

[54] **A METHOD OF TERMINATING A SEMI-RIGID COAXIAL CABLE**

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339/177 R, 177 E, 89 C; 29/628, 237, 234;
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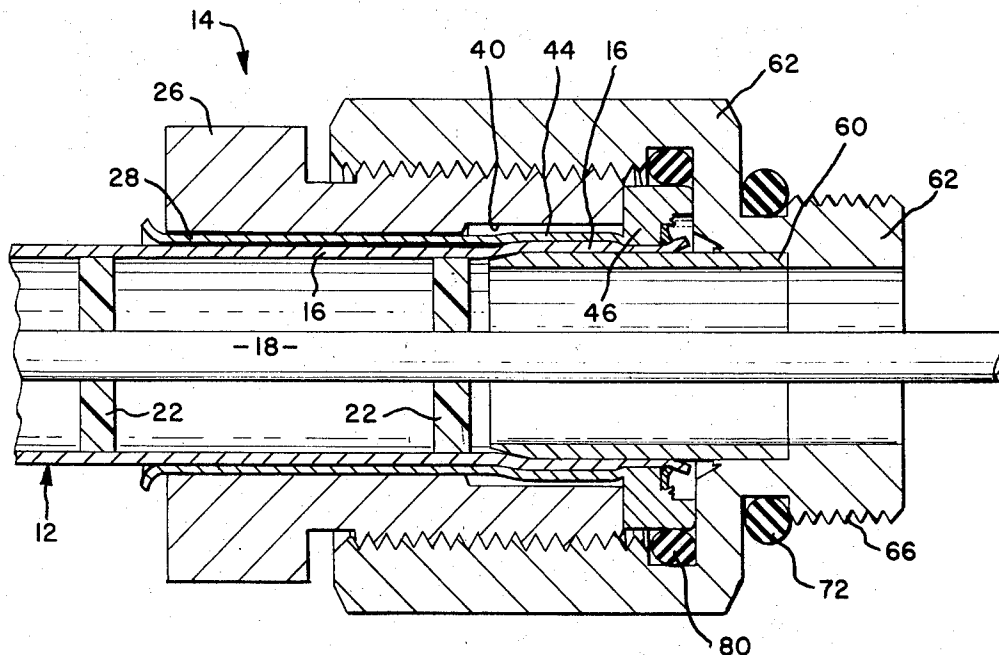
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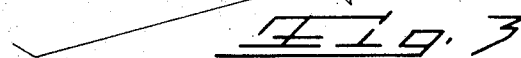
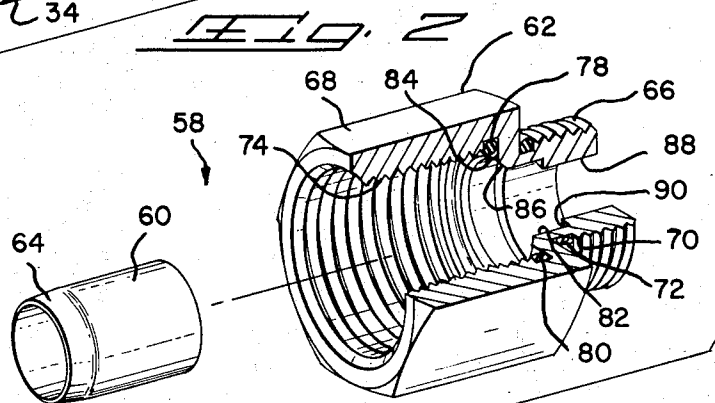
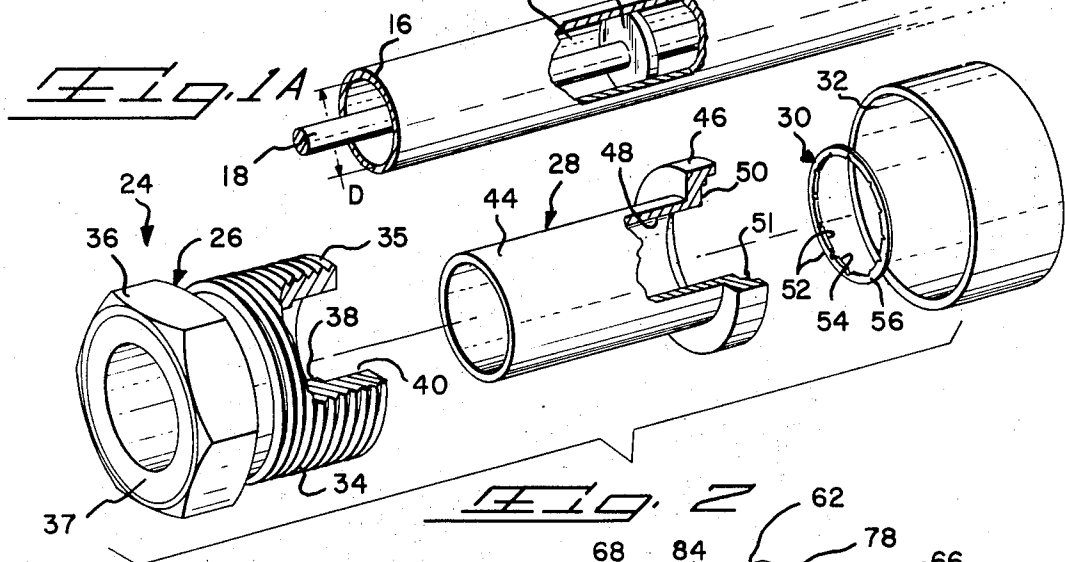
