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[54] **ELECTRICAL CONNECTOR WITH IMPROVED CABLE SUPPORT**

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[52] **U.S. Cl.** .....**339/101**, 339/103 R, 24/16 PB

[51] **Int. Cl.** **H01r 13/58**

[58] **Field of Search**.....339/101, 102, 103, 339/107, 213, 60, 63, 94; 24/16 PB

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[57] **ABSTRACT**

A plastic conduit affixed to and extending from the end of an electrical connector to prevent radial, axial and rotational forces acting on the electrical wires leading to the connector from reaching the connection of the connector contacts and electrical wires. The plastic cable support includes a plurality of axial slots that permit the cable support to be compressed into the wires passing through the conduit and at least one radial shoulder on the inside of the compressible portion so that the wires may be retained in a fixed position. The plastic cable support prevents radial, axial and rotational forces from reaching the connection of the wires to the contacts.

16 Claims, 5 Drawing Figures

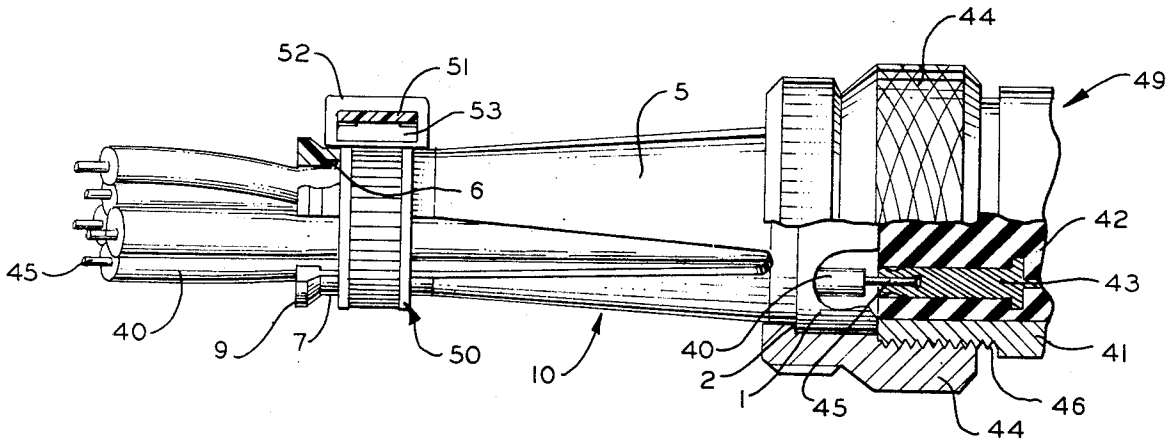


FIG. 1

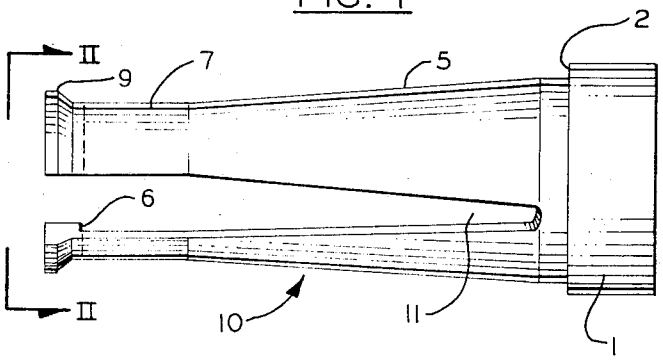


FIG. 2

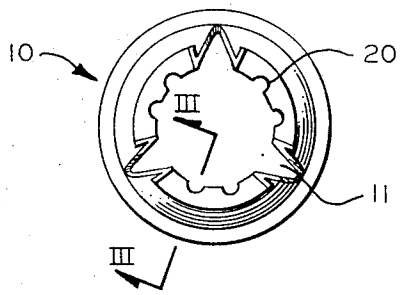
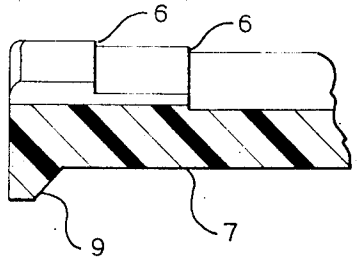


