

[54] **INTEGRAL HOUSING AND STRAIN RELIEF**

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[58] Field of Search **339/103, 104, 105, 106, 339/107, 101; 174/65, 135**

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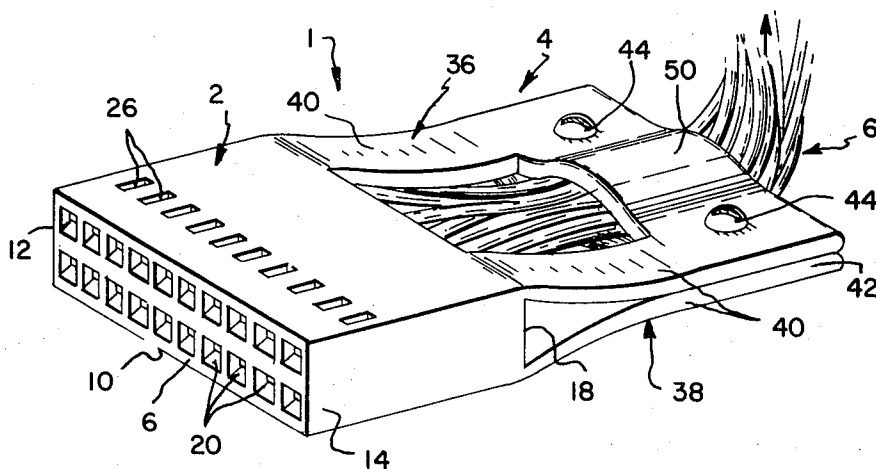
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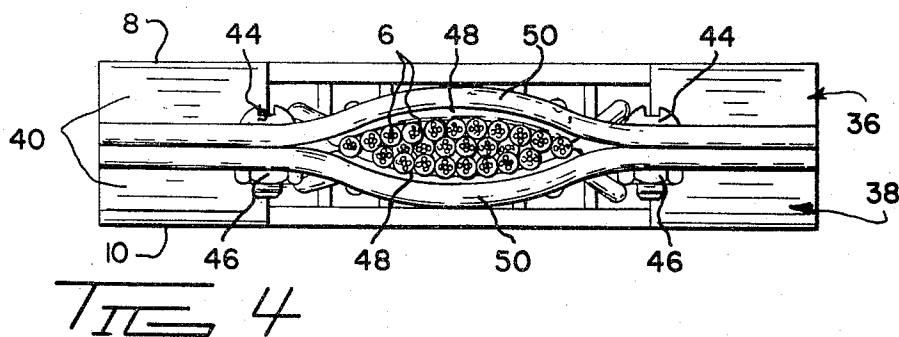
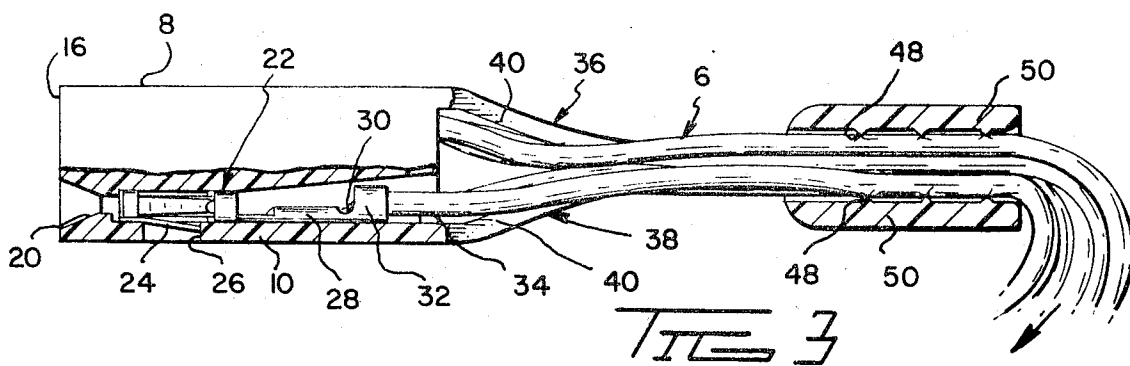
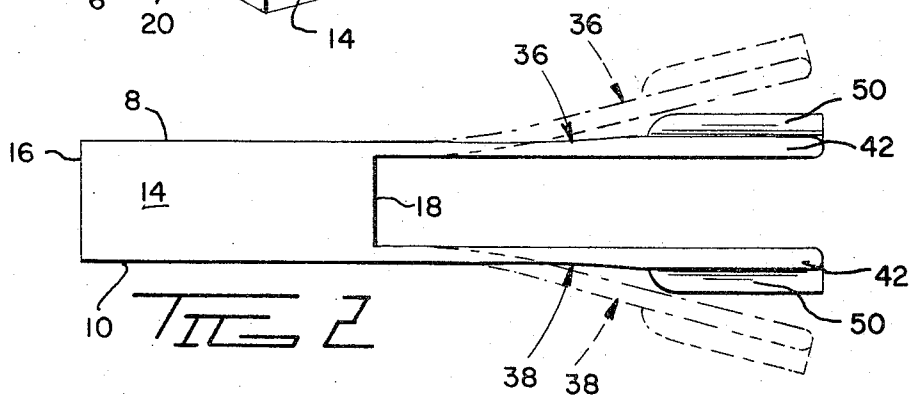
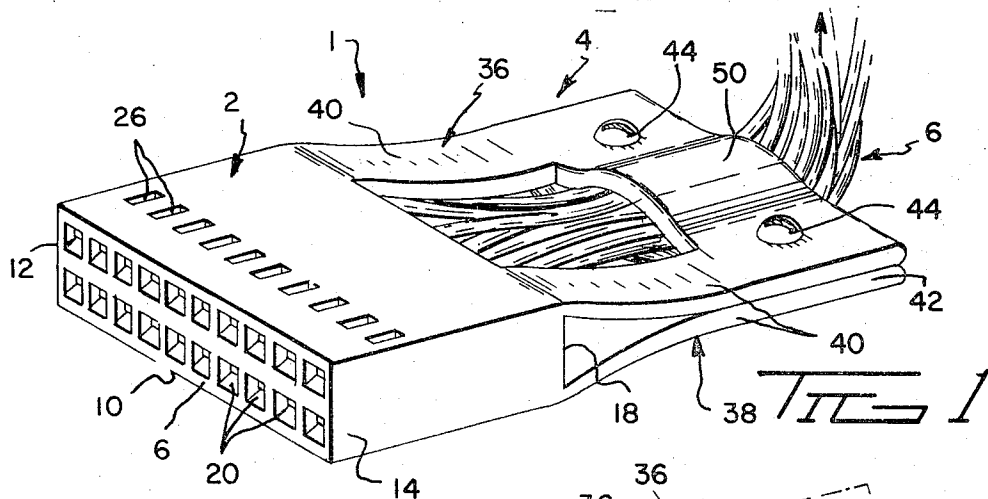
ABSTRACT