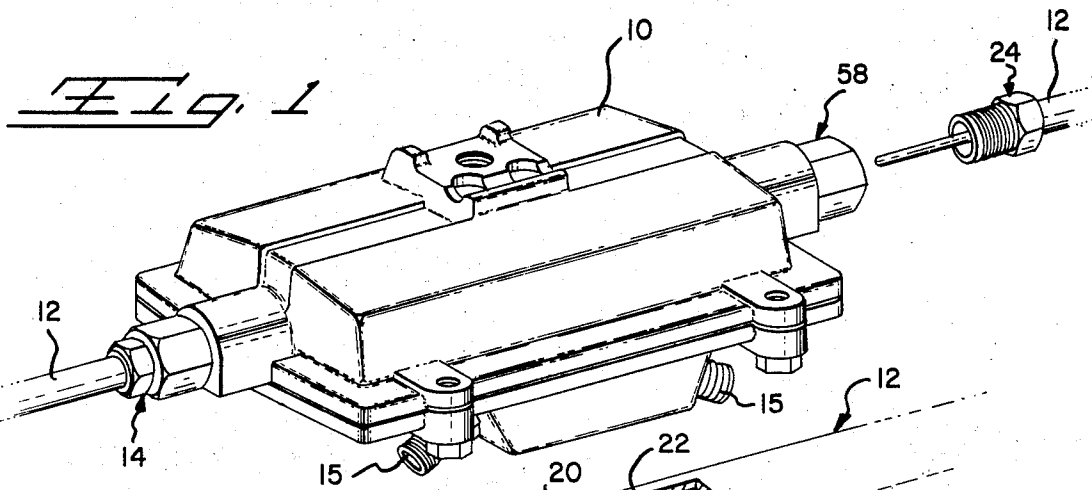
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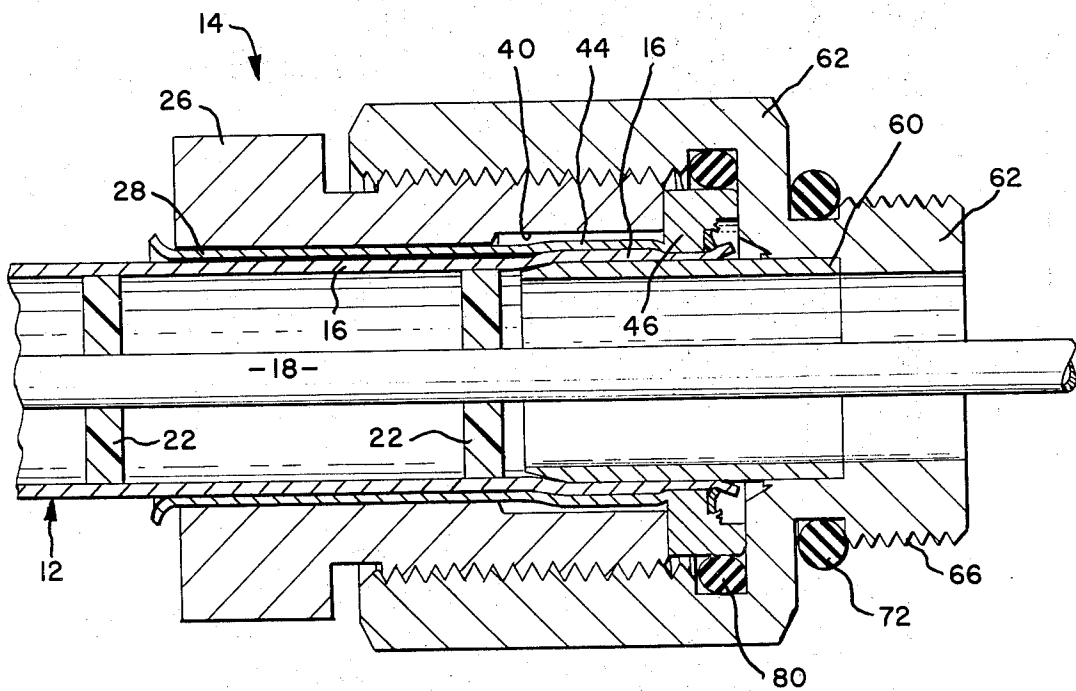
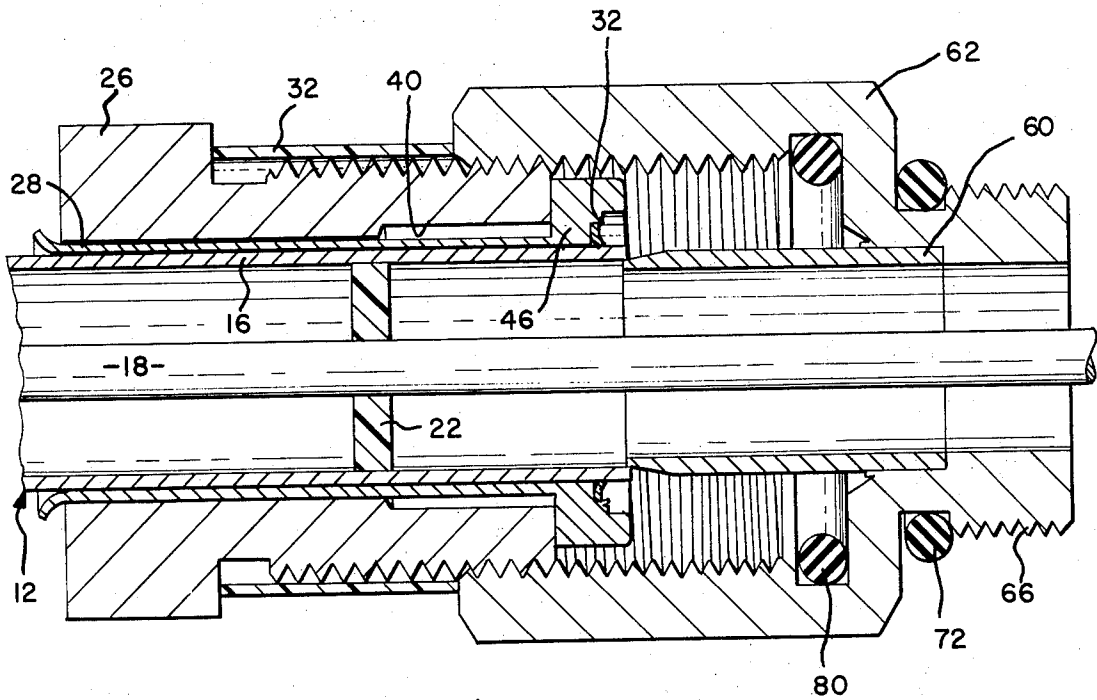
ABSTRACT