FIG. 3



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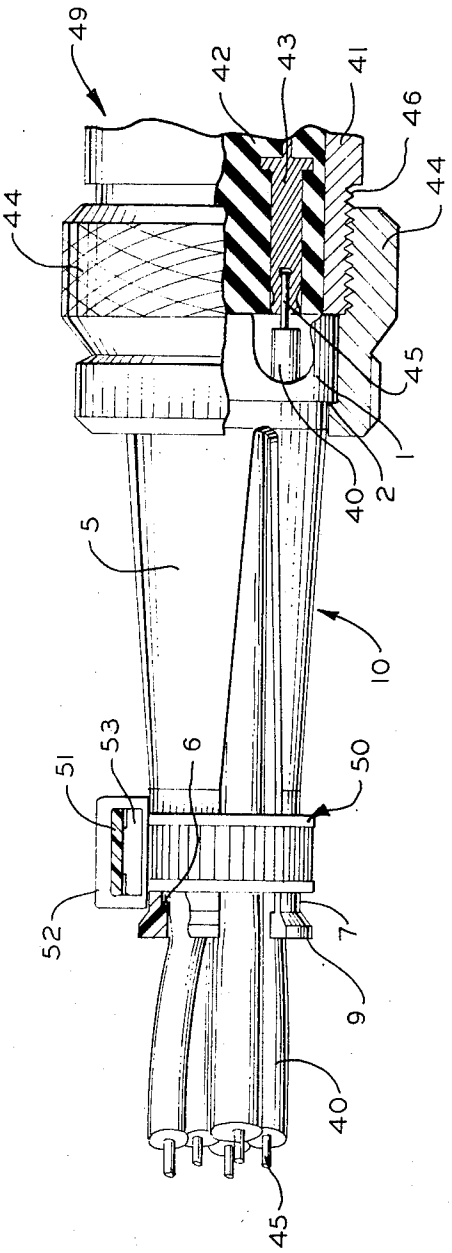


FIG. 5

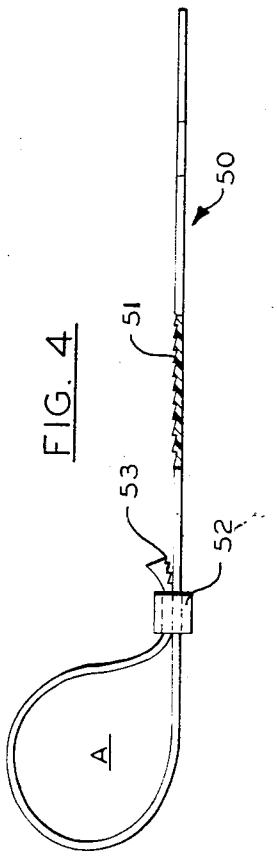


FIG. 4

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ELECTRICAL CONNECTOR WITH IMPROVED CABLE SUPPORT

CROSS REFERENCE TO RELATED APPLICATIONS

This application discloses material similar to that disclosed in application Ser. No. 156,640 filed June 25, 1972, entitled "Electrical Connector with Extended Cable Support," filed concurrently with this application and Ser. No. 156,639, filed June 25, 1972 entitled "Plastic Cable Support."

BACKGROUND OF THE INVENTION

This invention relates to electrical connectors of the axial connecting type wherein a plurality of electrical wires are connected into a predetermined circuit relationship with a plurality of electrical contacts. The invention is more particularly related to an improved electrical connector that includes means for removing the stresses that would normally be applied to the connection of the connector contacts and wires by forces external to the connector operating on the wires.

