March 17, 1936. H. A. DOUGLAS 2,034,090

WIRE TERMINAL FOR ELECTRICAL CONDUCTORS

Filed May 25, 1934 2 Sheets-Sheet 1

Fig. 1.

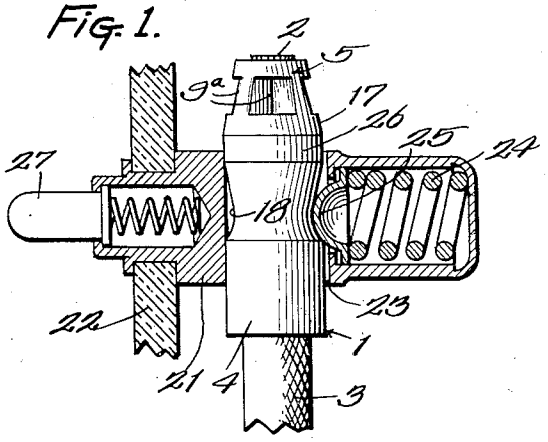


Fig. 4.

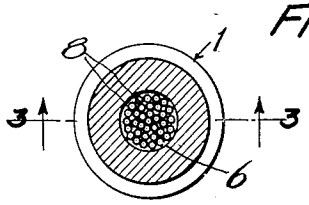


Fig. 5.

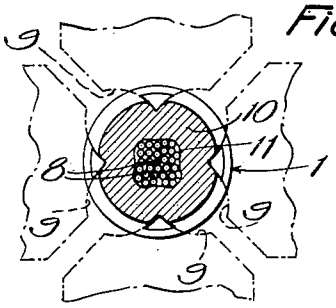


Fig. 2.

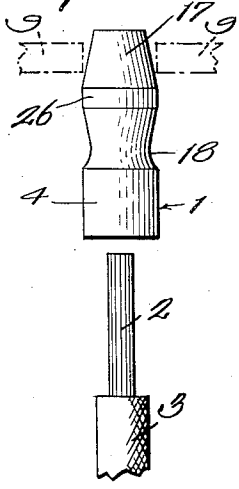


Fig. 3.

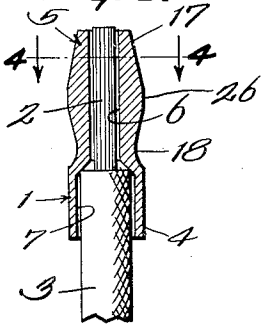


Fig. 6.

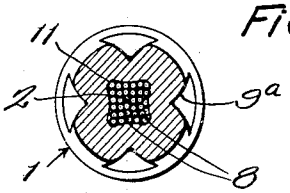


Fig. 7.

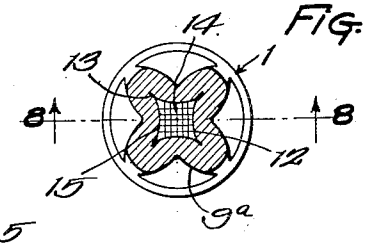


Fig. 8.

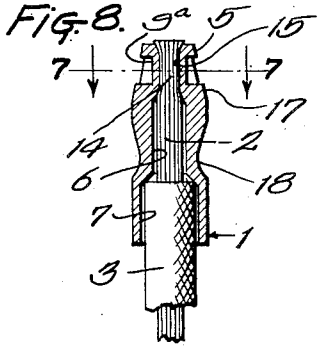


Fig. 9.

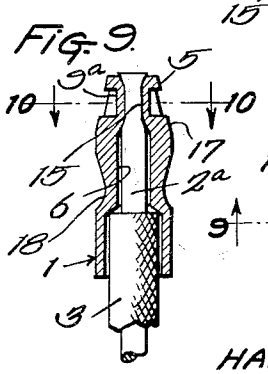
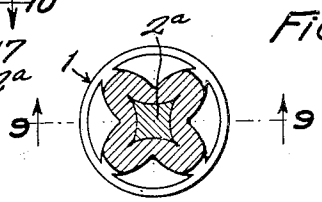


Fig. 10.



INVENTOR
HARRY A. DOUGLAS
BY Langdon Morr
ATTY.

