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[54] **HEAVY DUTY ELECTRICAL CONNECTOR AND STRAIN RELIEF THEREFOR**

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[58] **Field of Search** ..... 339/103–107, 339/187, 274; 174/135; 24/115 G, 132 AA, 132 AB, 132 AC, 249 SA

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[57] **ABSTRACT**

An integral strain relief for a heavy duty electrical connector that includes a housing made of two telescoped, cupshaped nylon sections each of which has an eccentric opening in a transverse wall. The openings are of approximately equal diameters and of the same eccentricity so that when the sections are mutually related the two openings move between alignment and partial disalignment. The two openings are sized to pass a heavy duty insulated electric cable for connection to electric terminals inside the housing when the openings are substantially aligned. Upon subsequent relative rotation of the two housing sections and partially disalignment of the two openings, said openings crimp and thereby clamp the cable thus applying a holding force that relieves the strain that would otherwise be induced at the terminals when an external pulling force is applied to the cable.

9 Claims, 7 Drawing Figures

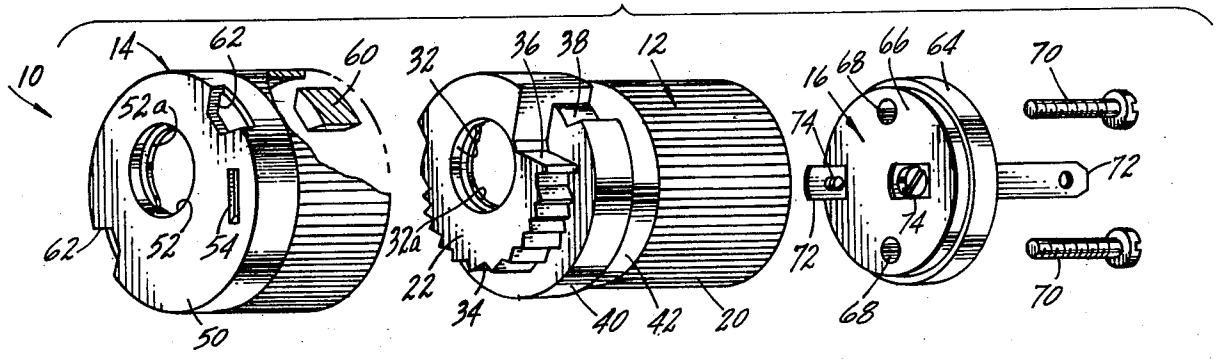

FIG. 1

FIG. 4

FIG. 3

FIG. 2

FIG. 7

FIG. 6

FIG. 5

HEAVY DUTY ELECTRICAL CONNECTOR AND STRAIN RELIEF THEREFOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

An improved strain relief for heavy duty electrical connectors.

2. Description of the Prior Art

Strain relief means for electrical connectors are quite common. However, as to heavy duty electrical connectors, the strain relief products presently available on the market suffer from several defects. They are quite costly to manufacture and are complex in construction. For the most part, the prior art structures do not provide sufficiently good strain relief. In addition; the prior art devices are frequently difficult to manipulate and are ungainly.

In one form of prior art connector a metal cap mounted on the connector housing has a pair of arcuate rearwardly projecting segments. The segments face one another and are movable towards and away from the longitudinal axis of the connector. Adjustable fastener means is used to secure ears on the segments to one another in a manner that permits the space between the segments to be varied. An electrical cable is threaded between the segments when they are spaced widely apart; the cable is connected to terminals within the connector; then the fastener means is tightened in order to shift the arcuate segments towards one another until they clamp the cable between them. The two confronting segments act as a strain relief.

In another example of the prior art a first arcuate segment is formed integrally with one of the housing sections while a second arcuate segment, that faces the first segment, is movable with respect thereto. Once again adjustable fastener means is used to couple the segments. The cable is connected to terminals within the connector and then the fastener means is manipulated to shift the movable segment into a clamping position against the cable.

Still another example of the prior art is a Jacob's chuck type of strain relief means. The connector housing is made in two parts, one of which longitudinally shifts upon relative rotation of the parts. A set of three flexible jaws on one part extends through a central opening in the other part. The cable is threaded between the opening defined by the tips of the jaws. When the parts are relatively rotated, the tips of the jaws approach one another to clamp the cable.

