

# United States Patent

[11] 3,614,296

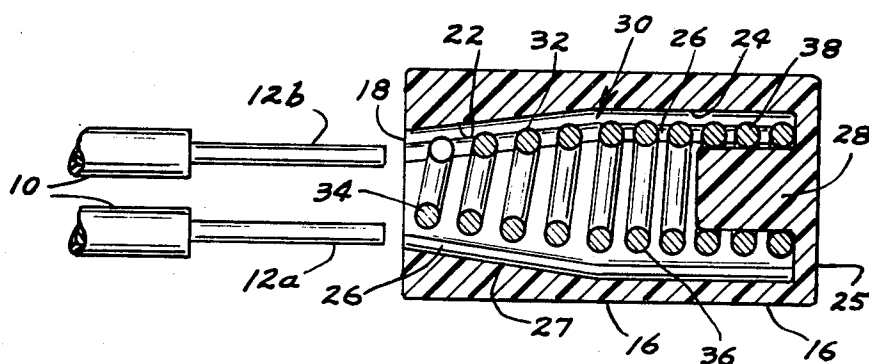
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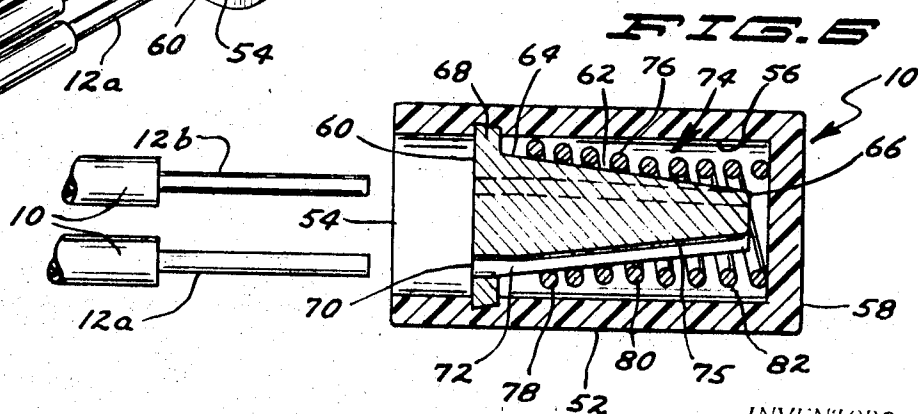
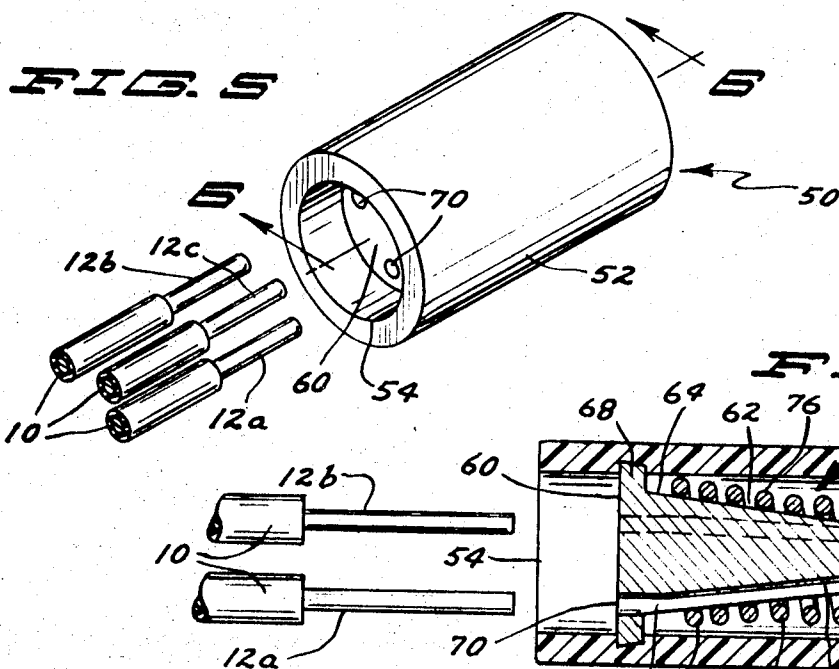