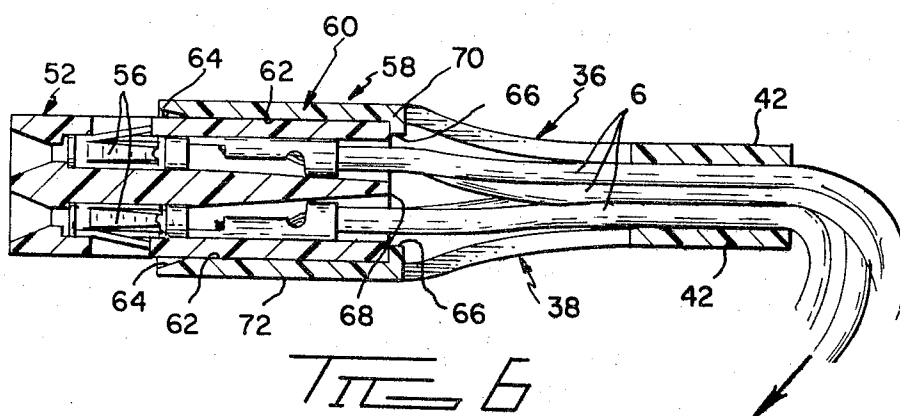
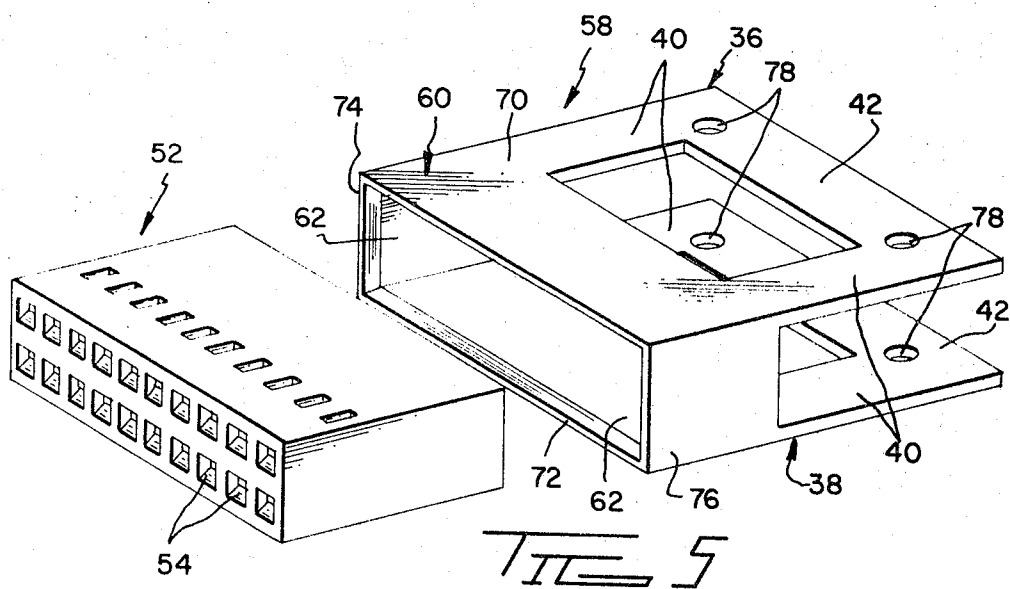
The present invention relates generally to a strain relief for conductors which are terminated to electrical terminals mounted within an insulation housing. In one embodiment the strain relief is integral with the housing. Each embodiment is initially flexible but subsequently rigidized and thereby non-deflectable to anchor the conductors to the housing and prevent twisting or bending of the conductors with respect to the terminals and the housing.