SUMMARY OF THE INVENTION

Brief Description of the Invention

The present invention provides a connector that is adapted to be located at one end of an insulated, electrically conductive wire, i.e., cable. The connector has a plastic, preferably nylon, housing comprised of two generally cup-shaped sections each of which is provided with a transverse wall portion. In each of the transverse wall sections there is an eccentric opening. The openings are of approximately equal diameters and the same eccentricity. The housing sections which are mutually telescoped or nested one within the other, are rotatable relative to one another whereby the openings can move between alignment and partial disalignment. The cable is fed through the two openings when they are substantially aligned and is connected internally of the housing to terminals. The openings clamp a cable between opposed sides thereof when the sections are mutually rotated to sufficiently disalign the openings.

Means is provided for limiting the relative rotational displacement of the housing sections in an opening-disaligning (clamping) direction. Means also is provided to limit the relative rotation to such direction so that the sections after clamping the cable will retain their grip and not back off. Cancelling means further is included for disabling the uni-directional/rotation limiting means when the cable is to be disconnected.

Purpose of the Invention

It is an object of this invention to provide an improved strain relief means for a heavy duty electrical connector.

Another object of the present invention is to provide an improved heavy duty electrical connector having strain relief means integral therewith.

Another object of the present invention is to provide an improved heavy duty electrical connector having means for retaining an integral strain relief means in a cable clamping position.

Another object of the present invention is to provide an improved heavy duty electrical connector having strain relief means, as described above, that includes means for disabling the retaining means.

Another object of the present invention is to provide means in a heavy duty electrical connector, as described above, that normally prevents the housing sections thereof from moving away from a cable receiving condition.

Another object of the present invention is to provide an improved heavy duty electrical connector, as described above, that includes interlocking means for preventing inadvertent separation of the two sections of the connector housing.

Other objects of the invention will in part be obvious and in part will be pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, and arrangement of parts which will be exemplified in the construction hereinafter described, and of which the scope of application will be indicated in the appended claims.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an exploded perspective view, partially broken away and partially in section, illustrating one embodiment of the present invention;

FIG. 2 is a top view of the device shown in FIG. 1, the relative positions of the housing sections being that of a cable-passing mode;

FIG. 3 is a side view, partially broken away and partially in section, illustrating constructional features of the present invention;

FIG. 4 is a transverse sectional view, taken substantially along the line 4—4 of FIG. 3;

FIG. 5 is another transverse sectional view, similar to FIG. 4, but illustrating the relative positions of the housing sections at the time of their assembly;

FIG. 6 is another transverse sectional view, similar to FIG. 4, but illustrating the relative positions of the housing sections in a cable-clamping mode; and

FIG. 7 is a fragmentary sectional view showing a particular feature of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, and in particular to FIGS. 1–3, it will be seen that the heavy duty connector **10** comprising the present invention includes a cup-shaped body section **12**, a cup-shaped cap section **14** that is concentrically telescoped over the closed end of the body section **12** and an end plug **16** that is received in and secured to the open end of the body section **12**. All of the three foregoing components preferably are molded of a synthetic plastic material, such as nylon or a phenolformaldehyde condensation product, in order to provide the connector **10** with the appropriate electrical insulation and heat resistant characteristics. Selected areas of the outer surface of the body section **12** and of the cap section **14** may be finished with knurling or the like to facilitate usage of the connector **10** in a manner such as will be described in detail hereinafter, i.e., relative rotation by hand.

The body section **12** is defined by a generally cylindrical sleeve **20** having an integral transverse wall **22** formed across one end thereof. The opposite end of the sleeve **20** is open and includes a downwardly extending annular lip **24** defining an annular seat **26**, and integrally formed bosses or lugs **28** that are provided with longitudinally extending, internally threaded bores **30**.

An longitudinally extending through opening **32** is formed in the end wall **22** of the body section **12**, being positioned eccentrically with respect to the longitudinal axis of said body section. Preferably, although not necessarily, at least a portion of the lower corner of the opening **32** is provided with a chamfer, i.e. bevel, **32a** for a purpose described hereinafter.