March 17, 1936. H. A. DOUGLAS 2,034,090

WIRE TERMINAL FOR ELECTRICAL CONDUCTORS

Filed May 25, 1934 2 Sheets-Sheet 2

Fig. 11.

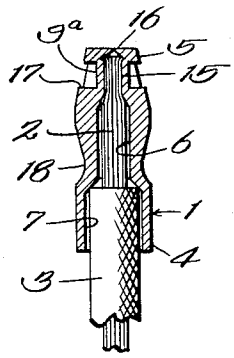


Fig. 12.

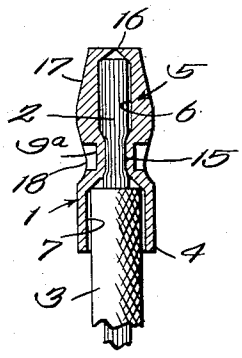


Fig. 13.

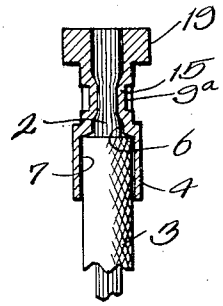


Fig. 14.

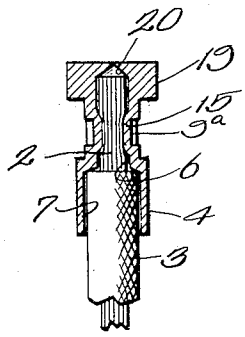


Fig. 15.

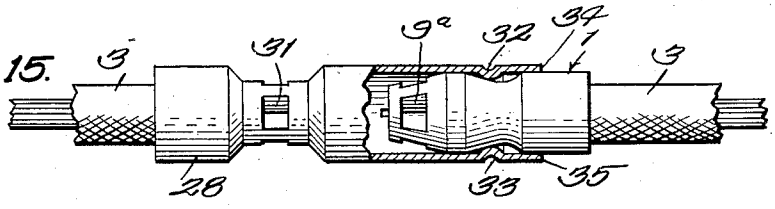


Fig. 16.

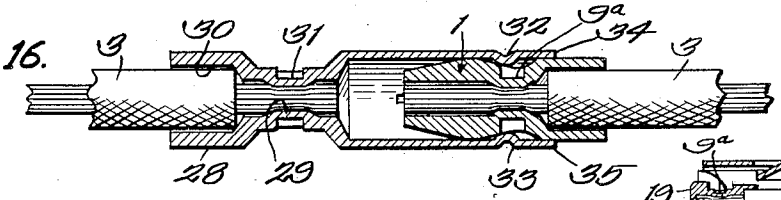


Fig. 17.

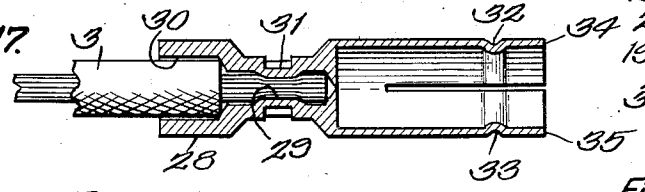


Fig. 20.

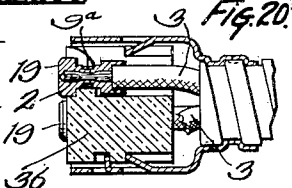


Fig. 21.

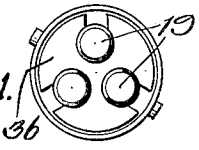


Fig. 18.

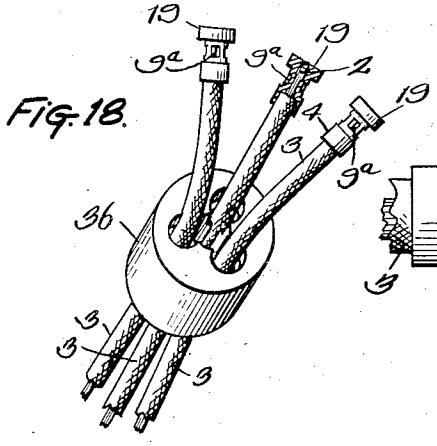
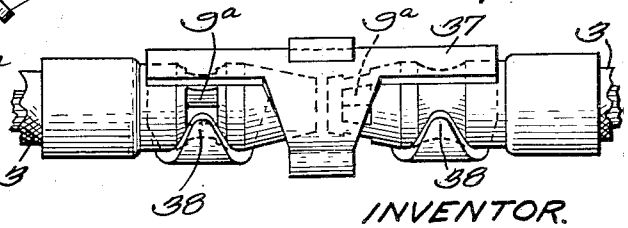


Fig. 19.