8 Claims, 6 Drawing Figures



SHEET 1 OF 2





INTEGRAL HOUSING AND STRAIN RELIEF

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part application of U.S. patent application, Ser. No. 313,021, filed Dec. 7, 1972, and now abandoned.

The present invention relates generally to a strain relief for electrical conductors terminated within an electrical housing. More particularly, the present invention resides in a strain relief which may be made separate from or integral with a housing within which are mounted electrical terminals terminated to the ends of a plurality of electrical conductors extending from the housing. The strain relief gathers the conductors into a bundle and anchors the conductors to the housing while also preventing separation of the conductors from the electrical terminals caused by relative bending or twisting of the conductors.

While the combination of a connector housing and strain relief is commonplace in the prior art, it has not been the practice to provide a connector housing with an integral strain relief designed for fabrication by simultaneous molding together with the connector housing. Instead it has been the practice to use a separate strain relief for the wires terminated in a connector housing, which separate piece must be clamped or otherwise joined to the connector housing by fasteners or the like. Such requirement for clamping required the strain relief to be bulky and to be fabricated from quite rigid materials, often metal, so as to decisively anchor both itself and the conductor wires to the housing.

According to the present invention, a strain relief is made integral with the housing without requiring a diversity of materials for the fabrication thereof. Instead the housing and strain relief combination is designed for simultaneous fabrication in a molding operation, for example. The strain relief of the present invention is designed to have a profile no larger than that of the connector housing itself. This advantageously allows a plurality of connector housings to be located in stacked relationship on closer centerlines than heretofore available in the prior art utilizing heretofore available strain relief structures. In addition, the present invention strain relief structure is initially flexible for ease in assembly of the terminations within the housing and to allow for fabrication of the strain relief with relatively thin structures requiring a minimum amount of materials, bulk, and without adding appreciable weight to the connector housing. As an added feature of the present invention, the strain relief is readily converted from a flexible and easily deflectable structure to a structure which is substantially rigid and non-deflectable in order to anchor the terminated conductors to the connector housing and resist substantial applied forces tending to bend and twist the conductor wires with respect to the electrical terminals mounted in the housing.

In one other embodiment of the invention, a strain relief is in the form of a generally flexible molded attachment which is detachably mounted on a connector housing which is not of special design for attachment of a strain relief device. This is accomplished by providing the strain relief of the present invention on a sleeve which is received over a convention housing. The sleeve may be designed with a shape to conform to the housing periphery, thereby avoiding any necessity for

changing or redesigning the housing to accommodate a strain relief device.

