July 15, 1952 H. W. SNYDER 2,603,680

ELECTRICAL PLUG CONNECTOR

Filed March 1, 1950

FIG. 1.

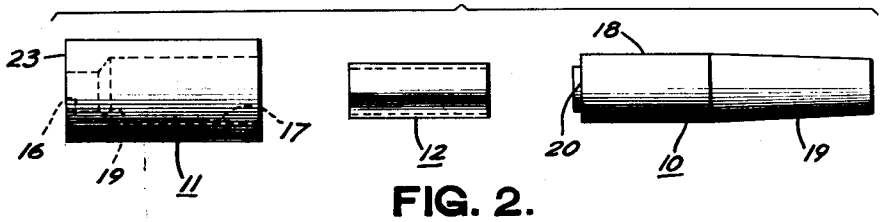



FIG. 2.

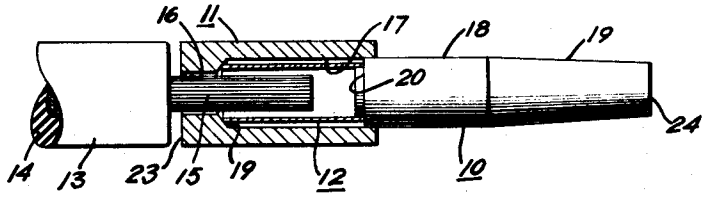



FIG. 3.

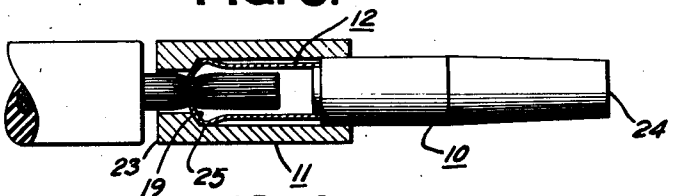



FIG. 4.

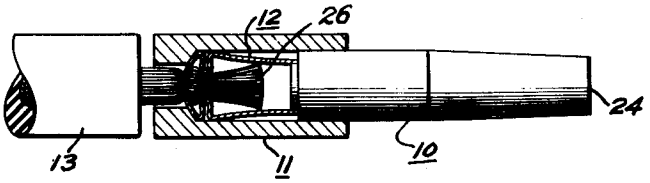



FIG. 5.

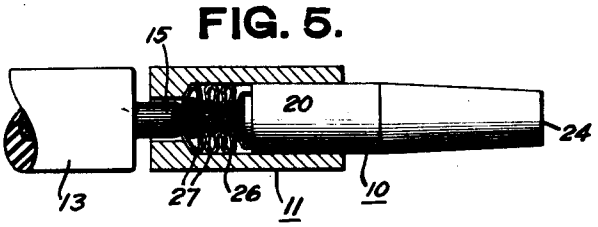



FIG. 6.

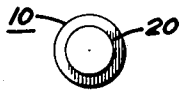
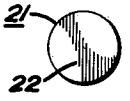



FIG. 7.




FIG. 8.




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## ELECTRICAL PLUG CONNECTOR

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Application March 1, 1950, Serial No. 146,970

3 Claims. (Cl. 173—269)

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This invention relates to an improved form of electrical plug connector particularly for heavy current carrying flexible cables adapted for welding lead conductors and other uses where such plugs may be employed.

The primary object of this invention is to provide an improved solderless electrical plug connector which may be easily and permanently attached to the end of flexible or extra flexible electrical cable and provide a connection between cable and plug of low electrical resistance and good mechanical strength. Other solderless type plug connectors either are of the screw type which may loosen and become disassembled or cause heating and arcing among their various parts, or else special tools are required for permanent assembly of the various parts. Among the advantages of this invention are: simplicity of design for ease in manufacture and assembly. Assembly may be done with only an arbor press (or common table vise in an emergency), no special tools being needed.

Other objects and advantages will appear to those skilled in the art from the following description, supplemented by the drawings illustrating highly satisfactory embodiments of the invention, and forming a part of this specification.

In the drawings:

Fig. 1 is an exploded side view of the plug connector elements in accordance with my invention.

Fig. 2 is a side view of the connector elements, with parts in longitudinal section, showing the parts with the end of a cable upon which they are to be applied.

Figs. 3 and 4 are similar side views illustrating successive positions of the elements as the plug member is pressed into position.

Fig. 5 is a similar side view showing the plug member in its final position, and the plug connector elements secured on a flexible cable in accordance with my invention.

Fig. 6 is a left end view of the plug member.

Fig. 7 is a side view of a modified form of plug member.

Fig. 8 is a left end view of the plug member shown in Fig. 7.