INVENTOR.
HARRY A. DOUGLAS
BY Langdon Morris
ATTY.

Patented Mar. 17, 1936

2,034,090

UNITED STATES PATENT OFFICE

2,034,090

WIRE TERMINAL FOR ELECTRICAL CONDUCTORS

Harry A. Douglas, Bronson, Mich.

Application May 25, 1934, Serial No. 727,503

20 Claims. (Cl. 173—269)

This invention relates to the production of wire terminals more particularly for electrical conductors, and is a continuation in part of this applicant's prior copending application, Serial No. 602,912, filed April 4, 1932.

Among other objects, the invention aims to provide an improved and simplified terminal for a current conducting wire, for example, in which the terminal is so joined to the wire as to reduce the voltage drop therebetween substantially to zero.

Another object of the invention is to provide a connection between the wire and the terminal without the use of solder and which will be stronger than connections produced with solder and which is not liable to deterioration.

Illustrative constructions and means for producing the same are shown in the accompanying drawings in which—

Figure 1 shows in elevation a plug terminal constructed in accordance with my invention and associated with one conventional circuit continuing device, shown largely in cross-section.

Figure 2 is a view somewhat reduced of the plug and the wire for which it is to constitute a terminal, in separated relation, this view indicating an early step in the practice of the invention, a portion of means for compressing the plug being shown in dotted lines.

Figure 3 is an axial section of the plug of Figure 2, but showing a later step in the practice of the invention in which the wire is inserted in the bore of the plug.

Figure 4 is an enlarged cross-section taken on the line 4—4 of Figure 3.

Figure 5 is a view similar to Figure 4, but indicating a later step in the practice of the invention.

Figure 6 is a view similar to Figures 4 and 5, but indicating a still later step.

Figure 7 is a view similar to Figures 4, 5 and 6, but indicating the final step in the production of the plug terminal and being a cross-section taken on the line 7—7 of Figure 8.

Figure 8 is an axial section of the plug, with the wire shown in elevation, and is a section taken on the line 8—8 of Figure 7, reduced to the scale of Figures 2 and 3.

Figure 9 is a view similar to Figure 8 illustrating use of a solid wire.

Figure 10 is a cross-section taken on the line 10—10 of Figure 9.

Figure 11 is a view similar to Figure 8 in which the bore 6 does not pass entirely through the tip portion 5, but is terminated adjacent thereto.

Figure 12 is a view similar to Figure 11 in which the terminal is secured to the wire by reducing the bore 6 intermediate the ends of the terminal in the reduced portion adapted to be engaged by the detent in a terminal receiving receptacle.

Figure 13 is a view similar to Figure 8 of a different type of terminal in which the bore extends through the tip thereof, but in which the terminal is secured to the wire by reducing the bore 6 intermediate the ends of the terminal.

Figure 14 is a similar view of a terminal similar to Figure 13 in which the bore 6 does not pass entirely through the tip portion, but is terminated adjacent thereto.

Figure 15 is a view in side elevation showing two types of terminals associated together to form a line connection with parts in section.

Figure 16 is a view partly in section illustrating the line connector portion with the bore extending entirely therethrough to receive one wire and the terminal upon the other wire secured in the manner illustrated in Figure 12 in which the bore 6 passes entirely through the terminal tip.

Figure 17 is a view in section of the line connector portion shown in Figure 16 in which the bore in that section does not pass all the way through, but is terminated adjacent the other terminal receiving member.

Figure 18 is a view partly in perspective and partly in section illustrating an application of the terminals shown in Figures 13 and 14 to an insulated block connector.