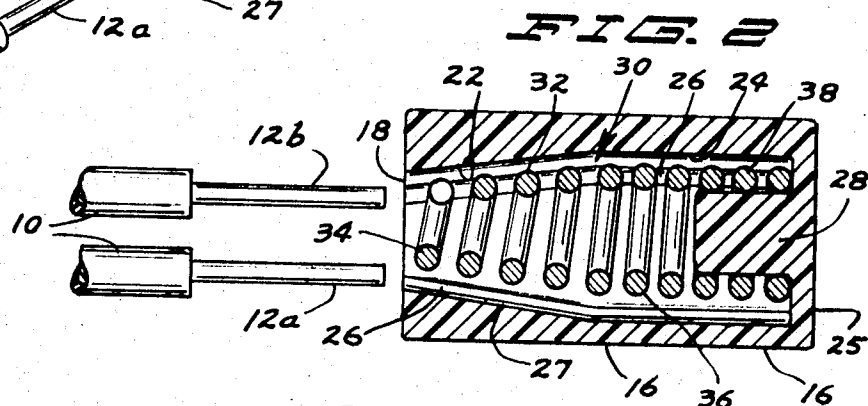
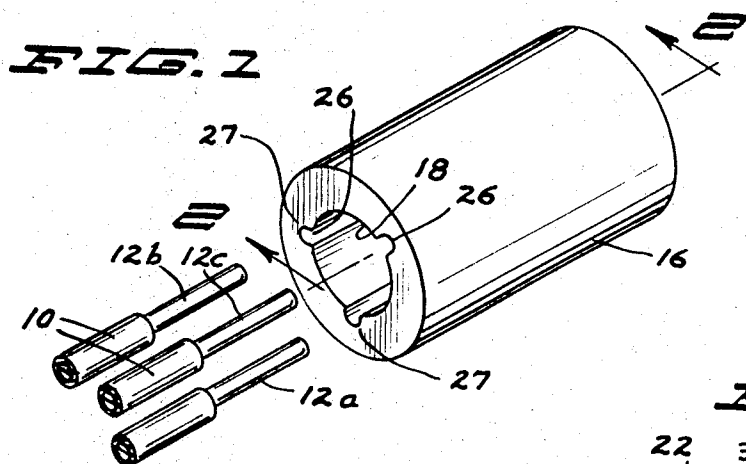
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Primary Examiner—Darrell L. Clay  
Attorney—Dugger, Peterson, Johnson & Westman