Referring to the drawings wherein similar reference characters designate corresponding parts throughout the several views, the solderless electrical plug connector or cable terminal connector in accordance with my invention consists of three members, a plug 10, a shell or socket 11 and a clamp sleeve 12 for application to a flexible type of cable 13 from the end of which insulation 14 has been removed to bare the cable wires at the

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end 15 for a suitable length approximately the length of the clamping sleeve, as shown in Fig. 2. Plug 10 and socket 11 are preferably made of brass or bronze having a high electrical conductivity, such as is usual for electrical plug connectors, and clamping sleeve 12 is preferably copper tubing having a wall thickness of approximately one thirty-second inch and suitable inside diameter to slide freely over the stripped end 15 of cable 13. The copper clamping sleeve is dead-soft annealed so that it may be readily crimped or deformed into gripping engagement with the bared wires at the end 15 of the cable.

The shell or socket member 11, at times hereinafter referred to as a first conductor element is machined or otherwise formed preferably from tube stock, of such dimensions that no machining is necessary on the outside. The tube socket preferably has a bore 16 of such diameter that the stripped end 15 of cable 13 may be freely inserted through it without requiring machining operations. The outer end of the shell or socket 11 has a larger concentric bore 17 machined to a close tolerance so that a "tight fit" (otherwise designated as a class 6 fit) will be provided between it and the cylindrical inner end 18 of the plug member. The angle of a bevel shoulder 19 between bores 16 and 17 is shown as sixty degrees with respect to the axis of the shell portion, though this angle may be varied.

Plug member 10, at times hereinafter referred to as a second conductor element, is preferably formed from standard rod stock of the required diameter providing the cylindrical portion 18 thereof, as mentioned above, or it may be formed from other stock and machined so that the cylindrical portion 18 with the required diameter is provided. The outer end 19 may be tapered so as to fit standard plug receptacles and the inner end is machined to a diameter slightly less than the inner diameter of clamping sleeve 12 to provide a small shoulder 20 thereon which facilitates the assembly of the plug connector on the end of a flexible cable.

While plug 10 provided with the shoulder 20 is preferable and requires in its formation only a simple minor operation in an automatic screw machine which does not add appreciably to manufacturing costs, the plug 21 shown in Figs. 7 and 8, having a flat end 22, may be used in place of such a shouldered plug 10. Plug 21 requires less machine work.

Plug 10 as illustrated, and above described, is provided with a tapered plugging end. However it will be understood that any conventional form

of terminal connecting means may be employed in place of such tapered end, the invention in the present case residing more particularly in the mechanical and electrical connection between the end of the cable and the terminal element. The connection is, however, particularly adapted for such a plug terminal in that it provides a highly reliable and otherwise satisfactory electrical and mechanical connection for heavy current carrying flexible cables which may be plugged into various plug receptacles to meet the demands as they change.

In assembling the improved solderless electrical connector upon the end of the flexible or extra-flexible electrical cable 13, the cable end must first be stripped of insulation 14 for a suitable length as previously explained. In the drawings this length is shown as being approximately the same as the length of the clamping sleeve 12, but this is a matter of design which will depend upon the length of bore 16, diameter and length of large concentric bore 17 of the shell or socket 11, and the wall thickness of clamping sleeve 12. I have found that satisfactory proportions of the various parts may be as follows: length of socket element 11, approximately six times the diameter of stripped end 15 of the flexible electrical cable; length of bore 16 of the socket, approximately equal the diameter of the stripped end 15 of the electrical cable; length of clamping sleeve 12 before deformation, approximately four and one-half times the diameter of the stripped end 15 of the electrical cable; and diameter of large bore 17 of socket 11, approximately one and one-half times the diameter of the stripped end 15 of the electrical cable. When these proportions are used and the cable stripped as described above, the stripped end 15 of the cable will extend approximately half way through the larger bore 17 of the socket 11 when inserted through the smaller bore 16 as shown in Fig. 2 where the portion 10 is shown inserted into the outer end of the shell or socket 11 in position to engage the clamping sleeve over the shoulder 20.