Figure 19 is a view in side elevation illustrating a different type of line connector in which one terminal is of the type illustrated in Figure 8 and the other of the type illustrated in Figure 12.

Figure 20 is a view in section illustrating an application of the terminals shown in Figures 13 and 14 to an insulated block connector, such as disclosed in this applicant's Patent No. 1,953,594, April 3, 1934.

Figure 21 is a view in end elevation of Figure 20.

In the illustrative construction shown in Figures 1 to 8, I have shown a generally cylindrical metallic plug 1 adapted to form a terminal for the current conducting wire 2 which generally carries the insulation 3. The plug 1 is preferably formed with a straight shank portion 4 and a bulbous tip portion 5. Referring particularly to Figure 3, the plug 1 is desirably first bored axially throughout its entire length as at 6 to receive the bared end of the wire 2 which is stripped of the insulation 3. The bore 6 is desirably counterbored as at 7 to permit a portion of the wire 2 with insula-

tion thereon to be received in the shank portion 4 of the plug to an extent that the end of the wire 2 is substantially flush with the end of the tip 5 of the plug.

In this instance, the wire 2 is stranded and is composed of the metallic strands 8, or may be a solid wire, such as 2a shown in Figures 9 and 10. As shown in the cross-sectional view (Fig. 4), when the wire 2 is first inserted (as shown in Figure 3) in the bore 6 of the plug 1 each of the strands 8 is substantially cylindrical which leaves interstices between the strands themselves and between the strands and the wall of the bore 6. In accordance with my invention, I swedge the metal of the plug and the metal of the strands 8 so that these interstices are substantially eliminated.

In Figure 5, I have shown a preferred next step in the illustrative process to produce a swedged terminal in which the plug 1 is engaged by more than two, in this instance four, swedging members such as the jaws 9, which are arranged ninety degrees apart about the axis of the plug, the oppositely disposed jaws constituting pairs. When moved centripetally, i. e. toward the axis of the plug, the jaws 9 force portions of the wall 10 of the plug 1 inwardly toward the bore 6, so that the bore is reduced in cross-sectional area as at 11.

In the illustrative construction the jaws 9 are desirably of the shape as shown and produce the indentations 9a in the tip 5 of the plug 1, so that the reduced bore 11 tends to assume an approximately square cross-sectional configuration and this configuration is accentuated as the jaws 9 move further inwardly to cause the plug at the point engaged by the jaws to assume the cross-sectional appearance shown in Figure 6 in which condition the strands 8 of the wire 2 received in the bore 6 of the plug have been forced closer together than in the condition of Figures 4 and 5. As the jaws 9 arrive at the limit of their movement centripetally of the plug 1, as shown in Figure 7, the bore of the plug, in the region of engagement of the plug with the jaws, has assumed the cross-section 12 in which the effective cross-sectional area of the bore has been substantially reduced from that of Figure 4 thus forming interengaging shoulders between the plug and wire as best shown in Figures 8 and 9. This substantial reduction is made possible in part by the jaws which permit the metal at the corners of the reduced bore at 12 to fold together, as at 13, thus enhancing the reduction of the bore. Also the strands 8, which in the step shown in Figures 5 and 6, were forced closer together, next as shown in Figure 7, have their available cross-sectional area of occupancy so reduced that they are deformed from their original circular cross-section and are forced to assume a cross-section, shown at 14, thus eliminating interstices between the strands themselves and between the strands and the deformed walls 15 of the bore at 12. This cross-section which is given the bore and the strands, in accordance with my invention, eliminates air spaces between the strands themselves and between the strands and the wall of the bore, so that the entry of moisture therebetween is prevented and the voltage drop between the wire 2 and the plug 1 is reduced substantially to zero. At the same time, I obtain a solid metal-to-metal contact and a practically integral coupling between the wire and the plug and the necessity of solder is entirely eliminated. Thus a much stronger connection is obtained between the wire and the plug than is possible with any means employing solder.

While in Figures 8 and 9 the bore 6 is shown passing entirely through the tip 5 and the wires 2 and 2a extending to the exterior surface of the tip 5, it may be desirable to terminate the bore short of the tip 5 as shown in Figures 11 and 12. In this case the bore 6 is terminated by a conical closure 16 which may or may not pierce the exterior of the tip 5.

