

[54] **ELECTRICAL CABLE TERMINATING AND GROUNDING CONNECTOR**

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174/89, 339/14 L, 339/89 R, 339/94 R

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174/75 C, 77 R, 78, 88 C, 89; 339/14 R, 14
L, 89 R, 89 M, 94 R, 94 A, 94 C, 94 M, 130
R, 130 C, 177 R, 177 E, 255 RT, 256 RT, 89
C

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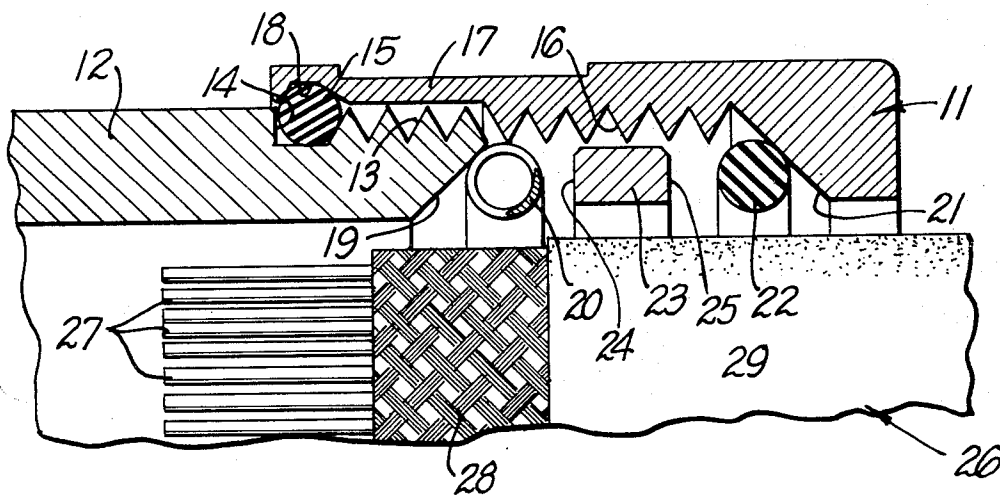
Primary Examiner—Laramie E. Askin

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[57] **ABSTRACT**

A terminating and grounding connector for electrical cables and the like. The connector includes a housing and an end member screw threadedly mounted on said housing. A resilient annular electrically conductive coil spring is mounted between adjacent portions of the housing and end member. As the end member is rotatably threaded toward the housing, an inwardly directed annular bevel engages the spring and moves it inwardly toward an electrically shielded portion of the cable. The spring is compressed circumferentially so that its inner periphery makes electrical grounding contact with the shielded portion of the cable. In an alternative embodiment, a plurality of separate shields from the interior of a cable are passed through and held between the coils of the spring.

8 Claims, 8 Drawing Figures



SHEET 1 OF 2

FIG. 1.

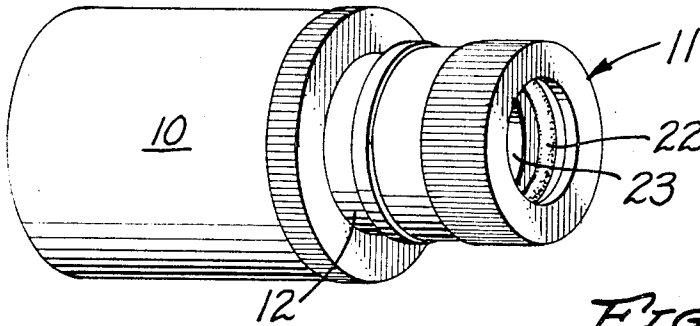


FIG. 2.

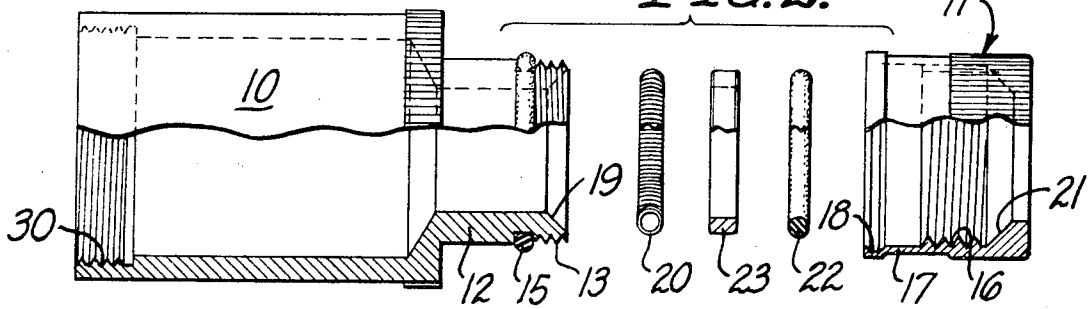


FIG. 3.

