12 with the fingers and pressing upwardly on the bottom of body 11 beneath opening 37, and the other hand grasping the socket 14 end of body 11, body 11 can be bent resiliently to make its underside concave, so that formations, 30, 31 are spread laterally to widen the opening of recess 25 therebetween, and the generally V-shaped end portion 28 of recess 25 is moved down out of line with prongs 47, 48. Pressure with the thumb of the hand holding the socket 14 end of body 11 beneath body 11 below the V-shaped end portion 28 of recess 25 assists in the lateral spreading, or transverse bending, of body 11 shown in FIGURE 2. End-to-end bending by both hands accomplishes the longitudinal "back bending" of body 11. This accomplished, body 12 is moved with the one hand down into recess 25 and longitudinally to insert prongs 47, 48 into tubular contact elements 58, 59, cable 55 sliding longitudinally outwardly in opening 37 as the longitudinal movement of body 12 relative body 11 is made. When the socket 14 end of body 11 is released, elastomeric body 11 resumes its undistended "back-bent" shape, and curved surfaces 40, 41 are snugly fitted by seats 32, 33, respectively. End surfaces 45, 46 of body 12 are fitted closely against shoulders 34, 35 at the seat ends. Body 12 fits snugly and resiliently within recess 25 over all of its side and lower surfaces.

The overhang of the upper sides of seats 32, 33 above body 12 insures that body 12 will be firmly held in place; the shoulder 34, 35—end surface 45, 46 engagements insure that the prongs will be firmly held with the tubular contact elements and that the corresponding body 12 end will be snugly fitted against the end of recess 25.

The tubular elastomeric elements 50, 51 are received into the enlarged end openings of the contact 58, 59 openings in body 12, and enlarged ring formations 52, 53 thereof form resilient fluid-tight seals with the contact ends and with the sides of their openings. Thus, the assembled connection is waterproof and free of ingress to the conductor elements by harmful gases and liquids.

The flat shape of engaged bodies and their resiliency enable the connection to withstand crushing and shocks, such as might be encountered were the connection run over by a car or truck, or struck by a hammer or falling object.

Stresses imposed longitudinally on the connection by tensions in opposite directions on cables 15, 55 cause no twisting or angular strains on the connection since cables 15, 55 and assembled bodies 11, 12 are all in line, longitudinal stresses thereon being in a direction to tighten the connection.

Referring now to FIGURES 6–9 of the drawings, there are shown three modified forms which the connection apparatus may take.

In FIGURES 6–7, body 11*a* is generally the same as body 11 of FIGURES 1–5, and body 12*a* is generally the same as body 12 of FIGURES 1–5, and corresponding parts of bodies 11*a*, 12*a* are indicated by the same reference numerals as pertain the bodies 11, 12 of FIGURES 1–5, except with the addition of the suffix "*a*" to the reference numerals of FIGURES 6–7. Cables 15*a* and 55*a* are secured by bonding to bodies 11*a*, 12*a* as before. Prongs 47*a*, 48*a* are of the same form and are secured in the same manner as prongs 47, 48 of FIGURES 1–5. Recess 25*a*, however, is of generally rectangular cross section and no V-shaped portion thereof corresponding to portion 28 of recess 25 is provided. Body 12*a* has uniform convex sides 40*a*, 41*a* corresponding to side end surfaces 40, 41 of body 12, and the sides of recess 25*a* are of corresponding concave shape so that sides 40*a*, 41*a* will fit snugly thereagainst when body 12*a* is placed in recess 25*a* of body 11*a*. Tubular contact elements 58*a*, 59*a*, tubular elastomeric elements 50*a*, 51*a* are identical with the corresponding elements of the FIGURES 1–4 embodiment.

As is indicated in FIGURE 7, body 12*a* is inserted into recess 25*a* of body 11*a* by "back-bending" body 11*a* as before, thumb pressure beneath body 11*a* not usually

being necessary to assemble the body parts of this embodiment but useful if desired. The prongs 47*a*, 48*a*, and elements 58*a*, 59*a* engage to make the electrical connection between conductor elements 16*a*, 17*a* and 56*a*, 57*a* of cables 15*a*, 55*a* as in the other embodiments.

In FIGURE 8, elements corresponding to those of FIGURES 1–5 and 6–7 are designated by similar reference numerals including the suffix "*b*." Bodies 11*b*, 12*b* are similar in form to bodies 11*a*, 12*a*. However, body 12*b* has at its end away from contact elements 58*b*, 59*b* a taper-sided integral extension 60, and recess 25*b* of body 11*b* has a corresponding taper-sided recess 61, the side tapers being such as to prevent removal of the extension 60 out of the mouth opening of recess 61, but permitting entrance of extension 60 into recess 61 when body 12*b* is placed in recess 25*b*. Bodies 11*b* and 12*b* are held together at the abutment therebetween corresponding to the locations of extension 60 and recess 61 to prevent relative separations resulting from longitudinal tensions across the connection.