This invention relates to a coaxial cable connector featuring inner and outer ferrules between which the outer conductor of a semi-rigid cable is squeezed. The assembly of the connector onto the cable is accomplished with ordinary standard hand wrenches operating on an outer coupling containing the outer ferrule nut threadedly engaging a connector body containing the inner ferrule. The structure of the connector preserves the critical diameters of the coaxial cable thereby reducing or eliminating reflective loss of radio frequency energy.

4 Claims, 6 Drawing Figures







A METHOD OF TERMINATING A SEMI-RIGID COAXIAL CABLE

This is a division, of application Serial No. 252,791, filed May 12, 1972, now Pat. No. 3778535.

BACKGROUND OF THE INVENTION

Semi-rigid coaxial cables have been developed for handling radio and ultra high frequency energy. Such cables typically have a center copper conductor and aluminum outer shield with air a large part of the dielectric medium therebetween. These conductors or cables are light weight and are especially suitable for use in cable television systems. However, considerable difficulty has been experienced in developing a suitable connector for terminating the coaxial cable. More particularly, difficulty is experienced in securing the connector shell to the cable shield with sufficient strength so that the two will not separate under physical loads or fail under thermal cycling which are normal in actual field operations.

In general, workers in the field have developed several approaches in terminating coaxial cable. One approach has been to provide a clamp or collet having interior teeth which are driven into the outer conductor so as to provide the mechanical gripping action.

The approach noted above and other similar approaches well known to those skilled in the art possess some drawbacks. The first is that the outer cable conductor is unsupported by the relatively weak cable dielectric at the clamping point so that it begins to collapse under load, i.e., it reduces radially so that the electrical and mechanical connection to the connector body deteriorates.

In order to counter the collapse of the outer conductor under clamping pressure a practice was developed to insert a sleeve or ferrule within and next to the outer cable conductor to provide support. This helped the collapsing problem considerably but introduced another problem; the characteristic impedance of a coaxial cable is a function of the inner dimensions; thus, by inserting the ferrule into the cable, the impedance at that point is changed and there is a reflective loss in the frequency energy being transmitted.

Accordingly, the present invention provides a device for terminating or connecting semi-rigid coaxial cable of the type having a center conductor surrounded by a dielectric medium and an outer conductor having a given inner diameter held to a given close tolerance for efficient signal transfer, which comprises a threaded insert assembly which includes a coupling nut having external threads on one end and two longitudinal concentric bores therein, one of the bores being larger than the second, a outer ferrule having a sleeve portion and radially extending rim portion, the sleeve portion adapted to slide into the coupling nut, and a retaining ring having teeth on the inner edges, the ring adapted to fit onto the cable, and an adapter assembly which includes a connector body having internal threads adapted to receive the external threads on the coupling nut, and also having three, longitudinal, concentric bores of differing diameters, and a inner ferrule having a beveled end, the ferrule adapted to be housed in one of the bores in the connector body and further adapted to be inserted into a end of the cable when the coupling nut and connector body are threadably joined.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a CATV directional tap to which semi-rigid coaxial cable is connected utilizing the present invention;

FIG. 1 a shows details of the coaxial cable of FIG. 1;

FIG. 2 is a perspective, exploded and partially sectioned view of one half of the connector construction in accordance with the present invention;

FIG. 3 is a perspective exploded and partially sectioned view of another half of the connector constructed in accordance with the present invention; and

FIGS. 4 and 5 illustrate the assembly of the connector shown in FIGS. 2 and 3 to a coaxial cable.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A CATV directional tap, designated at 10 in FIG. 1, is used, either on over-head lines or underground, to provide television signals, entering therein from distribution coaxial cable 12 attached thereto via coaxial connector 14, to the homes located along the TV cable. Tap 10 is a conventional directional coupler and splitter such as manufactured by Jerrold Electronics, Inc. In the model shown in FIG. 1, tap 10 contains a circuitry (not shown) which sends the TV signals into four different homes via house taps 15 (of which only two are seen).

Cable 12 is one type of semi-rigid coaxial cable whose structure can be seen in FIG. 1a. The cable includes an outer conductor 16 and a center conductor 18. The dielectric material separating the two conductors is air filled chamber, designated at 20, therebetween. Disks 22 of dielectric material such as polyethylene are positioned at spaced intervals along the inside of cable 12 to support and centralize center conductor 18.

As is well known, one of the critical dimensions in coaxial cable such as cable 12 is the diameter of the inner surface of outer conductor 16 shown as D in FIG. 1a. It is very important to avoid or at least minimize any change in this dimension. Where a change results in a mismatch of cable impedance and from that a reflective loss of radio frequency (R.F.) energy.

In accordance with the inventive concept a termination of coaxial cable 12 shown in FIG. 1a is provided through coaxial connector 14 which eliminates damaging deformation to cable 12 and which provides a means for attaching cable 12 to tap 10 without the use of special tools. Coaxial connector 14 is shown in detail in FIGS. 2 and 3 to which reference is now made.

FIG. 2 shows threaded insert assembly 24 of coaxial connector 14. The assembly includes a housing or coupling nut 26, outer ferrule 28 and cable retaining ring 30. FIG. 2 also shows guage 32 which is provided to insure proper installation of connector 14 onto cable 12 as will be described in detail below.