In Figures 1, 8, 9 and 11 the deformed walls 15 of the bore 6 are located in the tapered end portion 17 of the plug 1. This type of plug is also provided with a reduced annular portion forming an oppositely tapered surface 18 extending in the opposite direction from the taper 17 between the taper 17 and the counterbore 7 of the plug. This reduced portion 18 coacts with the detent for securing the plug 1 in a connecting receptacle, as shown in Figure 1. This invention contemplates forming the reduced portion 15 of the bore 6 in the portion 18 of the plug in the same manner as described forming the reduced portion in the taper 17 of the plug, as shown in Figure 12.

Terminals of this general character may be employed in switches in which the end of the terminal forms a contact and in such cases the end 19 forming the contact is preferably of greater diameter than the shank portion 4, as shown in Figures 13 and 14. In such constructions the bore 6 may pass through the exterior flat surface of the contact 19, as shown in Figure 13, or may be terminated by a conical closure 20 adjacent the exterior surface of the contact 19 and may or may not pierce this surface, as shown in Figure 14. In this type terminal the deformed walls 15 of the bore are located between the contact 19 and the shank portion 4 of the plug, as shown in Figures 13 and 14.

The terminal of the type shown in Figures 8, 9, 11 and 12 secured to the wire 2 in the manner described may be assembled with a circuit continuing device such as shown in Figure 1 which includes a block 21 which in turn may be secured to an insulating mounting 22. The plug 1 is received in a cylindrical aperture 23 in the block 21 and the plug is pressed to one side of this aperture by a strong coiled spring 24 through the intermediation of a detent 25 carried by the block. To enhance the area of contact between the plug 1 and the block 21, I have shown the block as having two spaced apart contacting surfaces, one represented by the shank portion 4 of the plug and the other by a similar cylindrical portion 26. The spring 24 presses both the shank portion 4 and the cylindrical portion 26 against one wall of the aperture 23 and is so constructed and arranged that the voltage drop between the plug and the block is substantially reduced. The detent 25 snaps into the reduced portion or annular groove 18 between the tapered tip 17 and the shank portion 4 of the plug making a yielding but secure engagement between the plug and block. The block 21 may terminate at its other end in a metallic spring pressed contact 27 for contacting, for example, with a central contact on a lamp base (not shown). A similar structure to that shown in Figure 1 is more fully described and claimed in my copending application, Serial No. 713,713, filed March 2, 1934.

The wire terminal, instead of being a plug as in the exemplification heretofore described, may be a spring sleeve adapted to snap over the bulbous tip 1 of the plug to provide a line con-

nection between two electrical conductors, both of which are wires. In Figures 15, 16 and 17, I have shown such a spring sleeve **28** which may be bored at **29** to receive the bared end of the wire **2** and counterbored at **30** to receive the insulation **3**, similar to the bore and counterbore in plug **1**. In the region of the bore **29** the external diameter of the sleeve is preferably reduced, as at **31**, in the manner hereinbefore described and the wall of the sleeve at this point may be compressed to produce external indentations therein and the consequent reduction of the bore **29**, in the manner described in reducing the bore **6** of the plug **1**. The spring sleeve **28** may receive the terminal plug **1**, the semi-annular internal ribs **32** and **33** on the spring portions **34** and **35**, respectively, of the sleeve **28** snapping over the bulbous tip of the plug **1** and being yieldingly retained in the annular groove **13** in the plug **1** by the inherent resiliency of the spring portions **34** and **35**, which function in some respects similarly to the spring pressed detent **25** of the block **21** shown in Figure 1.

The bore **29** may pass entirely through, as shown in Figure 16, or may stop short, as shown in Figure 17.

While in Figure 15 I have shown the particular terminal of Figures 1 through 8, and in Figure 16 I have shown the particular terminal of Figure 12 in which the bore extends through the tip, obviously I may use equally any of the terminals of Figures 1 through 12.