It has been a continuing problem to prevent forces applied to a cable from being transmitted to an electrical connector associated therewith. However, most of the devices devised to avoid this problem are costly, complicated, and generally require too many additional components to be added to the connector to avoid the problem. An example of one such device to prevent the transmission of the forces applied to a cable to the connector associated therewith is a metal clamp which is attached to the housing of the connector by a retaining ring. Such a clamp had to be machined and required nuts and bolts to compress the clamp into the cable. In many instances, the clamp was tightened too much causing the rigid metal clamp to cut into and sometimes through the cable. Certainly this was undesirable as the electrical signals traveling through the wires were conducted to the connector body and, where a high voltage is involved, a hazardous condition exists. Therefore, prior art cable support devices do not satisfactorily transmit the radial, axial and rotational forces away from the connector contact-wire junction.

SUMMARY OF THE INVENTION

This invention provides a plastic sleeve of simple construction, that is connectable to an electrical connector to prevent the transmission of radial, axial and rotational forces applied to the wires from being transmitted to the wire terminals in the connector.

The invention is a multi-contact axial type connector characterized by a plastic sleeve having one end connected to the electrical connector and the other end of the plastic sleeve, which includes at least one shoulder and a plurality of axial grooves on the inside thereof, in pressurized contact with the wires leading to the connector. This arrangement permits the sleeve to retain the wires in a fixed position relative to the connector for at least the length of the plastic sleeve. Axial forces applied to the wires are prevented from being transmitted to the connector by the shoulder inside the conduit which compressed into the wires, prevents axial movement of the wires. Axial grooves prevent the transmission of torque acting on the wires from reaching the connector contacts.

One embodiment of the invention includes an electrical connector of the type having a metal housing, a resilient body located in the housing, a plurality of electrical contacts located in the resilient body, and a plurality of wires each of which has one end electrically connected to a contact and the other end extending away from the connector, and a means for supporting the electrical wires a predetermined distance from the connector which comprises: a plastic conduit through which the wires pass, the conduit having a first end portion having a shape similar to the shape of the connector and a tapered portion that tapers away from the first end portion and terminates in an opening smaller than the opening in the first end portion, the tapered portion having at least one axial slot therein extending from the opening in the tapered portion so that the tapered portion is radially compressible; the tapered portion of the conduit further including a shoulder and axial grooves on the inside that contact the wires when the tapered portion is compressed so that an axial force and/or torque applied to the wires beyond the support is reduced at the connection of the contacts; means for radially compressing the tapered portion of the conduit, e.g., such as a plastic belt, so that the electrical wires extending through the conduit are retained in fixed position; and means for demountably attaching the conduit to the connector, e.g., a retaining ring that threads onto the connector so that the first end portion of the conduit is closer to the connector than the tapered portion whereby when the plastic conduit is attached to the connector and the tapered portion is compressed against the wires connected to the connector, radial, axial and rotational forces applied to the wires beyond the conduit are reduced at the connection of the wires to the contacts.

Accordingly, it is an object of this invention to provide an inexpensive cable support that may be connected to an axial type electrical connector to prevent radial, axial and rotational forces applied to the wires outside the connector from reaching that portion of the wire connected to the contacts in the electrical connector.

Another object of this invention is to provide an inexpensive device for preventing the breakage of wires from the electrical contacts in a connector.

It is still another object of this invention to provide a nonmetallic cable support.

It is another object of this invention to provide an improved cable support.

It is yet another object of this invention to support that portion of the resilient insert that extends beyond the connector housing.

It is still a further object of this invention to provide a cable support device that does not require the necessity of tools to attach the device to an electrical connector.

The above and other objects and features of the invention will become apparent from the following detailed descritpion taken in conjunction with the accompanying drawings and claims which form a part of this specification.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a preferred embodiment of the improved cable support.

FIG. 2 is a side view of FIG. 1 taken along lines II—II.