Accordingly it is an object of the present invention to provide an integral combination of an electrical connector housing and a strain relief for electrical conductors terminated to electrical terminals mounted within the housing.

It is another object of the present invention to provide an integral housing and strain relief for conductors terminated to electrical terminators mounted within the housing in a single molding operation simultaneous with fabrication of the housing itself.

Another object of the present invention is to provide a strain relief integral with an electrical connector housing wherein the strain relief has substantially a profile not larger than that of the connector housing itself while minimizing the bulk and weight of materials required in addition to the housing itself.

Another object of the present invention is to provide a strain relief for electrical conductors terminated within an electrical connector housing, which strain relief is initially flexible for ease in assembly of the conductors to electrical terminals mounted within the housing and which is subsequently converted to a non-deflectable substantially rigid structure resisting bending and twisting forces applied to the conductors and also anchoring the wires to the connector housing.

Another object of the present invention is to provide an integral combination of a connector housing and strain relief for electrical conductors terminated within the housing, wherein the strain relief is initially relatively thin and flexible permitting fabrication thereof with a minimum amount of materials and bulk, and wherein the strain relief is subsequently rigidized to anchor the conductors to the housing and prevent twisting or bending of the wires with respect to the housing, thereby providing an effective strain relief for the conductors.

Still another object of the present invention is to provide an initially flexible and deflectable strain relief device for attachment with a connector housing, and which is subsequently rigidized into a non-deflectable strain relief which gathers a plurality of conductors into a bundle and anchors the conductors with respect to an electrical connector housing within which the wires are terminated.

Another object of the present invention is to provide a strain relief device which is selectively designed to be adaptable with the periphery of an existing connector housing for containing a plurality of terminals terminated to electrical conductors, with the strain relief device being of sleeve configuration received over the connector housing and anchoring the conductors to the housing while at the same time preventing bending or twisting of the wires with respect to the housing.

Other objects and many attendant advantages of the present invention will be apparent upon perusal of the following detailed description taken in conjunction with the accompanying drawing wherein:

FIG. 1 is a fragmentary perspective of a unitary combination of a connector housing and integral strain relief for a plurality of electrical conductors terminated by electrical terminals mounted within the connector housing;

FIG. 2 is an elevation of the preferred embodiment illustrated in FIG. 1, illustrating in phantom the flexible and deflectable strain relief prior to assembly of the

electrical conductors for termination within the housing;

FIG. 3 is an enlarged elevation partially in section and with parts broken away illustrating the details of the preferred embodiment illustrated in FIG. 1;

FIG. 4 is an enlarged elevation of the right-hand side of the preferred embodiment illustrated in FIGS. 1 and 3; and

FIG. 5 is an enlarged fragmentary elevation of another preferred embodiment of the present invention illustrating in exploded configuration a connector housing and a strain relief device adapted for receipt over the housing periphery without a need for modifying or redesigning the housing; and

FIG. 6 is an enlarged fragmentary elevation in section illustrating the housing and strain relief device of FIG. 5 in assembled configuration and with the housing containing electrical terminals terminated to insulated electrical conductors which are anchored to the housing by the strain relief device.

With more particular reference to the drawing, there is illustrated in FIG. 1 generally at 1 a unitary combination of a connector housing illustrated generally at 2 and having an integral strain relief illustrated generally at 4, which strain relief is provided for purposely anchoring and preventing bending and twisting of a plurality of electrical conductors illustrated generally at 6 adapted for electrical termination within the housing 2. As shown the housing 2 is generally rectangular with a plurality of planar outer peripheral surfaces 8, 10, 12 and 14. The housing 2 is further provided with opposed endwalls 16 and 18, with a plurality of internal cavities some of which as shown at 20 extend generally parallel to one another and in communication with each of the end portions 16 and 18. Generally the cavities 20 are arranged in two rows, although other arrangements are intended to be covered by the scope of the present invention. For example, the housing 2 may be round or other shape instead of rectangular, thereby requiring the cavities 20 to be arranged in various configurations to fit within the outer peripheries of the housing 2. As shown in FIG. 3 each of the cavities 20 receives an exemplary electrical terminal 22 therein. For example, such electrical terminal may take the form of the type described in U.S. Pat. No. Re 26837. The terminal 22 includes a lance portion 24 latchably received in one of the recesses 26 provided in the periphery of the housing 2. In addition, the terminal 22 includes a barrel portion 28 crimped mechanically and electrically to an electrical wire 30, with another barrel portion 32 of the terminal 22 being crimped in mechanical engagement on the electrical insulation 34 covering the wire 30. In the embodiment specifically as shown the conductors 6 each comprises an electrical wire 30 covered by an insulation layer 34 forming individual wires. However it is to be understood that the conductors 6 may comprise other electrical conductors of the type attached to or encapsulated within a common strip or ribbon of insulation material with the conductors thereby forming discrete wires, metal or metallized circuits associated with the common strip of insulation material.