An important feature of the FIGURE 8 embodiment is the provision of the multiple body 12*b* elements integral with body 11*b* through cable elements 15*b*, which are bonded to the elements at their ends. This adaptation permits manifold-type connections between plural cables.

It is to be understood, of course, that an element 12*b* having connection with another cable 15*b* or corresponding to cables 55, 55*a*, will be received in recess 25*b*, it not being shown since it is identical to the two bodies 12*b* here shown integral with body 11*b*.

In FIGURE 9, the connection shown is identical with that of FIGURES 6–7, except that body 11*c* is of extended length and has a female electrical screw socket 63 disposed therewithin in bonded-together relation. Socket 63 permits connection with a corresponding threaded male electrical element (not shown) with wiring of socket 63 being in the conventional manner to the internal conductors of body 11*c*. Body 11*c* also includes integral body 12*c* part which is the same as bodies 12*b*, 12*b* of the FIGURE 8 embodiment except that extension 60 is omitted. Body 12*c*, then, is identical to body 12*a* of FIGURES 6–7.

Referring now to FIGURES 10, 11, and 12, another embodiment of the invention has the prongs on the inner member and the tubular contact elements in the outer member. As shown in FIGURE 10, body 11*d* has a recess 25*d* and an outlet 37*d* from the recess. Electrical conductor elements 16*d*, 17*d* lead from electrical cable 15*d* to tubular contact elements 64, 65, bonded at their outside surfaces with the material of body 11*d*. In FIGURE 11, body 12*d* is affixed to electrical cable 55*d* containing conductor elements 56*d*, 57*d*. Conductor elements 56*d*, 57*d* lead to electrical contact prongs 66, 67, which are constructed similarly as prongs 47, 48 as shown in FIGURE 5. It may readily be seen that this embodiment of the invention is used in substantially the same way as the other embodiments, and has the same advantages.

Although it is preferred that both the outer body and the inner body be made of a flexible insulating material, such as natural or synthetic rubber or polyethylene, it will be appreciated that only one of bodies need be flexible in order for the electrical contacts to be engaged and disengaged, while the other body may be made of a relatively rigid insulating material, such as phenolic plastic. Furthermore, either of the bodies may be made flexible. For example, in the embodiment of FIGURES 10, 11, and 12, body 12*d* may be made longer and sufficiently flexible to allow its being bent enough to be inserted into or removed from recess 25*d* without bending body 11*d*.

Thus it may be seen that any of these embodiments provides an electrical connection for connecting one elongate electrical conductor to another elongate electrical conductor which cannot be inadvertently disconnected by tensile strain, due to the fact that each of the cooperating electrical contacts faces the electrical conductor to which it is affixed, so that the application of tension to the conductors only tends to bring the contacts into closer engagement. It will be appreciated that in order for the contact to face the conductor to which it is attached, it is necessary for the conductor to bend around through substantially 180° from its point of attachment to the back of the contact, or for the contact to have such a 180° bend portion, or for the contact and conductor together to form such a 180° reverse bend or substantially J-shaped portion. In other words, a contact element faces its conductor when it is so positioned as to be engaged with a mating contact element by movement of the respective conductors in a direction tending to pull the conductors away from each other. A knife-blade type contact, for example, contacts on its sides, rather than on its end, but it faces, or points, in the direction toward which it must be moved to become engaged, that is, in the direction toward which its conductor extends.

While the contact and/or conductor may have sufficient strength itself to maintain the reverse bend shape against tension imposed on the connection, it is a feature of the invention to provide the necessary mechanical strength through structure adjacent the contact and conductor forming the insulation thereof and the mechanical interlock between the two parts of the connection.

Although the particular forms of electrical contacts shown and described herein are preferred, it will be evident that many other types of contacts known in the art may be used.

While the invention has been illustrated and described in connection with apparatus having dual electrical conductor elements, it is contemplated that the invention includes apparatuses having only one or more than two electrical conductor elements connected thereby, the exact arrangement of which will be apparent to those skilled in the art.

While preferred embodiments of the invention having the advantages and fulfilling the objects thereof hereinbefore described are shown and described, many modifications thereof may be made by a person skilled in the art without departing from the spirit of the invention, and it is intended to protect by Letters Patent all forms of the invention falling within the scope of the following claims.

I claim:

1. Apparatus for connecting elongate electrical conductors comprising a first body having a first end and a second end, a socket in a longitudinal face of said body, a conductor leading into said body at said first end and extending substantially longitudinally of said body to a point between said socket and said second end, an electrical contact element affixed to the end of said conductor and communicating with the side of the socket nearest the second end of the body; a second body having a first end and a second end, a portion of said body comprising a plug portion receivable in the socket of the first body, a conductor leading into said second body at said first end and extending substantially longitudinally thereof into said plug portion, and an electrical contact element affixed to the end of said conductor and communicating with the side of the plug nearest the first end of the second body, one of said bodies being made of a flexible insulating material.