FIG. 3 is a partial cross-sectional view of the conduit shown in FIG. 2 taken along lines III—III.

FIG. 4 is a plastic belt which is used to tie down the cable support in a fixed position around the wires leading to the connector.

FIG. 5 illustrates the cable support shown in FIG. 1 attached to a connector and supporting the electrical wires leading thereto.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, FIG. 1 illustrates a plastic conduit 10 having a configuration that embodies the principles of this invention. The conduit has a tapered portion 5 and cylindrical portions 1, 7 at each end of the conduit 10. Generally, the tapered portion 5 is frusto-conical in shape so that one end of the conduit has a large opening which is connected to a connector and the other end has a smaller opening which provides for the passage of wires to the connector. The larger cylindrical portion 1 of the conduit 10 includes a shoulder 2 which, in conjunction with a retaining ring (not shown), cooperates to fasten the conduit 10 to a connector. At the smaller cylindrical portion 7 of the conduit 10 there is a second shoulder 9 which, in conjunction with the tapered portion 5, operates to prevent the fastening means (FIG. 4) from moving axially beyond the cylindrical portion 7. The conduit 10 includes a slot 11 which extends from the opening in the smaller cylindrical portion 7 towards the opposite ends 1. When the conduit 10 is fabricated completely from a rigid material, such as plastic, which cannot be compressed, the axial slot 11 allows the smaller opening in the conduit to be reduced when a compressive force is applied to the cylindrical portion 7 of the conduit. Since the conduit is comprised of a rigid material, the cylinder cannot be bent and, hence, the wires within the cylinder cannot be bent.

FIG. 2 is a view looking into the smaller end of the conduit 10 shown in FIG. 1 at II—II. This view illustrates that there are three axial slots which permit the rigid conduit to be compressed. In addition to the axial slots 11 there are a plurality of axial grooves 20 which function to align the wires passing through the conduit and prevent rotational movement of the wires. Therefore, the size of the axial grooves depends upon the size of the wires leading to the connector, where the wires are enclosed in a sheath to form a single cable, these grooves 20 act as teeth to prevent the cable from twisting thereby preventing radial, axial and rotational forces, acting upon the cable, from being transmitted to the connector contacts (43, FIG. 5).

FIG. 3 is a partial cross-sectional view of the conduit 10 taken along lines III—III of FIG. 2. This view illustrates shoulders 6 which are located in the inside of the cylindrical portion 7 of the conduit 10. When the conduit is compressed (as shown in FIG. 5), the shoulders 6 press against the wires passing through the conduit and prevent a force, pulling on the wires, from pulling the wires away from the contacts within the connector.

FIG. 4 is one preferred device for compressing the conduit which incorporates the principles of this invention. This particular means for compressing the conduit 10 is a belt of plastic 50 that has a plurality of directional ridges or teeth 51 along one surface thereof, a friction buckle 52, and an enlarged end portion 53. The opening in the buckle 52 is larger in size than twice the cross-sectional area of the smaller remaining end portion of the belt but smaller in size than the combined cross-sectional area of the larger end portion 53 and the smaller end portion so that both end portions of the belt may not pass through the buckle together whereby when both of the end portions of said belt are drawn into said buckle together, the teeth in both of the end portions engage each other and force the belt into pressurized contact with the inside of the buckle thereby preventing further movement of the end portions of the belt into the buckle. When the belt is tightened around the conduit 10, the teeth 51 in one end portion engage the teeth in the other end portion 53 so that the belt cannot move in a direction that will enlarge the loop A. This results from the end portion 53 being drawn into the friction buckle 52 so that the teeth of the end portion 53 engage the teeth in the other portion of the belt to stop the movement of the belt in a direction that would enlarge the loop A. Removing the tension on the loop A allows the end portion 53 to move outside of the friction buckle 52 and therefore allow the belt to move in either direction as the teeth 51 are no longer engaged.