[54] **WIRE CONNECTOR WITH FRUSTOCONICAL GRIPPING SPRING**  
9 Claims, 8 Drawing Figs.

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339/256 S  
[51] Int. Cl. .... H02g 15/08  
[50] Field of Search ..... 174/87,  
84.3, 94.1; 339/217, 247, 254, 255, 256 S, 252,  
273, 273 S

**ABSTRACT:** A plurality of wires are gripped by a frustoconical coil spring which forces the wires tightly against surface portions formed on a rigid member having substantially the same degree of taper as the coil spring. In one embodiment the coil spring is placed within a recess provided in the rigid member and in a second embodiment the spring encircles the rigid member.





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FIG. 3

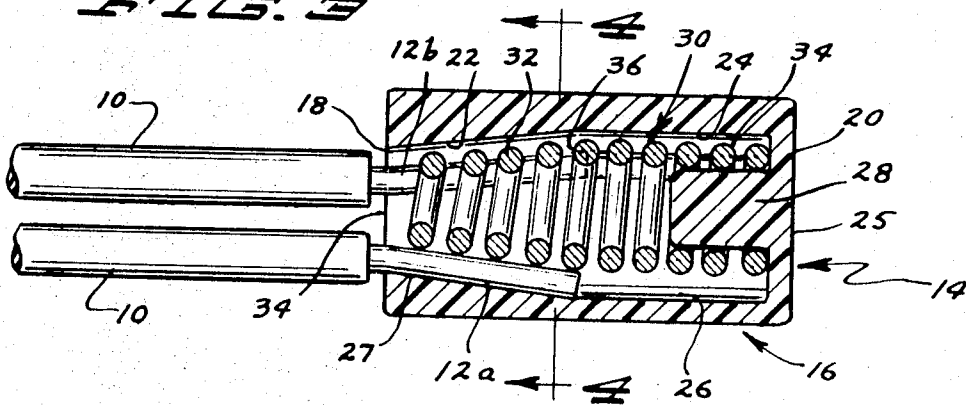


FIG. 4

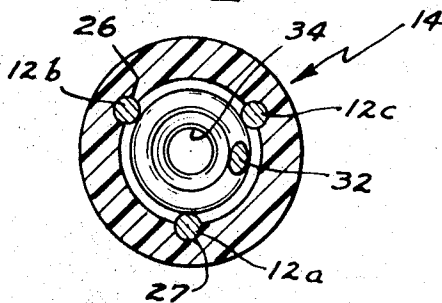


FIG. 7

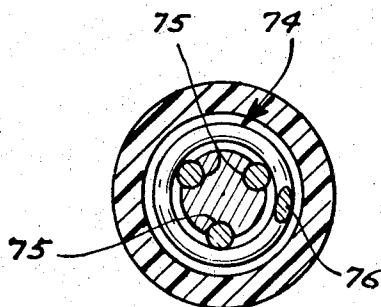
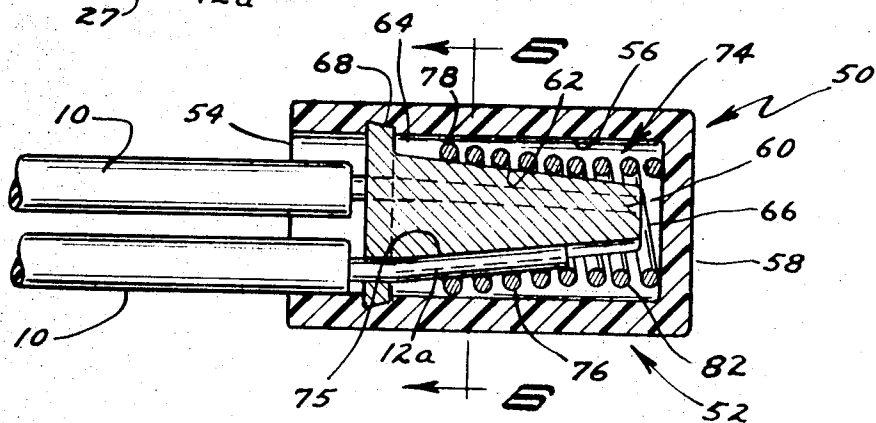


FIG. 8

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# WIRE CONNECTOR WITH FRUSTOCONICAL GRIPPING SPRING

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

This invention relates generally to wire connectors, and pertains more particularly to a connector in which the wires are held by a frustoconical or tapered coil spring.

### 2. Description of the Prior Art

Tapered or frustoconical gripping surfaces have been utilized in the past for gripping and holding a plurality of wires. For instance, U.S. Pat. No. 2,714,197, granted July 26, 1955 to Wharton et al. for "ELECTRICAL CONNECTORS" and U.S. Pat. No. 2,859,424, granted Nov. 4, 1958 to Arthur A. Berndt for "CONNECTOR FOR STRANDED CABLES" both utilize such surfaces. However, these prior art connectors are quite complex and costly to manufacture.

## SUMMARY OF THE INVENTION

Accordingly, one object of the present invention is to provide a wire connector that will be extremely simple, both as to its construction and also with respect to its use. More specifically, an aim of the invention is to avoid any twisting action that has heretofore been used in various prior art devices of this type.

Another object of the invention is to provide a connector for gripping wires that can be manufactured inexpensively, particularly with respect to the assembly thereof.

Another object is to provide a wire connector that will effectively grip several wires, yet which will grip one or two wires with equal facility and effectiveness. In furtherance of this particular object, the coil spring that is employed bears directly against the wires that are to be held and the various convolutions of the coil spring provide a serrationlike engagement with the wires. Consequently, a connector is herein described that will securely hold one, two or three wires once they have been inserted and will do so with good electrical contact.

Yet another object is to provide a connector of the foregoing character having a slightly differing taper that provides a gripping action that progressively increases with the amount of retractive movement or pull on the retained wires.

A still further object of the invention is to provide a connector for connecting a plurality of wires together that does not require use of any implement or tool in accomplishment the connection.