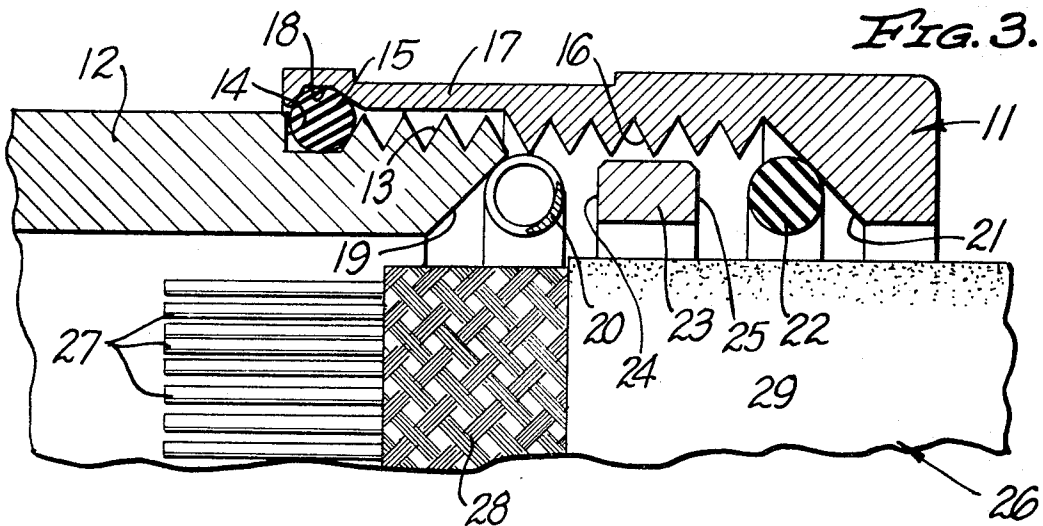


FIG. 4.

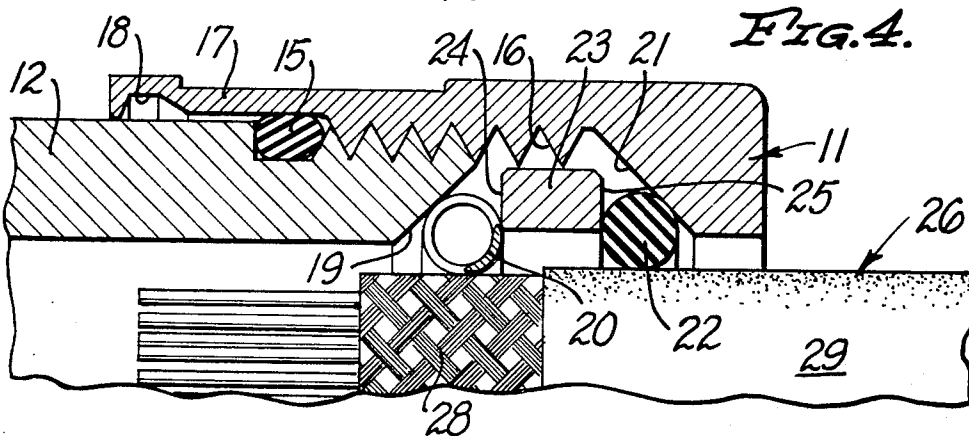


FIG. 5.

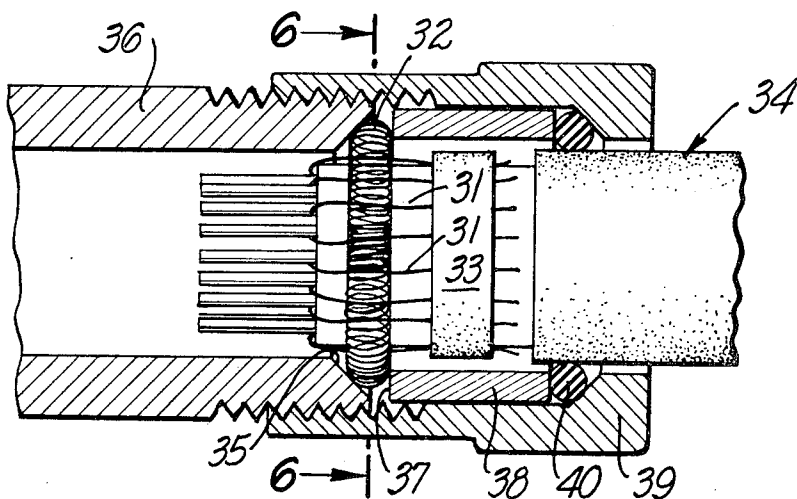


FIG. 6.