FIG. 5 illustrates the functional advantages of the plastic conduit and how it cooperates with the electrical connector 49 and the wires 40 connected thereto to transmit axial, radial and rotational forces away from the connector 49. The righthand portion of the FIG. 5 illustrates a partial cross-sectional view of a connector 49 that includes a resilient insert or body of nonconducting material (e.g., dielectric) 42, an electrical contact 43, and a metal housing 41 that includes a plurality of threads 46 for receiving a retaining ring 47. The retaining ring 47 threadably engages the electrical connector and, as it is tightened down, interacts with the shoulder 2 of the conduit 10 to bring the conduit into contact with the housing 41 of the electrical connector. The wires 40, having electrical conductors 45 therein, extend through the conduit 10 and to the electrical connector contacts 43 where they are either crimped or soldered to the contacts 43. The conduit 10, being comprised of a rigid material, protects the wires 40 within the conduit from being subjected to radial and axial forces. Without the conduit, movement of the wires 40 would weaken the connection of the wires to the contact 43, and in some instances break away entirely. When the cylindrical end portion 7 of the conduit is compressed by some means, such as the tie down strap 50, the wires 40 extending from the connector and within the conduit are both radially and axially supported.

While a preferred embodiment of the invention has been disclosed, it will be apparent to those skilled in the art that changes may be made to the invention as set forth in the appended claims, and, in some cases, certain features of the invention may be used to advantage without corresponding use of other features. For example, the general shape of the conduit shown has been cylindrical, however, electrical connectors take many physical configurations, e.g., rectangular, octagonal, etc., hence, the conduit may take different shapes while the objects of this invention may still be obtaned. Accordingly, it is intended that the illustrative and

descriptive materials herein be used to illustrate the principles of the invention and not to limit the scope thereof.

Having described the invention, what is claimed is:

1. In combination with an electrical connector of the type having several wires connected to the contacts thereof, the improvement comprising:

means for supporting, in a predetermined manner, said wires connected to said connector, said supporting means comprising: a conduit comprised of a nonresilient material through which said wires pass, said conduit having a first end portion having a shape similar to the shape of the connector and a tapered portion that tapers away from said first end portion and terminates in a second cylindrical conduit end portion terminating in an opening smaller than the opening in said first end portion, said second end portion and at least a portion of said tapered portion having at least one axial slot therein extending from said opening in said second end portion so that said second end portion is radially compressible, said second end portion of the conduit further including at least one nonround shoulder on the inside that contacts said wires when said second end portion is compressed so that an axial force applied to said wires beyond said support is reduced at the connection of the wires to the contacts;

means for radially compressing said second end portion of said conduit so that said electrical wires extending through said conduit are retained in fixed positions; and

means for demountably attaching said supporting means to said connector so that said first end portion of said conduit is closer to said connector than said tapered portion, whereby when said conduit is attached to said connector and said second end portion of the conduit is compressed against said wires connected to said connector, radial and axial forces applied to said wires beyond said conduit are reduced at the connection of the wires to the contacts.

2. The combination as recited in claim 1 wherein the inside of the second end portion of said conduit includes several axial grooves for receiving said wires leading from said connector.

3. The combination as recited in claim 1 wherein said conduit is a unitary integral structure comprised of plastic.

4. The combination as recited in claim 2 wherein said conduit is a unitary integral structure comprised of plastic.

5. In combination with an electrical connector of the type having a metal housing, a dielectric insert mounted within said housing, a plurality of electrical contacts mounted in said insert, and a plurality of electrical wires attached to said electrical contacts and extending away from said housing, the improvement comprising:

a strain relief conduit comprised of a nonresilient material through which said wires pass for supporting said wires a predetermined distance from said housing, said conduit comprising a unitary integral structure having a frusto-conical portion; a first cylindrical conduit portion at one end of said frusto-conical portion, said first cylindrical portion including a shoulder on the outside thereof that faces said frusto-conical portion; a second cylindrical conduit portion at the other end of said frusto-conical portion terminating in a free end that includes a shoulder on the outside thereof and at least one nonround shoulder on the inside of said second cylindrical portion, each shoulder facing in the direction of the frusto-conical portion, said second cylindrical portion further including a plurality of axial grooves on the inside thereof for receiving said wires leading from said housing; and a plurality of axial slots in said second cylindrical portion and said frusto-conical portion that extend the entire axial length of said second cylindrical portion and into at least a portion of said frusto-conical portion, said axial slots defining a plurality of fingers extending in a direction away from said first cylindrical portion, said fingers comprising greater than one half of the circumference of said second cylindrical portion;

coupling means for engaging the shoulder on said first cylindrical portion of said conduit and for demountably coupling said conduit to said connector housing; and

means for compressing said second cylindrical portion around said electrical wires whereby said electrical wires leaving said connector housing are supported by said conduit.

6. In combination with an electrical connector of the type having a metal housing, a dielectric insert mounted within said housing, a plurality of electrical contacts mounted in said insert, and a plurality of electrical wires attached to said electrical contacts and extending away from said housing, the improvement comprising:

a strain relief conduit comprised of a nonresilient material through which said wires pass for supporting said wires a predetermined distance from said housing, said conduit comprising a unitary integral structure having a frusto-conical conduit portion; a first cylindrical conduit portion at one end of said frusto-conical portion, said first cylindrical portion including a shoulder on the outside thereof that faces said frusto-conical portion; a second cylindrical conduit portion at the other end of said frusto-conical portion terminating in a free end that includes a shoulder on the outside thereof and at least one nonround shoulder on the inside of said second cylindrical portion, each shoulder facing in the direction of the frusto-conical portion, said second cylindrical portion further including a plurality of axial grooves on the inside thereof for receiving said wires leading from said housing; and a plurality of axial slots in said second cylindrical portion and said frusto-conical portion that extend the entire axial length of said second cylindrical portion and into at least a portion of said frusto-conical portion, said axial slots defining a plurality of fingers extending in a direction away from said first cylindrical portion that comprise greater than one half of the circumference of said second cylindrical portion; and

coupling means for engaging the shoulder on said first cylindrical portion of said conduit and for

demountably coupling said conduit to said connector housing.

7. In combination with an electrical connector of the type having a metal housing, a dielectric insert mounted within said housing, a plurality of electrical contacts mounted in said insert, and a plurality of electrical wires attached to said electrical contacts and extending away from said housing, the improvement comprising:

a strain relief conduit comprised of a nonresilient material through which said wires pass for supporting said wires a predetermined distance from said housing, said conduit comprising a unitary integral structure having a frusto-conical conduit portion; a first cylindrical conduit portion at one end of said frusto-conical portion, said first cylindrical portion including a shoulder on the outside thereof that faces said frusto-conical portion; a second cylindrical conduit portion at the other end of said frusto-conical portion terminating in a free end that includes a shoulder on the outside thereof and at least one nonround shoulder on the inside of said second cylindrical portion, each shoulder facing in the direction of the frusto-conical portion, said second cylindrical portion further including a plurality of axial grooves on the inside thereof for receiving said wires leading from said housing; and a plurality of axial slots in said second cylindrical portion and said frusto-conical portion that extend the entire axial length of said second cylindrical portion and into at least a portion of said frusto-conical portion, said axial slots defining at least three axially rigid but radially moveable fingers extending in a direction away from said first cylindrical portions; and

coupling means for engaging the shoulder on said first cylindrical portion of said conduit and for demountably coupling said conduit to said connector housing.