Coupling nut 26 contains external threads 34 on end 35, and a hexagonal surface 36 on end 37. Internally, coupling nut 26 defines two concentric bores of differing diameters. The smallest diameter bore 38, beginning at end 37, meets the largest diameter bore 40 which begins at end 35. The diameter of smallest bore 38 is slightly greater than the outer diameter of outer ferrule 28.

Outer ferrule 28 consists of a sleeve 44 and a rim 46. Sleeve 44 is thin walled and is slightly longer than coupling nut 26. Rim 46 extends outwardly for a distance slightly less than the root diameter of external threads 34 on coupling nut 26. Internally, outer ferrule 28 defines a bore 48, and within rim 46 a internal, annular recess 50 having a step 51. The diameter of bore 48 is slightly greater than the outer diameter of coaxial cable 12 and the diameter of recess 50 within step 51 is sized to receive therein cable retaining ring 30.

Cable retaining ring 30 is characterized by having serrations or spring fingers 52 on its inner edge 54. The inner diameter of ring 30 with the inner spring fingers 52 in a nondeformed position is slightly less than the outer diameter of coaxial cable 12. The outer diameter of ring 30 is slightly smaller than the diameter of groove 50 located in outer ferrule 28.

Guage 32 is a thin-walled plastic or heavy paper collar whose inner diameter is only large enough to allow the collar to be slipped over threads 34 on coupling nut 26.

FIG. 3 shows feed-through adapter assembly 58 of coaxial connector 14. The assembly includes an inner ferrule 60 and connector body 62.

Inner ferrule 60 is a thin-walled cylinder whose forward or leading end 64 (toward the left of the drawing) is beveled inwardly. The outer diameter of inner ferrule 60 other than beveled end 64 is slightly greater than inner diameter D of coaxial cable 12.

Connector body 62 contains external threads 66 on one end which are sized to be received by internal threads (not shown) in tap 10. RFurther, connector body 62 has a hexagonal surface 68 to facilitate assembly via a standard wrench. A recess 70, located between threads 66 and surface 68, is provided to receive O-ring 72. Internally, connector body 62 defines three concentric bores of differing diameters. The largest diameter bore is 74 and it contains internal threads 76 which mate with external threads 34 on coupling nut 26. A recess 78, located immediately adjacent to threads 76, receives O-ring 80. The next larger diameter bore is 82 and where it meets bore 74 a shoulder 84 is formed. The corner between bore 82 and shoulder 84 has been bevelled as shown at 86. The diameter of bore 82 is large enough to accommodate inner ferrule 60 therein. The smallest diameter bore is 88 and where it meets bore 82, shoulder 90 is formed. Shoulder 90 is of the same thickness as inner ferrule 60 and the diameter of bore 88 equals the inner diameter of inner ferrule 60.

ASSEMBLY OF THE PREFERRED EMBODIMENT

FIGS. 4 and 5 illustrate the assembly of coaxial connector 14 onto coaxial cable 12.

Prior to assembly on cable, outer ferrule 28 is inserted into coupling nut 26 to where rim 46 abuts against end 35 of the coupling nut. The portion of sleeve 44 which extends beyond end 37 of coupling nut 26 is flared outwardly as shown in FIG. 4 so that the outer ferrule cannot move longitudinally but can move rotationally. Cable retaining washer 30 is inserted into recess 50 in rim 46, coining over step 51 to lock the ring in place. Guage 32 is slid over threads 34 on coupling nut 26.

Connector body 62, with inner ferrule 60 staked into an interference fit in bore 82, is threaded onto coupling nut 26 as far as guage 32 permits.

Coaxial cable 12 is then inserted into the partial assembly described above until touching contact is made with inner ferrule 60. At that point the cable cannot be slid further in without considerable force thus alerting the assembler that the cable has been pushed through cable retaining washer 30 the optimum distance. As the cable is pushed in, the inwardly extending spring fingers 52 tightly grasp washer 30 around the cable thereby locking it in threaded insert assembly 24.

Connector body 62 is now backed off coupling nut 26. Feed through adapter assembly 58 may now be attached to a cable television directional tap 10 via external threads 66 and internal threads (not shown) on the tap as seen in FIG. 1 on the right side of tap 10. O-ring 72 seals the attachment in a manner well known in the art.

