This invention relates to a wire connector, and more particularly to a freely expandable spring coil connector adapted to be threadably applied by manual or mechanical torque to the ends of wires for the purpose of joining them together.

In our co-pending patent application, Serial No. 564-232, filed of even date herewith, and now abandoned and our prior issued Patent No. 2,656,204, there is disclosed a novel type of wire connector coil in which a continuous resilient but stiff wire is formed into a series of convolutions. This connector coil can be threadably applied to provide a stiff, resilient coil having a firmly directed enlarged opening and a diminished portion rearwardly thereof, the rear end of the coil having simple frictional driving contact during threading of the coil upon wire ends to be connected.

It is, therefore, an important object of the invention to provide a coil-type connector coil with substantially circular convolutions and no protruberances in special cooperation with a plain shield or cup element wherein positive driving force may be imparted to the coil through the last, or several last, convolutions thereof.

It is, therefore, an important object of the invention to provide a wire connector coil with substantially circular convolutions, the rearmost of which are adapted to expand under unwinding driving force and thereby to be engaged automatically in increasing gripping relation the inner surface of a simply formed sleeve in accordance with the increasing applied driving force.

Another object of the invention is to provide a double-ended wire connector wherein a coil is provided with enlarged opposed mouths and a reduced medial portion, and driving means for selectively driving the coil from either end in threading or unthreading relation with a plurality of overlapped wire ends.

These and other objects and advantages of the invention will more fully appear from the following description, made in connection with the accompanying drawings, wherein like reference characters refer to the same parts throughout the several views and in which:

FIGURE 1 is a side view of a typical wire coil made in accordance with our invention and mounted upon a driving element in frictional engagement prior to threading upon wire ends, portions of the driving element being sectioned vertically to better show the relationship of the parts;

FIGURE 2 is an end view of the wire coil of FIGURE 1 with the driving element removed;

FIGURE 3 shows another form of our invention wherein a driving element encompasses the entire coil, the connector being mounted upon the ends of a plurality of wires;

FIGURE 4 is a vertical section taken on the line 4-4 of FIGURE 3 and showing in enlarged view the relative position of the members while the connector is being threaded upon a plurality of wire ends;

FIGURE 5 shows another alternate form of the invention, the shield portion being vertically sectioned to show the relationship of the parts; and

FIGURE 6 shows the alternate form of FIGURE 5 in its threaded relation with a plurality of wire ends, the coil and shield being vertically sectioned.

With continued reference to the drawing, FIGURE 1 shows our connector preliminarily conditioned for mounting upon wires to be connected. The connector comprises two main elements, the coil 10 and the driving element 11. The coil 10 has a series of substantially circular convolutions of stiff but resilient wire 12, a suitable material being spring steel such as piano wire. The convolutions 12 define a flared, forward receiving mouth 13, a diminished medial portion 14 and rearward terminal convolutions 15. Forward convolutions 16 may be substantially of equal diameter for several turns where they define the enlarged receiving mouth 13. The coil 10 may be so constructed that the rearward terminal convolutions 15 are identical with the forward convolutions 16 so that a symmetrical structure exists. In such case, rearward opening 17 is identical with the forward receiving mouth 13 and the device may be utilized from either end. The coil will, of course, be turned in the same rotative direction irrespective of which end is driven onto the wires.

The driving element 11 comprises a sleeve portion 19 which is provided with a smooth inner surface 20 of substantially circular cross section of a diameter exactly equal to, or slightly less than, the diameter of the rearward terminal convolutions 15 in their relaxed condition separate from the driving elements. The driving element 11 may be provided with gripping means such as the handle 21 which will assist in the manual or mechanical rotation of the driving element and coil during threading of the connector upon wires to be connected. It will be noted by reference to FIGURE 2, that no protruberance exists on the outer surface 22 of coil 10 and, hence, the rearward terminal convolutions 15 lie in frictional engagement with the inner surface 20 of the driving element 11 without any abutting means whatsoever. It is intended that coil 10 interfit with the driving element 11 by merely pressing the elements together or, in some instances, by rotating the driving element 11 in a reverse or unwinding direction, that is, counter-clockwise on coil 10, as viewed in FIGURE 2.

Referring now to FIGURES 3 and 4, an alternate form of the invention is shown with connector 23 applied to a plurality of wires 24 whose ends 25 lie in overlapped relation. The connector 23 comprises a spring coil element 10 which may be identical with that shown in FIGURE 1. The driving element, however, comprises a sleeve 26 which extends for the length of the coil and may retain coil 10 against endwise displacement through such means as intumescence 27 at each end. The sleeve 26 may have a perfectly smooth inner surface 28 which is cylindrical, as shown in FIGURE 4, and this surface lies in the same frictional engagement with the rearward terminal convolutions 15 and the symmetrical forward convolutions 16, the connector 23 being usable from either open end 29, as shown. The outer surface 30 of the sleeve 26 may be roughened, knurled or otherwise formed with means for increasing the firm connection with a driving tool or with the fingers as the case requires. In FIGURES 3 and 4, the outer surface 30 is shown with hexagonal
3 flattened surfaces so that a wrench may be applied thereto. This form is particularly adaptable to large-sized connectors requiring mechanical tools.