8. A strain relief clamp for an electrical connector element having multiple attachment points for the connection of the ends of several wires extending therefrom, comprising:

a conduit comprised of a nonresilient material through which said wires pass for supporting said wires a predetermined distance from said housing, said conduit comprising a unitary integral structure having a frusto-conical conduit portion; a first cylindrical conduit portion at one end of said frusto-conical portion, said first cylindrical portion including a shoulder on the outside thereof that faces said frusto-conical portion; a second cylindrical conduit portion at the other end of said frusto-conical portion terminating in a free end that includes a shoulder on the outside thereof and at least one nonround shoulder on the inside of said second cylindrical portion, each shoulder facing in the direction of the frusto-conical portion, said second cylindrical portion further including a plurality of axial grooves on the inside thereof for receiving said wires leading from said housing; and a plurality of axial slots in said second cylindrical portion and said frusto-conical portion that extends the entire axial length of said second cylindrical portion and into at least a portion of said frusto-conical portion, said axial slots defining a plurality of fingers extending in a direction away from said first cylindrical portion that comprise greater than one half of the circumference of said second cylindrical portion.

9. The combination recited in claim 8 including coupling means, engaging the shoulder on said first cylindrical portion of said conduit, for demountably coupling said conduit to said connector element.

10. The combination recited in claim 9 including means for compressing said second cylindrical portion around said electrical wires whereby said electrical wires leaving said connector housing are supported by said conduit.

11. A strain relief clamp for an electrical connector element having multiple attachment points for the connection of the ends of several wires extending therefrom, comprising:

a conduit comprised of a nonresilient material through which said wires pass for supporting said wires a predetermined distance from said housing, said conduit comprising a unitary integral structure having a frusto-conical conduit portion; a first cylindrical conduit portion at one end of said frusto-conical portion, said first cylindrical portion including a shoulder on the outside thereof that faces said frusto-conical portion; a second cylindrical conduit portion at the other end of said frusto-conical portion terminating in a free end that includes a shoulder on the outside thereof and at least one nonround shoulder on the inside of said second cylindrical portion, each shoulder facing in the direction of the frusto-conical portion; and a plurality of axial slots in said second cylindrical portion and said frusto-conical portion that extends the entire axial length of said second cylindrical portion and into at least a portion of said frusto-conical portion, said axial slots defining a plurality of fingers extending in a direction away from said first cylindrical portion that comprise greater than one half of the circumference of said second cylindrical portion.

12. The combination recited in claim 11 including coupling means for engaging the shoulder on said first cylindrical portion of said conduit and for demountably coupling said conduit to said connector element.

13. A strain relief clamp for an electrical connector element having multiple contacts for the connection of the ends of several wires extending therefrom, comprising:

a conduit comprised of a nonresilient material through which said wires pass for supporting said wires a predetermined distance from said housing, said conduit comprising a unitary integral structure having a frusto-conical conduit portion; a first cylindrical conduit portion at one end of said frusto-conical portion, said first cylindrical portion including a shoulder on the outside thereof that faces said frusto-conical portion; a second cylindrical conduit portion at the other end of said frusto-conical portion terminating in a free end that includes a shoulder on the outside thereof that faces in the direction of the frusto-conical portion, said second cylindrical portion further including a plurality of axial grooves on the inside thereof for

receiving said wires leading from said housing; and a plurality of axial slots in said second cylindrical portion and said frusto-conical portion that extend the entire axial length of said second cylindrical portion and into at least a portion of said frusto-conical portion, said axial slots defining a plurality of fingers extending in a direction away from said first cylindrical portion that comprise greater than one half of the circumference of said second cylindrical portion.

14. A strain relief clamp as recited in claim **13** including coupling means for engaging the shoulder on said first cylindrical portion of said conduit and for demountably coupling said conduit to said connector element.

15. A strain relief clamp as recited in claim **13** including means for compressing said second cylindrical portion around said electrical wires whereby said electrical wires leaving said connector housing are supported by said conduit.

16. A strain relief clamp as recited in claim **14** including means for compressing said second cylindrical portion around said electrical wires whereby said electrical wires leaving said connector housing are supported by said conduit.

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