With reference to FIG. 5, final assembly of coaxial connector 14 takes place when threaded insert assembly 24, with coaxial cable 12 attached thereto via the manner disclosed above and with guage 32 removed, is threadedly attached to feed through adapter assembly 58. As coupling nut 26, which can rotate freely about outer ferrule 28 and cable 12 attached thereto, is threaded into connector body 62, inner ferrule 60 enters inside outer conductor 16 and begins to spread it radially outwardly, beveled end 64 aiding in a manner well known in the art. As the inner ferrule is advanced farther into the cable, the outer conductor is squeezed against rim 46 where it becomes thinned; i.e., the outer conductor is longitudinally extruded in either direction away from the rim. In addition, both a portion of sleeve 44 and outer conductor 16 is expanded radially outwardly into bore 40 in coupling nut 26 with the net result that the inner diameter of the outer conductor is maintained through coaxial connector 14 and coaxial cable 12 is securely attached thereto without sever deformation as would occur in a clamp or crimp type connection.

As coupling nut 26 bottoms out clamping rim 46 to connector body 62, O-ring 80 seals the connector against entry of water along the threads as seen in FIG. 5. A metal-to-metal seal in the expanded area of sleeve 44 and outer conductor 16 prevents water entry along the outer cable conductor.

A novel feature of the present invention is that assembly of connector 14 is accomplished entirely with only standard wrenches; no special tools such as hand crimping devices are needed.

As is now apparent, the assembly is quick, sure and uncomplicated so that only simple installation instructions are required.

Another novel feature of the present invention is that the coaxial connector disclosed herein maintains the characteristic impedance of the coaxial cable to which it is attached.

Though the invention has been described with respect to a specific preferred embodiment thereof, many variations and modifications thereof will immediately become apparent to those skilled in the art. It is therefore the intention that the appended claims be interpreted as broadly as possible in view of the prior art to include all such variations and modifications.

What is claimed is:

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1. A method of terminating a semi-rigid coaxial cable having a metallic tubular outer conductor onto a connector comprising the steps of:

- a. staking an inner ferrule into a connector body having a bore therethrough; 5
 - b. inserting a outer ferrule having a rim and a sleeve projecting axially from said rim, through a coupling nut until said rim engages an end of said nut, 10
 - c. flaring an end of said sleeve protruding from the end of said coupling nut opposite said end engaging said rim thereby securing said outer ferrule to said coupling nut; 15
 - d. staking a cable retaining ring having inwardly facing serrations into a inwardly facing recess in said rim; 20
 - e. sliding a guage over external threads on said coupling nut;
 - f. threading said coupling nut into said connector body until said connector body engages said guage; 25
 - g. inserting an end of said coaxial cable through said outer ferrule and through said retaining ring until said cable abuts said inner ferrule and whereby said serrations grip said cable;
 - h. removing said connector body from said coupling nut; 30
 - i. removing said guage from said coupling nut;
 - j. re-threading said connector body onto said coupling nut thereby driving said inner ferrule into said tubular outer conductor causing said outer conductor and said sleeve on said outer ferrule to radially deform outwardly. 35
2. The method of claim 1 adding the step of longitudinally extruding said outer conductor adjacent to said rim on said outer ferrule during said re-threading of said connector body onto said coupling nut. 40

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3. A method of terminating a semi-rigid coaxial cable having a metallic tubular outer conductor onto a connector comprising the steps of:

- a. staking an inner ferrule into a connector body having a bore therethrough;
 - b. inserting a outer ferrule having a rim and a sleeve projecting axially from said rim, through a coupling nut until said rim engages an end of said nut;
 - c. flaring an end of said sleeve protruding from the end of said coupling nut opposite said end engaging said rim thereby securing said outer ferrule to said coupling nut;
 - d. staking a cable retaining ring having inwardly facing serrations into a inwardly facing recess in said rim;
 - e. placing a gauge over external threads on said coupling nut;
 - f. threading said coupling nut into said connector body until said connector body engages said gauge;
 - g. inserting an end of said coaxial cable through said outer ferrule and through said retaining ring until said cable abuts said inner ferrule and whereby said serrations grip said cable;
 - h. removing said gauge from said coupling nut;
 - i. continuing the threading of said connector body onto said coupling nut thereby driving said inner ferrule into said tubular outer conductor causing said outer conductor and said sleeve on said outer ferrule to radially deform outwardly.
4. The method of claim 3 adding the step of longitudinally extruding said outer conductor adjacent to said rim on said outer ferrule during said re-threading of said connector body onto said coupling nut. 45
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