With the stripped end 15 of the cable held in place (by hand or other convenient means) and the inner end 23 of the shell or socket 11 supported by angle brackets or other convenient means, pressure is applied to end surface 24 of the plug 10 (or 21) by means of the plunger of an arbor press or other convenient means. Under this pressure the plug 10 is forced into large concentric bore 17 of the shell portion and the end surface of the plug surrounding shoulder 20 engages and applies longitudinal pressure upon the clamping sleeve 12. Under the influence of this longitudinal pressure, the inner end 25 of the clamping sleeve is forced against bevel shoulder 19 of the shell or socket 11 and deformed against the stripped end 15 of the flexible electrical cable as shown in Fig. 3. When no further deformation is possible in this direction, the wall of the clamping sleeve 12 collapses inward and folds against the stripped end 15 of the flexible electrical cable and also against the wall of the larger bore 17 of the shell or socket 11 substantially as shown in Fig. 4 and exerts a substantial radial pressure between cable end 15 and the socket bore. In the process of folding inward, the clamping sleeve 12 pulls and pinches some strands of the stripped end 15 of the flexible electrical cable 13 causing the end to fray substantially as shown at 26 in Fig. 4. Continued pressure upon surface 24 of the plug 10 causes repeated "folding" of the clamping sleeve until the same is completely folded and compressed substantially as shown at 27 in Fig. 5, and the stripped end 15 of the flexible electrical cable is clamped in place by means of the radial pressure previously noted and also by the pinching of the cable strands between the folds of the clamping sleeve.

When the pressing operation is completed the plug 10 is firmly gripped within the larger concentric bore 17 of the socket member 11 by reason of the "tight fit" between this larger concentric bore 17 of the socket and the cylindrical portion 18 of the shell or socket 11. As shown in Fig. 5 both the end of clamping sleeve 12 and frayed ends 26 of the stripped portion 15 of cable 13 are in intimate contact or engagement with the end of plug 10, which insures a good electrical contact between the wires of the cable and the plug, and tends to solidify the connection between the socket 11 and plug 10.

From the foregoing it will be seen that the cable connection illustrated, particularly with a plug connector, has numerous advantages in providing an electrical connection with terminal connecting members, or as the cable terminal connection in other forms of connections for flexible stranded wire cables, and it is to be understood that the invention includes such connections within the scope of the claims.

I claim:

1. A connector for the terminal of an electric cable including a deformable cylindrical tubular clamping sleeve having an internal diameter slightly greater than the bared conductor end of the cable to be inserted thereinto, a first connector element having a longitudinal bore therethrough of a diameter through which the bared conductor end may pass at one end and into the clamping sleeve and of a diameter greater than the sleeve at its other end so that one end of the sleeve may be inserted therein and over the end of the conductor, means on said element for effecting a crimping of said end of the sleeve into the conductor, a second connector element having a cylindrical end portion of a diameter to provide a tight fit in the increased diameter bore of said first connector element, and an extension of reduced diameter on the end of the second connector element for entering the opposite end of the sleeve providing a guide and an abutment so that when this second element is driven into the first element it will compress the sleeve to deform it so as to alternately engage and grip the bared conductor and the surface of the bore so as to lock the parts in assembled relation.

2. A connector for the terminal of an electric cable including a deformable cylindrical tubular clamping sleeve having an internal diameter slightly greater than the bared conductor end of the cable to be inserted thereinto, a first connector element having a longitudinal bore therethrough of a diameter through which the bared conductor end may pass at one end and into the clamping sleeve and of a diameter greater than the sleeve at its other end so that the sleeve may be inserted therein and over the end of the conductor, said element having a beveled shoulder at the juncture of the larger smaller diameters of the bore, tapering from the smaller diameter and providing a forming surface for the clamping sleeve so that upon application of endwise pressure on the sleeve, its end engaging this tapering surface will be contracted and caused to bite into the bared conductor, and a second connector element having a cylindrical

end portion of a diameter to provide a tight fit in the increased diameter bore of said first connector element so that when this second element is driven into the first element it will compress the sleeve to deform it so as to alternately engage and grip the bared conductor and the surface of the bore so as to lock the parts in assembled relation.

3. A connector for the terminal of an electric cable including a deformable cylindrical tubular clamping sleeve having an internal diameter slightly greater than the bared conductor end of the cable to be inserted thereinto, a first connector element having a longitudinal bore therethrough of a diameter through which the bared conductor end may pass at one end and into the clamping sleeve and of a diameter greater than the sleeve at its other end so that one end of the sleeve may be inserted therein and over the end of the conductor, and a second connector element having a cylindrical end portion of a diameter to provide a tight fit in the increased diameter bore of said first connector element, an extension of reduced diameter on the end of the second connector element providing an abutment



for engaging the end of the conductor which will enter the end of the sleeve and afford a guide therefor and an annular cavity between the extension and said larger bore of the first connector element, said cavity providing a shoulder between the extension and end of the second connector element affording an abutting surface for the opposite end of the sleeve so that when this second element is driven into the first element it will compress the sleeve to deform it so as to alternately engage and grip the bared conductor and the surface of the bore so as to lock the parts in assembled relation.

HENRY WILLIAM SNYDER.


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