The strain relief 4 comprises first and second flexible beams illustrated generally at 36 and 38 each of said beams comprising a pair of spaced relatively thin flexible webs 40 integrally joined together by a band portion 42 bridging between the webs 40 of each arm 36 or 38. As shown, the webs 40 extend outwardly of the

housing and are integrally joined at their ends to the housing 2. The webs 40 are generally flush with the peripheral surfaces 8, 10, 12 and 14 of the housing 2 and thereby have a profile no larger than that of the housing itself. Accordingly a profile advantage is provided over the prior art strain relief structures which had to be clamped over the housing 2 thereby projecting in encirclement over the housing and substantially adding to the bulk and profile thereof. In addition each of the arms 36 is made from a minimum of materials, since the webs 40 and bands 42 are relatively thin. As shown in FIG. 2 the webs 36 are fabricated to project outwardly at right angles to the housing 2. Since they are relatively thin they are readily flexible outwardly away from each other as shown in phantom line to thereby widen the space therebetween and facilitate receipt of the conductors 6 therebetween and assembly of the conductors into terminated positions within the housing 2. Also the relatively thin configuration of the arms 36 and 38 reduces the bulk and weight of materials required for fabrication thereof, thereby minimizing additions to the bulk and weight of the housing. As more particularly shown in FIGS. 1, 3 and 4, the arms 36 and 38 may be deflected flexibly toward each other into engagement over the plurality of conductors 6. The arms 36 and 38 engage each other at their free ends defined by the bands 42. The bands 42 are advantageously secured together by fasteners, for example, nuts 44 having cooperating bolts 46. For example, the bands 42 are suitably apertured to receive the bolts 44 therethrough. The arms 36 and 38 are therefore joined together at their free ends by the nut and bolt fasteners in generally compressive engagement on the conductors 6 received therebetween. As shown more particularly in FIG. 3, the bands 42 may be provided with at least one or a plurality of ribs 48 projecting therefrom in engagement on at least some of the wires 6 received between the bands 42. Despite the fact that the arms 36 and 38 are relatively thin and flexible initially, when they are joined together, for example, by fasteners as described, at their free ends, the once flexible arms become substantially rigid and non-deflectable. More particularly, the arms 36 and 38 are joined at spaced locations to and on the housing 2. The free ends of the arms 38 and 36 are joined together. This forms a rigid triangular structure preventing relative movement of the arms with respect to the points at which they are joined to the housing and to each other at their free ends. Such a rigid triangular structure forms a relatively rigid triangular truss wherein the once flexible and deflectable ribs 40 become substantially rigid acting together as a non-flexible and non-deflectable beam connected to said housing at one end and gripping said conductors at the other end which is at a location spaced from said housing. Since the resulting beam is substantially non-deflectable, it resists any bending or twisting forces applied to the conductors 6 in the direction, for example, of the arrow illustrated on the drawing, which forces would tend to separate the conductors from the terminals 22 and from the housing 2. Accordingly, the strain relief according to the present invention grips the conductors anchoring them to the connector housing and also prevents the transmission of forces applied to the wires to prevent the wires from bending, twisting or otherwise separating from the terminals 22. As shown in FIGS. 1 and 4, the bands 42 are provided with outwardly bowed configurations 50 opposite each other.