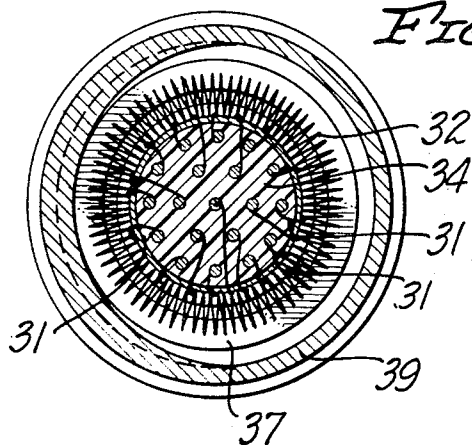


FIG. 8.

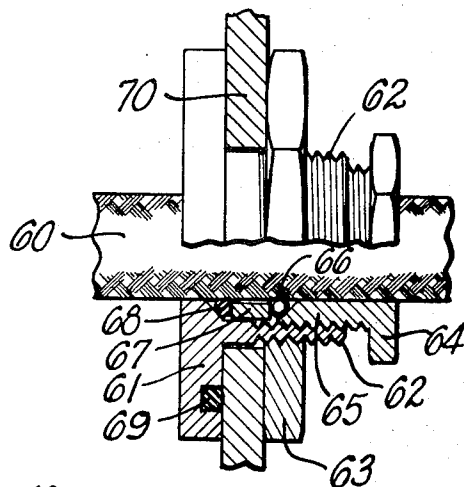
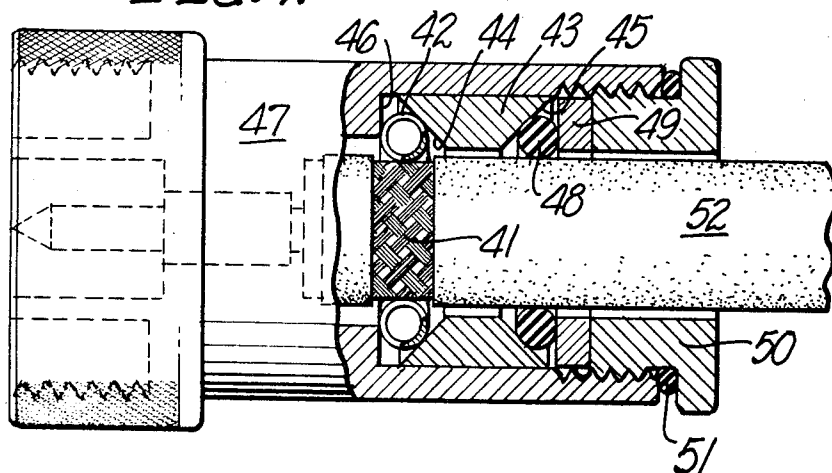


FIG. 7.



ELECTRICAL CABLE TERMINATING AND GROUNDING CONNECTOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a terminating and grounding connector for electrical cables and the like.

2. Description of the Prior Art

Cable terminating and grounding connectors of the type now in use comprise several separate parts which must be assembled together at the time the connector is installed. The terminating and grounding operation customarily requires a considerable amount of time, resulting in high labor costs. Close tolerances are usually involved, with likelihood of disconnections or shorting. The shielding braid is sometimes broken during the preparation and assembly operation.

The existing devices and methods do not provide true EMP (EMI/RFI) shielding either alone or in combination with environmental sealing.

SUMMARY OF THE INVENTION

The present invention provides an electrical cable terminating and grounding connector which is an improvement over the prior art in many ways. A unitary connector member is completely preassembled at the factory and need not be disassembled in use. The connector is merely slipped loosely over the end of the cable prior to the termination of the conductors.