Terminals of the type shown in Figures 13 and 14 may be employed in connection with a switch or a lamp socket as shown in my prior copending application, Serial No. 644,281, filed November 25, 1932. These terminals also may be mounted in a block of insulation **36**, to serve as contacts, and in Figures 18 and 20 I have shown a terminal of the type shown in Figure 14 so mounted. In Figure 18 I have shown this terminal mounted in the block from a central aperture, and in Figure 20 from the exterior.

It will be obvious that in either mounting I may employ equally the terminal of Figure 13.

The terminals as disclosed herein also may be employed in cooperation with a line connector, as shown in Figure 19. The particular line connector herein shown includes a metallic sleeve **37** having spaced apart spring tongues **38** which are adapted when the plug **1** is inserted to snap into and be yieldingly retained in the annular groove **18** of the plug by the inherent resiliency of the portions **38** which function in some respects similar to the spring pressed detent **25** of the block **21** shown in Figure 1. In Figure 19 I have shown one terminal of the type shown in Figure 8 and one terminal of the type shown in Figure 15, but obviously I may employ any of the terminals of Figures 1 through 12, or even the terminals of Figures 13 and 14.

What I claim is:

1. A connector terminal for electric conductors including the combination of an electric conductor composed of strands of wire with an elongated cylindrical terminal plug of metal relatively heavier than the conductor having a frustroconical termination at one end and an axial bore throughout, receiving the said conductor and secured thereto by constricting the bore longitudinally at four oppositely disposed points intermediate the tapered surface of said end by the application of sufficient external force to cause the metals of the connector and conductor to flow into each other between the said constricted portions of the terminal.

2. An electrical connection comprising a substantially cylindrical body having a preformed reduced neck and an axial passage, a conductor within the passage, said body having an exterior indentation at the neck part forming a projection into the passage clamping the conductor.

3. An electrical connection comprising an insulated electric conductor and terminal, the terminal having an axial bore entirely therethrough, one section of which is proportioned to receive the conductor and another larger section proportioned to receive the insulation of the conductor, said terminal having a preformed annular furrow intermediate its ends forming a relatively thin wall at the bottom of said furrow indented to clamp the conductor disposed within the smaller section of the bore.

4. An electrical connection comprising a substantially cylindrical body having intermediate its ends a preformed circumferential furrow and an axial passage, a conductor inserted into the passage, said body having an exterior indentation within the furrow forming a projection into the passage clamping the conductor.

5. An electrical connection comprising a substantially cylindrical body having intermediate its ends a preformed circumferential furrow and an axial passage forming a wall of reduced thickness at the position of the furrow, a conductor inserted into the passage, said body having an exterior indentation within the furrow forming a projection into the passage clamping the conductor.

6. An electrical connection comprising an insulated electric conductor and terminal therefor, said terminal comprising a substantially cylindrical body having an annular furrow intermediate its ends, a passage extending axially through the body and properly proportioned at one end to receive the conductor and to reduce the walls of the bottom of the furrow to a thin condition, with the opposite end of the recess properly proportioned to receive the insulation of the cable, said thin walls being idented for clamping the conductor therein.

7. An electrical connection, including members united in swedged relation; said members comprising metallic conductor means and a sleeve in which said conductor means is disposed; said sleeve having a preformed tapered outside surface; and said sleeve and said conductor means being united in swedged relation in a transverse plane through said tapered surface.

8. An electrical connection, including members united in swedged relation; said members comprising metallic conductor means and a sleeve in which said conductor means is disposed; said sleeve having a preformed portion of reduced outside diameter; and said sleeve and said conductor means being united in swedged relation in a transverse plane extending through said portion.

9. An electrical connection, including members united is swedged relation; said members comprising metallic conductor means and a sleeve in which said conductor means is disposed; said sleeve bearing at least three swedge-indentations spaced circumferentially in a common general plane transverse to said sleeve; said conductor means and said sleeve having a continuous solid-metal cross-section in said common general transverse plane.

10. An electrical connection, including members united in swedged relation; said members

comprising metallic conductor means and a sleeve in which said conductor means is disposed; said sleeve bearing four swedge-indentations spaced circumferentially in a common general plane transverse to said sleeve; said conductor means and said sleeve having a continuous solid-metal cross-section in said common general transverse plane.