For example, these bowed portions may be provided permanently in the original molded, or otherwise fabricated, configuration of the bands 42. The outwardly bowed portions 50 are opposed and cooperate with each other when the arms 36 and 38 are flexibly deflected toward each other to gather the individual conductors 6 into a neat bundle. Of course, if the individual conductors 6 are of the type connected to a common cable or otherwise attached or imbedded in a strip of insulation material, the bundling and gathering feature of the arms 36 and 38 may be eliminated. As a further feature of the present invention the arms 36 and 38 are connected on the housing generally laterally outward from the longitudinal axes of the longitudinally aligned cavities 20. Accordingly with the arms 36 and 38 being deflected flexibly toward each other into mutual engagement against the conductors 6, the arms when fastened together will be maintained generally in longitudinal alignment with the cavities 20 thus advantageously supporting the conductors 6 at spaced locations from the housing 2 but generally with the conductors in longitudinal extended alignment with the longitudinal axes of the cavities. The overall profile of the strain relief 4 thus is no larger than the profile of the housing 2 itself, allowing simultaneous molding with the housing, and in use allowing a plurality of like housings 2 to be stacked in immediately adjacent relationship without interference between the strain relief structures 4 of respective housings. In addition, since the web portions 40 are joined to the housing in coincidence with the outer peripheral surfaces 8, 10, 12 and 14 thereof, the outer peripheral surfaces of the housing may be changed to any desired shape such as a cylinder or the like, with the web portions 40 thus being readily arranged on the end 18 of the housing for compatibility and correspondence with the desired profile and periphery of the housing. And since the web portions 40 are relatively thin and flexible they can be readily deflected flexibly into any required positions to enable connection of the band portions 42 by the fasteners 44, despite the orientation required of the webs 40 for correspondence with changed outer periphery configurations of the housing 2.

Another preferred embodiment of the present invention will be described in detail with reference to FIGS. 5 and 6. Generally shown at 52 is an exemplary connector housing of the prior art fabricated from dielectric material and having a plurality of internal cavities, some of which are shown at 54 containing a corresponding electrical contact or terminal exemplary ones of which are illustrated at 56. The terminals 56 may be of any desired type utilized in conjunction with the housing 52 and which are advantageously terminated to individual insulated conductors, some of which are illustrated at 6. In accordance with accepted practice, the exemplary housing 52 is fabricated from dielectric material. As shown it is generally rectangular in shape although the periphery thereof may take any desired shape. As shown generally at 58 a preferred embodiment of the invention includes a strain relief device which is adapted for association with the housing 52. More particularly the strain relief device 58 includes a sleeve portion 60 the interior surfaces 62 of which are formed into an enclosed shape in conformity with the outer periphery of the housing 52. As shown, the sleeve interior surfaces 62 form a generally rectangular enclosure. However, the interior surfaces 62 may be specifi-

cally formed into an enclosure of any desired configuration so as to conform with the corresponding periphery of a dielectric connector housing which may be of any configuration. The strain relief device is further adapted to slidably receive the connector housing within the confines of the enclosure defined by the surfaces 62. Accordingly as shown in FIG. 6, the rectangular shaped housing 52 is received internally of the sleeve portion 60. Each of the surfaces 62 is provided with a chamfer 64 internally thereof to provide a slight funnel configuration to facilitate ease in receiving the housing 52 within the sleeve portion 60. In addition FIG. 6 illustrates that the sleeve portion 60 is also provided with protruding lip portions 66 on an end of the sleeve portion opposite to the funnel entry portion formed by the chamfers 64. The lips 66 protrude beyond the surfaces 62 and are adapted to engage against an end 68 of the housing 52 to thereby limit insertion of the housing within the sleeve portion 60, and further to maintain the sleeve portion 60 in a desired location while in encircling relationship with respect to the housing 52.

As in the previous embodiment, the strain relief device 58 comprises first and second flexible beams illustrated generally at 36' and 38'. Each of said beams comprises a pair of spaced, relatively thin flexible webs 40 integrally joined together by a band portion 42 bridging between the webs 40 of each arm 36 or 38. As shown, the webs 40 extend outwardly of the housing, when the sleeve portion 60 is received over the housing as described. The webs 40 also extend outwardly of the sleeve portion 60 and are generally flush with the outer peripheral surfaces 70 and 72, 74 and 76 of the sleeve portion 60. The webs 40 also have a profile no larger than that of the sleeve portion itself. Accordingly a profile advantage is provided over the prior art strain relief structures which had to be clamped over the housing 2 and generally fastened thereto with some sort of clamping device which substantially added to the bulk and profile of the housing. In the present invention illustrated in FIGS. 5 and 6, each of the arms 36 is made from a minimum of material, since the webs 40 and bands 52 are relatively thin. This contributes to the low profile arrangement of the clamping device 58.