After the conductors have been terminated, the connector is slipped down into place and tightened by screw threaded rotation of one part with respect to the other. This tightening operation brings the grounding ring into secure gripping engagement with the shielding or grounding members to provide complete EMP (EMI/RFI) sealing. At the same time, and through the same operation, the exterior of the cable may be separately gripped and environmentally sealed as well.

It is accordingly among the objects of the invention to provide a cable terminating and grounding connector which is simple in construction and which is far simpler in use and installation than similar devices of the type now in use. This simplicity and greater speed of installation of the connector necessarily result in substantial savings in time and labor cost.

Another object of the invention is to provide such a connector which is pre-assembled so that it cannot be improperly assembled in use and dangers of disconnections and shortings are eliminated.

A further object of the invention is to provide a connector which in a single assembly operation furnishes complete EMP (EMI/RFI) shielding and an environmental seal.

Still another object of the invention is to provide such a connector in which the gripping pressure is self-equalizing around the entire diameter and in which the electrical grounding path is short and uniform around the entire diameter.

It is a further object of the invention to provide in a modified embodiment of the invention a connector in which the grounding ring comprises a coil spring, around and through the coils of which a plurality of grounding conductors are passed so that they are held between the coils of the spring.

Another object of the invention is to provide a connector which in case of repair can easily be removed to permit repairs and subsequently moved back into place

without disassembly or re-assembly operations being required.

The invention also comprises such other objects, advantages and capabilities as will later more fully appear and which are inherently possessed by the invention.

While there are shown in the accompanying drawings preferred embodiments of the invention, it should be understood that the same are susceptible of modification and change without departing from the spirit of the invention.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is an isometric view of a connector in assembled condition;

FIG. 2 is an exploded side elevational view of the same, partly in section;

FIG. 3 is an enlarged partial sectional view of a connector in place on a cable prior to tightening of the connector parts;

FIG. 4 is a view similar to FIG. 3 showing the connector parts tightened together and the rings in gripping engagement with the cable;

FIG. 5 is a longitudinal sectional view of an alternative embodiment of connector, with the cable shown in elevation;

FIG. 6 is a sectional view taken on line 6—6 of FIG. 5, showing the individual shields passing through the coils of the spring;

FIG. 7 is a side elevational view partly in section of another embodiment of the invention showing a coaxial assembly with the bevels facing in reverse directions;

FIG. 8 is a side elevational view partly in section of still another embodiment of the invention, showing its use to electrically ground and seal a cable passing through a bulkhead.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A first preferred embodiment of connector which has been selected to illustrate my invention is shown in FIGS. 1-4 of the drawings. The connector comprises a housing 10 and an end member 11. The housing 10 is provided at one end thereof with a neck 12, the end of which is provided with external screw threading 13. An annular groove 14 extends around the neck 12 adjacent to the inner end of the threading 13. A resilient O-ring 15 is mounted within the groove 14.

One end of the end member 11 is provided with internal screw threading 16 formed complementarily to and adapted to engage with the threading 13 of the housing 10. Extending outwardly beyond the threading 16 is an unthreaded portion 17, beyond which at the extreme end of the end member 11 is a groove 18 which is adapted to fit around the O-ring 15.

Referring to FIG. 3 of the drawings, it will be seen that the O-ring 15 provides a loose but secure rotatable connection between the housing 10 and the end member 11, even when the threading 13-16 is disengaged. It accordingly provides a means for maintaining the connector parts in a unitary condition prior to the time the connector is brought into use.

The end of the housing 10 adjacent to the end member 11 is provided with an inwardly directed annular bevel 19, which preferably extends at a 45° angle. Mounted adjacent to the bevel 19 is an annular coil spring 20 which acts as a grounding member. The normal outer diameter of the spring 20 is approximately

equal to that of the outer edge of the bevel 19 or the minor diameter of the internal screw threading 16.

The end of the end member 11 which is directed toward the housing 10 is also provided with an annular bevel 21 which also preferably extends on a 45° angle. Mounted adjacent to the bevel 21 is a resilient O-ring 22, the normal outer diameter of which is approximately equal to that of the spring 20 and the midportion of the bevel 21.

Disposed between the spring 20 and O-ring 22 is a circular spacer 23, which is preferably formed of rigid material and which has preferably straining (with slight chamfer) sides 24 and 25 which are adapted to engage the sides of the spring 20 and O-ring 22 opposite from the bevels 19 and 21. The outer diameter of the spacer 23 is approximately equal to the normal or uncompressed outer diameter of the spring 20 and O-ring 22.