Briefly, the invention comprises a coil spring having a plurality of resilient convolutions, at least some constituting a frustoconical section. In one embodiment, the outer circumference of the frustoconical spring section engages the wires to be gripped and in a modification of the invention the interior of the frustoconical section performs the engaging function. In both embodiments, the frustoconical section forces the inserted wires against surface areas having a taper corresponding generally to, but differing slightly from, that of the frustoconical section and any attempt to withdraw the wires increases the wedging force so that they are securely held. Specifically, a number of grooves formed in the tapered or frustoconical surface, the number corresponding to the number of wires to be accommodated, guide the wires into the connector to facilitate their insertion and to assure a positive retention thereof, especially due to a slightly varying tapered relation imparted thereto.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of one embodiment our invention may assume, the embodiment accommodating three wires which are in the process of being inserted;

FIG. 2 is a sectional view taken in the direction of line 2—2 of FIG. 1, the view showing the condition of the coil spring before the wires are inserted;

FIG. 3 is a sectional view corresponding to FIG. 2 but illustrating the spring in a gripping relation with the wires;

FIG. 4 is a transverse sectional view taken in the direction of line 4—4 of FIG. 3;

FIG. 5 is a perspective view resembling FIG. 1 but depicting a different embodiment of the invention;

FIG. 6 is a sectional view taken in the direction of line 6—6 of FIG. 5 for the purpose of showing the spring prior to gripping the wires;

FIG. 7 is a sectional view corresponding to FIG. 6 but with the wires held in a gripped condition by the springs, and

FIG. 8 is a sectional view taken in the direction of line 8—8 of FIG. 7.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to the embodiment illustrated in FIGS. 1—4, it will be seen that three wires labeled 10 have been shown, the wires having stripped or bare ends 12a, 12b and 12c.

The wire connector itself has been designated generally by the reference numeral 14 and comprises a rigid shell or casing 16, preferably of dielectric material so as to render the connector self-insulating when used electrically. The shell 16 has an opening at 18 which provides an entrance for the bared wire ends 12a, 12b and 12c into a frustoconical bore 22 extending throughout approximately half the length of the shell 16. In the illustrated form, the bore 22 connects with or merges into a cylindrical bore 24 that continues for the remainder of the shell length, that is, to be closed and labeled 25. The interior of the shell 16 is formed with three grooves 26 for receiving the several bare ends 12a, 12b and 12c which extend the complete length of the frustoconical bore or surface 22 and also the complete length of the cylindrical bore or surface 24. The grooves 26 have a depth less than the diameter of the wire ends 12a, 12b and 12c which they are to accommodate. It will be somewhat helpful, it is believed, to assign the reference numeral 27 to the groove bottoms, for the bottom portion coextensive with the length of the frustoconical section 22 form tapered working surfaces that assist in providing the wedging action hereinafter more fully explained. Although not perceptible from the drawings, the bottoms 27 diverge slightly (about 0.004 inch per inch of connector length). Stated somewhat differently the groove bottoms possess a rate of taper somewhat greater than that of the bore 22, that is they get deeper in a direction away from the opening 18. For a purpose made manifest immediately below a cylindrical lug 28 is formed integrally with the bottom 20.

Having mentioned the lug 28, attention is now directed to a resilient coil spring 30 having a number of convolutions 32 that progressively increase from a relatively small diameter at one end labeled 34 to a relatively large diameter at 36. More specifically, the degree of taper corresponds to that of the bore 22 but differs slightly from the groove bottoms 27 (because the taper of the groove bottoms differs from that of the bore 22, as explained above). The convolutions denoted by the reference numerals 34 and 36 reside at opposite ends of the frustoconical coil spring section 32. The coil spring 30 additionally includes convolutions having the same diameter as the convolution 36, thereby forming a cylindrical section labeled 38. In the present embodiment some of the convolutions forming the cylindrical section 38 are passed onto the lug 28 and in this way the coil spring 30 is anchored within the shell 16 in preparation for the insertion of the wire ends 12a, 12b and 12c.

The manner in which our connector 14 is used should be readily understood from the information already given. It will be appreciated that the user need only insert the bare wire ends 12a, 12b and 12c into the various grooves 26, doing so through the opening 18. Such action will cause the ends 12a, 12b and 12c to abut the convolution 34 and further movement will compress the coil spring 30. Stated somewhat differently, the smaller convolution 34 is urged to the right, thereby increasing the clearance between the bottoms 27 of the grooves 26 and the exterior of the convolution 34, as well as the other convolutions constituting the frustoconical section 32. The

coil spring 30 will only compress to the extent necessary to permit the wire ends 12a, 12b and 12c to be received and the biasing tendency for the spring 30 to return to its original length causes the wire ends 12a, 12b and 12c to be pressed outwardly against the groove bottoms 27.