The webs 36 are fabricated to project outwardly generally at right angles to the sleeve portion 60. They may however project outwardly at any angle desired. Since they are relatively thin they are readily flexible outwardly away from each other to widen the space therebetween and thereby to facilitate receipt of the conductors 6 therebetween, as well as assembly of the conductors into terminated positions within the contacts or terminals 56 of the housing 2. Also the relatively thin configuration of the arms 36 and 38 reduces the bulk and weight of materials required for fabrication thereof, thereby minimizing additions to the bulk and weight of the housing adapted with the strain relief device 58. As more particularly shown in FIG. 6, the arms 36 and 38 may be deflected flexibly toward each other into engagement over the plurality of conductors 6. The arms 36 and 38 engage each other at their free ends defined by the bands 42. The bands 42 are advantageously secured together by fasteners, for example, nuts and bolts, not shown, similar to the nuts and bolts 44 and 46 described with regard to FIGS. 1-4. For example, the bands 42 are suitably apertured to receive the bolts therethrough as illustrated at 78. The arms 36

and 38 are therefore joined together at their free ends by the nut and bolt fasteners and are in generally compressive engagement on the conductors 6 which are received therebetween. Although not shown in either FIGS. 5 or 6, the bands 42 may be provided with at least one or a plurality of ribs, similar to the ribs 48 described in conjunction with the embodiment of FIGS. 1 - 4, which ribs project from the webs into engagement on at least some of the wires or conductors 6 received between the bands 42. Despite the fact that the arms 36 and 38 are relatively thin and flexible initially, when they are joined together, for example, by fasteners as described, at their free ends, the once flexible arms become substantially rigid and non-deflectable. More particularly, the arms 36 and 38 are flexible initially but when they are joined at spaced locations at their end portions they form a rigid triangular structure. More particularly, the arms 36 and 38 are joined at their webs 42 which define the free ends of the arms. Additionally, the other ends of the arms which are integral with the sleeve portion 60 are joined to the sleeve portion 60 at spaced locations from the webs 42. As shown in FIG. 6, such resultant joining of the arms forms a rigid generally triangular structure preventing relative movement of the arms, with respect to the points at which they are joined to the sleeve, and also with respect to the points at which they are joined to each other at their free ends. Such a rigid triangular structure forms a relatively rigid triangular truss wherein the once flexible and deflectable ribs 40 become substantially rigid, acting together as a non-flexible and non-deflectable beam, connected to said sleeve portion at one end, and gripping said conductors at the other end which is at a location spaced from the sleeve portion. Since the resulting beam is substantially non-deflectable, it resists any bending or twisting forces applied to the conductor 6 in the direction, for example, of the arrow illustrated in FIG. 6. Such twisting or bending forces would tend to separate the conductors from the terminals 22 and from the housing 2. Accordingly, the strain relief device according to the present invention grips the conductors to anchor them to the housing, and also prevents the transmission of forces applied to the wires which would cause bending of the wires or twisting of the wires or otherwise separating the wires from the terminals 22.

Although not shown in either FIGS. 5 or 6, the bands 42 may be provided with outwardly bowed configurations opposite each other similar to the configurations 50 described in conjunction with the preferred embodiment of FIGS. 1 - 4. For example, these bowed portions may be provided permanently in the original molded, or otherwise fabricated, configuration of the bands 42. As in the prior embodiment, such outwardly bowed portions may cooperate with each other when the arms 36 and 38 are flexibly deflected toward each other, to gather the individual conductors into a neat bundle. Of course, in the embodiment shown in FIGS. 5 and 6, the bundling and gathering feature of the arms 36 and 38 may be eliminated. In similar fashion, the preferred embodiment illustrated in FIGS. 1 - 4 may be modified to eliminate the opposed bowed portions 50, since it has been found that even with the conductor 6 being separate and unattached one from the other, the bundling and gathering feature may be eliminated if desired.