The connector as described is completely assembled at the factory in the condition shown in FIGS. 1 and 3 of the drawings. When the connector is to be used, it is slipped over the end of a cable 26 prior to termination of the cable leads 27. After the leads 27 have been terminated, the connector is moved into place and secured to a conventional terminal, plug, adapter or the like by any suitable conventional means such as for example only the internal screw threading 30 shown at the end of the housing 10 remote from the end member 11.

Before the connector is moved into place, the external conductive braid 28 of the cable 26 is exposed around its entire periphery along the area which will be disposed adjacent to the spring 20. The outer resilient insulation 29 or the like is left intact along the area which will be disposed adjacent to the O-ring 22.

Manual pressure is then applied to the end member 11 to move it longitudinally toward the housing 10 and to rotate it simultaneously. This simultaneous longitudinal movement and rotation causes the adjacent ends of the screw threads 13 and 16 to engage each other. Thereafter, only rotation is necessary to cause continued longitudinal movement of the end member 11 toward the housing 10.

As the end member 11 moves, the O-ring 15 moves out of the groove 18 at the inner end of the end member 11 and engages the smooth inner surface of the unthreaded portion 17. It accordingly provides a sliding environmental seal between the end member 11 and the housing 10.

As the end member 11 moves toward the housing 10, the coil spring 20 is engaged on one side by the angled face of the bevel 19 of the housing 10 and on the other side by the straight side of the washer 23. This pressure causes the coil spring 20 to be moved inwardly along the bevel 19. As the spring 20 moves inwardly, it is progressively compressed circumferentially and reduced to an outer diameter corresponding to that of the portion of the bevel 19 which it engages.

As the spring 20 is moved inwardly, compressed and diametrically reduced, its inner periphery is brought into progressively tighter engagement with the outer periphery of the braid 28 of the cable 26. The pressure with which the spring 20 engages the braid 28 is uniform around the entire periphery of the braid 28.

Because the spring 20 is in simultaneous contact with the housing 10 and the braid 28, the braid 18 is electrically grounded to the housing 10 along a short path

comprising less than half of the cross sectional thickness of the spring 20.

At the same time, the O-ring 22 is simultaneously compressed between the angled face of the bevel 21 of the end member 11 and the opposite straight side of the washer 23. The O-ring 22 is likewise moved inwardly and compressed circumferentially to reduce its diameter.

As the O-ring 22 is moved inwardly and compressed, its inner periphery is brought into progressively tighter engagement with the outer periphery of the outer insulation 29 of the cable 26. The pressure which the O-ring 22 exerts on the insulation 29 is uniform around the entire periphery of the insulation 29. The O-ring 22 provides environmental sealing of the cable 26. The O-rings 15 and 22 thus provide complete environmental sealing at both ends of the connector.

It will accordingly be seen that by a single screw threading operation the cable is grounded and environmentally sealed, providing complete EMP (EMI/RFI) shielding and environmental sealing as well.

The same structure is capable of use in terminating a cable of the type having a plurality of conductors which are shielded individually and/or in bundles. FIGS. 5 and 6 of the drawings show such a structure in which a plurality of grounding conductors or shields 31 are stripped from their leads and bent back to extend through the coils of a coil spring 32. The free ends of the shields 31 may be held by a band 33 such as tape, shrink tubing or the like which extends around the cable 34.

The spring 32 is disposed between a bevel 35 formed on a housing 36 and the straight wall 37 of a washer 38. An end member 39 is threadably connected to the housing 36 toward the bevel 35, causing the spring 32 to be moved radially inwardly and compressed circumferentially. As the spring 32 is compressed, the space between its individual coils is reduced, bringing the coils into tighter gripping engagement with the shields 31.

The shields 31 are thus increasingly securely held and are simultaneously grounded to the housing 36. The coils of the spring 32 are self-equalizing, so that all of the shields 31 are gripped with the same amount of force even though there may be shields between some of the coils and not between others, or the shields may have different thicknesses. An O-ring 40 is moved inwardly and compressed circumferentially in the same manner described to provide environmental sealing of the exterior of the cable 34.

It will be noted that the coil spring 32 serves a dual function of collecting and holding the shields 31 and simultaneously grounding them electrically.

Instead of passing the individual shields through the coils of a coil spring, it is also possible to strip the shields from their leads and bend them back into overlying relationship with the braid. The free ends of the shields may be held in the manner shown and described, if desired. A grounding ring of any type may then be used to fit around and ground the shields simultaneously with the braid.