Once received in the grooves 26, any attempt to retract the wire ends will be resisted by virtue of the fact that the frustoconical spring section 32 will urge or wedge the wire ends more forcibly outwardly against the bottoms 27 of the several grooves 26. Each action is made more positive by reason of the slightly differing taper imparted to the groove bottoms 27 with respect to that of the frustoconical section 32. Additionally, the rounded cross section or outer curvature of each convolution of the section 32 functions as a tooth, bearing tightly against the bare wire ends 12a, 12b and 12c in a serrationlike fashion to provide further assurance against inadvertent removal or retraction of the wire ends. Consequently, the wire 10 are firmly gripped by the connector 14.

It will be appreciated that all three wires 10 need not be gripped, for if only one wire 10, say the one having the bare end 12a, is inserted, the action is the same because any attempt to retract or withdraw the wire end 12a will pull the conical section 32 therewith and will wedge the wire end 12a against the bottom 27 of the particular groove 26 in which this end is received. The same retentive or wedging action exists when only two wires 10 are to be held.

Although it is believed evident, the lug 28 need not exert any real degree of retentive force against the cylindrical section 34 of the coil spring 30, for once the wires have been inserted, the wedging action itself prevents the coil spring 30 from being retracted. In other words, it is only prior to the actual use of the connector 14 that the lug 28 performs a worthwhile function. It merely keeps the coil spring 30 from shifting within the interior of the shell 16 until the wires have been inserted, so it is not essential that the lug 28 fixedly hold the spring, thus facilitating its assembly, as the spring can be readily introduced through the opening 18 and simply pressed onto the lug 28.

Describing now the modification appearing in FIGS. 5-8, it will be discerned that this embodiment has been designated in its entirety by the reference numeral 50. A casing or shell 52 is employed and is preferably of dielectric material so that it can be used in various electrical environments without having to cover it with insulation. Providing an entrance at one end for the bare ends 12a, 12b and 12c is an opening 54 leading into a cylindrical bore 56 extending generally throughout the length of the entire shell 52, the closed end thereof having been assigned the reference numeral 58.

Contained within the bore 56 is a plug or insert 60. The plug 60 may be of metal or plastic and is formed with a frustoconical surface 62 that decreases in diameter from one end indicated by the reference numeral 64 to the other end labeled 66. The plug 60 is formed with an annular flange 68 that is embedded in the material constituting the shell 52 and the plug 60 is in this way fixedly held within the shell 52. The flange 68 is provided with three holes 70, each communicating with one end of several grooves 72 formed in the frustoconical surface 62. It is through the holes 70 that the bare ends 12a, 12b and 12c are inserted in the present instance. The bottom of each groove 72 has been designated by the reference numeral 75 and possesses a slightly increased degree of taper as compared with the frustoconical section 62, that is they get deeper toward the smaller end 66 of the plug 60.

A resilient coil spring 74 encircles the frustoconical surface section 62, having a section 76 that tapers to the same degree as the frustoconical surface section 62, but not quite as much as the groove bottoms 75. The section 76, to describe it slightly differently, is composed of a number of convolutions, the larger convolution 78 being at the left and the diameter of the convolutions progressively decreasing toward the other end of the frustoconical section 76, the smaller convolution at the other end of the section 76 having been given the reference numeral 80. In the illustrated instance, a cylindrical

section 82 of the coil spring 72 continues toward the closed end 58 of the shell 52 and abuts thereagainst.

In use, the action derived from the connector 50 is generally similar to that obtained when using the connector 14, although the construction thereof is quite different. In the use of the connector 50, the wire ends 12a, 12b and 12c are inserted through the holes 70 to engage the convolution 78 and force it to the right as viewed in FIGS. 6 and 7, thereby compressing the coil spring 74. In so doing, the convolution 78 is shifted to a location along the frustoconical surface 62 where the clearance is increased by reason of the decrease in the diameter of the section 62. Of course, an increase between the interior of the frustoconical spring section 76 occurs as well as an even greater increase with respect to the bottom 75 of the various grooves 72 (owing to the different rate of taper). When the bare ends 12a, 12b and 12c have been inserted sufficiently, then further compression of the coil spring 74 ceases, but any attempt to retract the wires 10 will result in the convolutions constituting the frustoconical section 76 being pulled in the direction of attempted retraction with the consequence that the resulting wedging action increases with the amount of retractive effort. A positive retention of the wire ends 12a, 12b and 12c is thereby provided with the connector 50 as with the earlier-described connector 14.