11. An electrical connection, including members united in swedged relation; said members comprising metallic conductor means and a sleeve in which said conductor means is disposed; said sleeve bearing a plurality of generally V-shaped swedged-indentations spaced circumferentially in a common general plane transverse to said sleeve; said conductor means and said sleeve having a continuous solid-metal cross-section in said common general transverse plane.

12. An electrical connection, including members united in swedged relation; said members comprising metallic conductor means and a sleeve in which said conductor means is disposed; said sleeve having a preformed peripheral surface-contour; said sleeve bearing a plurality of swedge-indentations spaced circumferentially in a common general plane transverse to said sleeve; the outer surfaces of the portions of said sleeve intermediate said indentations remaining substantially in or within said contours; and said conductor means and said sleeve having a continuous solid-metal cross-section in said common general transverse plane.

13. An electrical connection, including members united in swedged relation; said members comprising metallic conductor means and a sleeve in which said conductor means is disposed; said sleeve bearing a plurality of swedge-indentations spaced circumferentially in a common general plane transverse to said sleeve; said sleeve, in said plane, at each place intermediate said indentations, being folded in by the swedging, and having portions of its inside walls folded against each other; and said conductor means and said sleeve having a continuous solid-metal cross-section in said common general transverse plane.

14. An electrical connection, including members united in swedged relation; said members comprising metallic conductor means and a sleeve in which said conductor means is disposed; and said conductor means and sleeve being swedged into a continuous solid-metal cross-section in a predetermined transverse general plane, and the cross-sectional outline of said conductor means in said plane being a polygon having at least three vertexes.

15. An electrical connection, including members united in swedged relation; said members comprising metallic conductor means and a sleeve in which said conductor means is disposed; and said conductor means and sleeve being swedged into a continuous solid-metal cross-section in a predetermined transverse general plane, and the cross-sectional outline of said conductor means in said plane being a polygon having concyclic vertexes.

16. An electrical connection, including members united in swedged relation; said members comprising metallic conductor means and a sleeve in which said conductor means is disposed; and said conductor means and sleeve being swedged into a continuous solid-metal cross-section in a predetermined transverse general plane, and the cross-sectional outline of said conductor means in said plane being a polygon having four vertexes.

17. An electrical connection, including members united in swedged relation; said members comprising metallic conductor means and a sleeve in which said conductor means is disposed; and said conductor means and sleeve being swedged into a continuous solid-metal cross-section in a predetermined transverse general plane, and the cross-sectional outline of said conductor means in said plane being a polygonal having cusp-like vertexes.

18. An electrical connection, including members united in swedged relation; said members comprising metallic conductor means and a sleeve in which said conductor means is disposed; and said conductor means and sleeve being swedged into a continuous solid-metal cross-section in a predetermined transverse general plane, and the cross-sectional outline of said conductor means in said plane being a substantially equilateral polygon of at least three sides.

19. A plug and socket terminal unit, comprising cooperable socket and plug elements, said plug element including members united in swedged relation; said members comprising metallic conductor means and a sleeve in which said conductor means is disposed; said sleeve bearing at least three swedge-indentations spaced circumferentially in a common general plane transverse to said sleeve; said conductor means and said sleeve having a continuous solid-metal cross-section in said common general transverse plane.

20. A plug and socket terminal unit, comprising cooperable socket and plug elements, said socket element being provided with a recess, said recess and said plug element having substantially complementary cooperable surface portions, said plug element comprising members united in swedged relation, said members comprising metallic conductor means and a sleeve in which said conductor means is disposed, said sleeve having a preformed peripheral surface contour in which is included said surface portion complementary to said cooperable surface portion of said recess, said sleeve bearing a plurality of swedge-indentations in said preformed peripheral surface contour, spaced circumferentially in a common general plane transverse to said sleeve, the outer surfaces of said sleeve remaining substantially in or within said preformed contour so that said cooperable surface portion of said plug element remains substantially complementary to said cooperable surface portion of said recess, and said conductor means and said sleeve having a continuous solid-metal cross-section in said common general transverse plane.

HARRY A. DOUGLAS.