2. Apparatus as defined by claim 1 wherein the side of the socket in the first body nearest the first end of said first body coacts with the coinciding side of the plug portion of the second body to prevent movement of the first end of the first body towards the first end of the second body.

3. Apparatus as defined by claim 1 wherein said con-

ductors and said contact elements are all in substantially the same plane.

4. Apparatus as defined by claim 1, including means providing a substantially watertight seal around the contact elements when they are in engagement.

5. Apparatus as defined by claim 1, including overhanging means at the side of said socket, and complementary recessed surfaces on the side of said plug portion whereby said second body is held secured in said recess.

6. Apparatus as defined by claim 1 wherein said first body is made of a flexible, insulating material, and said second body is comparatively rigid.

7. Apparatus as defined by claim 1 wherein said second body is made of a flexible insulating material and said first body is comparatively rigid.

8. Apparatus as defined by claim 1 wherein said contact elements comprise mating prongs and tubular members.

9. Apparatus as defined by claim 1 wherein the contact element in the first body is a prong and the contact element in the second body is a tubular member.

10. Apparatus as defined by claim 1 wherein the contact element in the first body is a tubular member and the contact element in the second body is a prong.

11. An electrical connection comprising a pair of conductors extending in opposite directions, a substantially 180° bend portion on one end of each conductor, a contact element on the end of each conductor facing the same direction as the conductor extends, each engageable with the other contact element by movement in the direction toward which said conductors extend, an insulating body embedding each 180° bend portion, one of said insulating bodies being flexible, and a cavity in one lateral face of said flexible body communicating with the contact element attached to the conductor end embedded in the flexible body, said cavity being adapted to receive a portion of the other insulating body when the contact elements are engaged.

12. An electrical connection comprising a flexible outer body and an inner body, each having a somewhat flat, elongate shape and each having a first end and a second end; a generally rectangular socket in one flat face of said outer body; at least two opposite walls of said socket being concave to form seats in said walls and portions overhanging said socket, said inner body having convexly curved walls complementary to said concave walls and having a width substantially equal to the width of said socket, whereby the inner body may be fitted snugly within the socket and be retained therein by the overhanging portions; an electrical conductor embedded in said outer body extending longitudinally thereof out the first end of the outer body and past the socket to near the second end of the body; an electrical contact attached to the end of the conductor near the second end of the outer body having communication with the socket in said outer body; an electrical conductor embedded in said inner body extending longitudinally thereof out the second end of the inner body and to near the first end of the inner body; and an electrical contact attached to the end of the conductor near the first end of the inner body adapted to make contact with the outer body electrical contact upon longitudinal movement of said inner body into said socket and applying a tensile force to said conductors, said flexible outer body being adapted to be bent to open said socket whereby said inner body may be inserted into said socket and retained therein until the outer body is again bent.

13. An electrical connection comprising a pair of conductors extending in opposite directions, a substantially 180° bend portion on one end of each conductor, a contact element on the end of each conductor facing the same direction as the conductor extends, each engageable with the other contact element by movement in the direction toward which said conductors extend, an insulating body embedding each 180° bend portion, and a cavity in one lateral face of one of said bodies communicating with the contact element attached to the conductor end embedded in said one body, said cavity being adapted to receive a portion of the other insulating body when the contact elements are engaged.

14. Apparatus for connecting elongate electrical conductors comprising a first body having a first end and a second end, a socket in a longitudinal face of said body, a conductor leading into said body at said first end and extending substantially longitudinally of said body to a point between said socket and said second end, an electrical contact element affixed to the end of said conductor and communicating with the side of the socket nearest the second end of the body; a second body having a first end and a second end, a portion of said body comprising a plug portion receivable in the socket of the first body, a conductor leading into said second body at said first end and extending substantially longitudinally thereof into said plug portion, and an electrical contact element affixed to the end of said conductor and communicating with the side of the plug nearest the first end of the second body.

References Cited in the file of this patent

UNITED STATES PATENTS

1,967,021	Gary	July 17, 1934
2,149,550	Richards et al.	Mar. 7, 1939
2,190,230	Cole	Feb. 13, 1940
2,332,846	Fladd	Oct. 26, 1943
2,478,143	Watts	Aug. 2, 1949
2,499,825	Havlicek	Mar. 7, 1950
2,672,594	Morton	Mar. 16, 1954
2,677,115	Stevens	Apr. 27, 1954

FOREIGN PATENTS

921,393	Germany	Dec. 16, 1954
710,996	Great Britain	June 23, 1954