Referring to FIGURE 4, one open end 29 has been applied over the wire ends 25 and the connector has been turned in threading engagement with the wire ends so as to exert a torque tending to unwind the coil 10. Because the convolutions of the coil are stiff, but resilient, the coil will tend to expand and this fact facilitates the threading of the coil 10 upon the wire ends 25 while still exerting considerable force thereon. The tendency to unwind also causes a progressive expansion of the coil rearwardly to the terminal convolutions 15. It is because the convolutions 15 were already in frictional engagement with the inner surface 28 of shield 26, that the applicance of torque is made possible. The tendency to slightly expand intensifies the frictional engagement and results in a firm gripping relation which continues to become more firm as the torque is increased.

If it is desired to remove the wire connector 23, the driving element or sleeve 26 may be rotated in the opposite direction, in which case the forward convolutions 16 now perform the driving function previously assumed by convolutions 15. The convolutions 16 expand and become firmly engaged against slipping while the reversing process takes place. As long as no torque is applied to the connector in either direction, each individual coil convolution will maintain an independent spring grip upon the wire ends 25 and will seek its own diameter irrespective of that of the others.

An important feature of our invention is the maintenance of a clearance space 36 between the medial reduced portion 14 and the inner surface 28 of the sleeve 26. It will be noted that even when the intermediate convolutions are fully expanded over the wire ends 25, they still will be unbacked or unbraced and will offer no more resistance to turning than that due to the free resilience of each of the convolutions.

In order to obtain the novel driving connection between the sleeve and the spring coil, it is requisite that the sleeve or driving element have less resilience than the coil itself. If the sleeve were to deform more readily than the coil, no build-up of frictional engagement could be accomplished and increasing the torque for driving the connector would reach a point where slippage would occur after a predetermined counter-force in threading the coil on the wire ends was established.

In some instances, we have found that but a single rearward terminal convolution is adequate to provide the binding force desired for driving the spring connector into threaded engagement with the wire ends. When torque is removed from the driving element, the frictional engagement is reduced to a nominal value which will permit slippage and removal of the sleeve, if so desired, as in the form shown in FIGURE 1.

Referring now to FIGURES 5 and 6, we have there shown a spring coil 31 having a medial reduced portion 32 and forward convolutions 33 which are larger in diameter than the rearward convolutions 34. Sleeve 35 is of frusto-conical construction (exaggerated for purposes of illustration) and the slight taper is such as to engage the rearwardmost of the terminal convolutions 34 with greater initial frictional contact. In this form, a back wall 36 is shown in solid form although it is understood that, in any of the forms shown, the sleeve or driving element may be provided with a rearward opening to permit the insertion of wires into either end of the coil, if desired. The forward end of the sleeve 35 may be provided with intumescence flanges 37 which retain the coil 31 within the sleeve.

When the connector is rotated in unwinding direction with respect to its retained coil 32, the convolutions of the coil 32 will be caused to threadably engage the wire ends 25 in the manner previously described. Here, again, even though there is a slight taper to the sleeve element 35, the same progressing expanding phenomenon takes place with the resulting binding force which will prevent slippage during the forward driving of the connector.

Where the connector is used to join the ends of electrical wires, the entire connection may be covered with dielectric tape or an insulating sleeve as is well known in the art.

It may thus be seen that we have provided a novel and inexpensive wire connector wherein the coil portion may be constructed of simple circular convolutions, the rearmost of which are in relatively light frictional engagement, but capable of creating a strong binding force during the threading of the coil upon wire ends to effect a strong union.

It will, of course, be understood that various changes may be made in the form, details, arrangement and proportions of the parts without departing from the scope of our invention.

What we claim is:

1. A connector for threadably fastening together the ends of a plurality of wires which comprises, a stiff resilient open-ended coil having at one end a wire receiving mouth, a portion of diminished diameter rearwardly of the wire receiving mouth and at the other end at least one driving convolution, and a driving element having a smooth bore coaxially encompassing the driving convolutions of said coil, the bore of said driving element encompassing said portion of diminished diameter in annular space clearance, the outermost diameter of said driving convolutions in relaxed condition being at least as large as that of said bore, said driving element having engagement only with the outermost diameter of said driving convolutions, whereby torque applied to the driving element in a rotative direction tending to unwind said coil will cause the coil to bear against the bore surface of the driving element with increased force at the area of frictional engagement and thereby resist slipping while threading the coil upon the ends of wires to be joined.

2. The connector set forth in claim 1 wherein the coil convolutions at each end of said coil lie in frictional engagement with the bore surface of said driving element.

3. The connector set forth in claim 1 wherein both said coil and said driving element have openings extending completely therethrough whereby wires to be connected may be inserted respectively at both ends of the connector.

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