We claim:

1. A wire connector comprising a resilient coil spring member composed of a number of convolutions, at least some of said convolutions forming a frustoconical section increasing from a smaller diameter at one end to a larger diameter at the other end, and a rigid member formed with a frustoconical surface having a groove therein providing a sloping surface having a taper corresponding generally to that of said spring section, said frustoconical spring section being within the frustoconical surface of said rigid member so that said sloping surface is juxtaposed in a coacting relationship with said spring section, whereby said spring member may be longitudinally compressed to increase the clearance between said sloping surface and said spring section to receive therebetween a wire to be gripped.

2. A wire connector comprising a resilient coil spring member composed of a number of convolutions, at least some of said convolutions forming a frustoconical section increasing from a smaller diameter at one end to a larger diameter at the other end thereof, and a rigid shell member closed at one end and open at the other end increasing from a smaller diameter at its open end to a larger diameter at its closed end, said coil spring member being received within said shell member so that the smaller diameter end thereof is near the open end of said shell member and the larger diameter thereof is adjacent the closed end of said shell member, said frustoconical surface section of said shell member having several longitudinally extending grooves of a depth less than the diameter of the wire to be held, said several grooves being angularly spaced with respect to each other, whereby insertion of the wire into one of said grooves via said open end of said shell member will longitudinally compress the coil spring member to an extent that the clearance between the bottom of said groove and the convolution near the end of the groove via which the wire is inserted is equal to the diameter of the inserted wire.

3. A wire connector in accordance with claim 2 in which said grooves become deeper in a direction away from the ends thereof via which the wires are inserted.

4. A wire connector in accordance with claim 1 in which said shell is of dielectric material.

5. A wire connector in accordance with claim 2 in which the end opposite the smaller end of said coil spring is anchored with respect to the closed end of said shell.

6. A wire connector comprising a shell open at one end and closed at the other end, a resilient coil spring member composed of a number of convolutions, at least some of said convolutions forming a frustoconical section increasing from a smaller diameter at one end to a larger diameter at the other end thereof, and a rigid member formed with a frustoconical

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surface section also increasing from a smaller diameter at one end to a larger diameter at the other end thereof, said frustoconical surface section having several longitudinally extending grooves of a depth less than the diameter of wire to be held, said rigid member constituting a plug having an annular flange extending outwardly and anchored in the shell near the open end thereof, said flange having a plurality of holes therein for the insertion of a plurality of wire ends into said several grooves, said plug having formed exteriorly thereon said frustoconical surface which contains said grooves and said grooves being aligned with said holes in said flange, the frustoconical section of said spring tapering from a larger diameter near said flange to a smaller diameter adjacent said closing end and said smaller diameter end abutting against the closed end of said shell, whereby insertion of the wires into said grooves via said one end will longitudinally compress said coil spring member to an extent that the clearance between the bottom of said grooves and the convolution near the end of the grooves via which the wires are inserted is equal to the diameter of each inserted wire.

7. A wire connector in accordance with claim 6 in which said shell is of dielectric material.

8. A wire connector comprising a dielectric shell member open at one end and closed at its other end, a rigid plug ele-

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ment within said shell having outwardly projecting means thereon at one end anchored to said shell member near its said open end and tapering to a smaller end near the closed end of said shell, said plug element having at least one groove extending from the larger or anchored end thereof toward its said smaller end to provide a tapered surface, a resilient coil spring member composed of a number of convolutions, at least some of said convolutions forming a frustoconical section encircling said plug element and tapering from a larger diameter adjacent said projecting means to a smaller diameter toward the smaller end of said plug element, the taper of said spring section corresponding generally to that of said groove surface, whereby a wire may be inserted into said groove via the open end of said shell member and said spring longitudinally compressed to increase the clearance between said sloping surface and said spring section to receive and grip said wire therebetween.

9. A wire connector in accordance with claim 8 in which said anchoring means includes an annular flange embedded in the shell member, said flange having a hole aligned with said one groove, and in which the smaller end of said coil spring abuts the closed end of said shell member.

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