As in the prior embodiment, the embodiment of FIGS. 5 and 6 include the arms 36 and 38 connected to the sleeve portion 60 generally laterally outward from the longitudinal axes of the cavities 54, when the sleeve portion is received over the housing 52. Accordingly, with the arms 36 and 38 being deflected flexibly toward each other into mutual engagement against the conductor 6, the arms when fastened together will be maintained generally in longitudinal alignment with the cavities 54 thus advantageously supporting the conductors 6 at spaced locations from the housing 2, but generally with the conductors in longitudinal extended alignment with the longitudinal axes of the cavities 54. The overall profile of strain relief 4 is thus no larger than the thickness of the sleeve portion 60 which itself closely confines itself to the profile of the housing 2. The strain relief device 58 is purposely molded into a very thin configuration from dielectric material. The thinness of the device permits the entire device to be somewhat flexible allowing it to closely conform to the outer periphery of the housing 52 in tight fitting relationship. This has a further advantage in that when the arms 36 and 38 are flexibly deflected toward each other, the deflection forces are transmitted to the sleeve portion 60 itself to which the arms 36 and 38 are integrally joined. The sleeve portion 60 itself is thereby slightly compressed together in a pinching type relationship over the housing 52, which even further assures the containment of the housing 52 within the sleeve portion 60. Due to the low profile of the relatively thin sleeve portion 60, a plurality of housings 52 are permitted to be stacked in closely spaced relationship without interference between the corresponding strain relief devices 58 provided on the respective housings. Since the web portions 40 are joined to the housing to the sleeve portion in coincidence with the outer peripheral surfaces thereof, the outer peripheral surfaces of the sleeve portion may be changed to any desired shape such as a cylinder or the like, with the web portions 40 thus being readily arranged on the end of the sleeve portions 60 for compatibility and correspondence with the desired profile and periphery of the sleeve portion. Since the web portions 40 are relatively thin and flexible they can be readily deflected flexibly into any required position to enable connection of the band portions or the fasteners, despite the orientation required of the webs 40 for correspondence with the changed outer periphery configurations of the housing 2. In other words, the web portions 40 may be oriented in different planes about the periphery of the sleeve portion but may be relatively twisted from their orientation on the sleeve portion 60 to permit the web portions 40 to be connected together by the fasteners.

Although preferred embodiments and modifications of the present invention have been shown and described in detail, other embodiments and modifications of the present invention are intended to be covered in the spirit and scope of the appended claims, wherein:

In the claims:

1. In a connector having a plurality of electrical terminals electrically connected respectively to a plurality of conductors and received within a housing of insulation material, a strain relief for the conductors, comprising: first and second arms on said housing receiving said conductors, said arms being relatively thin and flexible substantially along their lengths, said arms further being flexibly deflected toward each other to grip

said conductors therebetween, and said arms being joined together and abutting at their free ends to form a non-flexible and non-deflectable triangular truss connected to said housing and extending outwardly from said housing in gripping relationship on said conductors at a location spaced from said housing, thereby providing a strain relief resisting twisting and bending of said conductors with respect to said terminals and said housing.

2. The structure as recited in claim 1, wherein, said arms are integral with said housing and are individually flexible, first away from each other to freely receive said conductors therebetween, and second toward each other into gripping relationship on said conductors received therebetween.

3. The structure as recited in claim 1, wherein said housing is provided with longitudinal aligned cavities receiving said terminals therein, said conductors extend generally longitudinally from said cavities, and said arms are connected on said housing generally laterally outward from the longitudinal axes of said cavities, whereby said arms are flexibly deflected toward each other in mutual engagement against said conductors extending generally longitudinally of said cavities.

4. The structure as recited in claim 2, wherein, said housing is provided with longitudinally aligned cavities receiving said terminals therein, and said arms are connected on said housing generally laterally outward from the longitudinal axes of said cavities, whereby said arms are flexibly deflected toward each other into mutual engagement against said conductors which are electrically connected to said terminals and project generally longitudinally of said cavities.

5. The structure as recited in claim 1, wherein, each arm includes a pair of flexible webs extending outwardly of said housing, with a band portion connecting said webs and engageable on said conductors.

6. The structure as recited in claim 5, wherein, said band portions are provided with projecting ribs engageable in gripping relationship on said conductors.

7. The structure as recited in claim 5, wherein, said conductors are individually insulated wires, and said band portions are provided with opposed permanently outwardly bowed portions cooperating to provide an outwardly bowed encirclement area receiving said wires therethrough, said encirclement area of said bands thereby serving to gather said wires into a bundle as the wires extend between said bands.

8. In a connector having a plurality of electrical terminals electrically connected respectively to a plurality of conductors and received within a housing of insulation material, a strain relief for the conductors, comprising: a sleeve portion detachably received over the outer periphery of said housing, first and second arms on said sleeve portion receiving said conductors, said arms being relatively thin and flexible substantially along their lengths for deflection flexibly toward each other to grip said conductors therebetween, and said arms being joined together and abutting at their free ends to form a non-flexible and non-deflectable triangular truss connected to said housing and extending outwardly from said housing in gripping relationship on said conductors at a location spaced from said housing, thereby providing a strain relief resisting twisting and bending of said conductors with respect to said terminals and said housing.

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