FIG. 7 of the drawings shows another alternative embodiment of the invention in which the iris is used to terminate a coaxial connector. The coaxial cable has a shielding braid 41 which is exposed in the area adjacent to a coil spring 42. A washer 43 has a pair of oppositely directed bevels 44 and 45. The spring 42 is gripped be-

tween the bevel 44 and a straight wall 46 formed on the housing 47. An O-ring 48 is gripped between the bevel 45 and the straight wall of a washer 49. An end member 50 is threadedly connected to the housing 47. An O-ring 51 on the end member 50 provides environmental sealing.

When the end member 50 is tightly connected to the housing 47, the spring 42 is moved radially inwardly and circumferentially compressed to bring its inner periphery into tight gripping engagement and electrical contact with the outer periphery of the exposed portion of the shielding braid 41. This provides effective electrical grounding of the braid 41. At the same time, the O-ring 48 is moved inwardly and circumferentially compressed to bring its inner periphery into tight gripping engagement with the outer periphery of the cable 52 to provide an environmental sealing.

In any embodiment of the invention except that shown in FIGS. 5 and 6, an O-ring formed of conductive elastomeric material may be used instead of a coil spring. The mechanical and electrical functions of the device remain exactly the same.

FIG. 8 of the drawings shows another embodiment in which the invention is utilized to ground a probe, shaft or braided cable 60 as it passes through a bulkhead 70. A connector housing 61 has a screw threaded shank 62 which extends through an opening in the bulkhead 70 surrounding the cable 60. A lock nut 63 holds the housing 61 in place. An end member 64 has a threaded shank 65 which engages the

The inner end of the shank 65 engages one side of a spring 66. A spacer 67 has a straight side which engages the opposite side of the spring 66. An O-ring 68 is disposed on the opposite side of the spacer 67. The side of the O-ring 68 remote from the spacer 67 is engaged by a bevel formed on the head of the connector housing 61.

As in the previously described embodiments, the spring 66 is compressed circumferentially to ground the cable 60 to the bulkhead 70. The O-ring 68 is compressed circumferentially to environmentally seal the cable 60.

A second O-ring 69 may be used to provide an environmental seal between the head of the connector housing 61 and the side of the bulkhead 70.

It will be obvious that the positioning of the coil spring and O-ring in any of the embodiments shown and described might be reversed where the grounding shield extends around the outside of the cable. It will also be obvious that the connector may be adapted to substantially any type of cable or terminating structure.

I claim:

1. A terminating connector for an electrical cable, said connector including a housing and an end member

connected to said housing and mounted for longitudinal movement with respect to said housing, said connector having an open center adapted to receive a cable, a resilient annular electrically conductive spring mounted within said connector between said housing and end member, an annular spacer mounted adjacent to the side of said spring remote from said housing, a resilient annular O-ring mounted between said spacer and said end member, a first inwardly directed annular bevel formed on a portion of said connector directly adjacent to said spring and a second inwardly directed annular bevel formed on a portion of said connector directly adjacent to said O-ring, said end member adapted to be moved longitudinally toward said housing to compress said spring and O-ring simultaneously, said spring being adapted to engage a shielded portion of the cable to electrically ground the cable and said O-ring being adapted to engage an insulated portion of the cable to form an environmental seal around the periphery of the cable.

2. The structure described in claim 1, said first bevel being formed on one end of said housing and said second bevel being formed on a portion of said end member.

3. The structure described in claim 1, both said first and second bevels being formed on opposite sides of said spacer.

4. The structure described in claim 1, said spring and O-ring being interchangeable with each other.

5. The structure described in claim 1, and interengaging means between said end member and housing for holding said end member in connected relationship to said housing with said spring, spacer and O-ring mounted therein prior to installation of said connector on a cable.

6. The structure described in claim 5, and a second O-ring mounted in a pair of grooves formed in overlapping portions of said housing and end member, said O-ring acting to hold said end member in connected and assembled relationship to said housing prior to installation of said connector on a cable.

7. The structure described in claim 6, said end member having an unthreaded portion disposed adjacent to the groove holding said second O-ring, said unthreaded portion adapted upon longitudinal movement of said end member toward said housing to compress said second O-ring and provide an environmental seal between said housing and end member.

8. The connector described in claim 1 in combination with a cable shield having a plurality of separate leads, said leads being bent back to extend between and be gripped by the coils of said spring.

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