As shown for example in FIGS. **1** and **4–6**, an integral concentric incomplete gear segment **34** is formed on the periphery of the end wall **22**. A single tooth **36**, at one end of the segment **34** is made larger than the other teeth. In addition, in a position longitudinally below the plane of the teeth of the rack **34**, the end wall **22** is provided with a pair of longitudinally extending widely angularly spaced notches or grooves **38** (only one of which is shown) in FIG. **1** that are positioned other than 180 degrees apart. The notches **38** are located in a full diametric portion **40** that is spaced longitudinally above the remainder of the cylindrical section **20** in order to define an annular recess or undercut **42**.

Turning now to the cap section **14** it will be seen, particularly in FIG. **1**, that it has an end wall **50** in which a longitudinally extending opening **52** is formed. The opening **52** is of the same diameter as the opening **32** and has the same radius of eccentricity. The openings are large enough to pass a heavy duty insulated electrical cable. Preferably, although not necessarily, the opening **52** is chamfered as at **52***a*. As will be explained more fully hereinafter, the openings **32** and **52**, as well as the chamfers **32***a* and **52***a*, cooperate with one another to clamp the insulation portion of the wire that passes therethrough. The end wall **50** is, in addition, provided with a through slot **54** that is positioned adjacent a lug **56** (see FIG. **5**) formed on the inside surface of the cap **14**. A resilient leaf pawl **58** has an edge suitably retained in a slot **59** formed in the lug **56** and passes across and directly beneath the slot **54**. The cap **14** includes with a pair of opposed integral projections **60** that extend radially inwardly from the inside surface thereof. The projections **60** are angularly spaced apart by an arc equal to that separating the notches **38**. To facilitate molding of the cap **14**, a pair of mold-pin-passing openings **62** in the wall **50** are aligned with the projections **60**.

The end plug **16** is molded with an integral flange **64** that mates with the annular lip **24** and a reduced diameter portion **66** that mates with the annular seat **26** in the body section **12**. A pair of clearance through holes **68** are formed in the end plug **16** in order to permit fasteners, such as screws **70**, to pass therethrough and threadingly engage the tapped bores **30** in the body section **12**. In the particular embodiment illustrated, a pair of male contact prongs **72**, the offset shanks of each of which includes a tapped opening in which a screw **74** is received, are mounted in the end plug **16**. After the insulated electrical cable is passed through the openings **32** and **52** the electrically conductive cores thereof, which may be either solid or stranded, are secured to the contacts **72** as by the screws **74**. It should be understood that while male contacts have been illustrated, the scope of the present invention also includes the use of female contacts.

The connector **10** of the present invention is supplied to the consumer with the telescoped section in the relative angular relationship illustrated in FIG. **5**. The cap section **14** has been telescoped over the body section **12**. To accomplish this the lugs **60** have been passed longitudinally through the slots **38** and the pawl **58** has been positioned to the side of the enlarged tooth **36**. The openings **32** and **52** were almost in registery with one another remote from the remaining teeth (see FIG. **4**). The cap section **14** and the body section **12** then were rotated relative to one another so that pawl **58** was forced over the enlarged tooth **36**. The lugs **60** thereby were positioned in the annular recess **42** away from the notches **38**. It will be appreciated that the cap section **14** cannot be removed from the body section **12** without forcing the pawl **58** back over the enlarged tooth **36** and this is extremely difficult since the tooth **36** is provided with a buttress back face that is at an angle that resists reverse rotation, being almost perpendicular to the length of the pawl. The openings **32** and **52** are now in registry. The remaining teeth of the gear segment are also of buttress shape to inhibit, in conjunction with the pawl **58**, reverse rotation. The connector **10** is now ready for the insertion of an electric cable through the openings **32** and **52**.

After the conductor ends are connected to the contacts, further relative rotation of the cap section **14** and the body section **12** to the position shown in FIG. **6**, causes the pawl **58** to ride successively over the teeth **34** until a desired clamping position is reached. At this time, and because of the relative rotation, the registered portions of the two openings **32** and **52** will be reduced in size and will assume a general shape of an oval having sharg ends (see FIG. **6**). The curved edges of the oval shaped opening engage and tightly squeeze the insulation of the cable. The chamfered edges **32***a* and **52***a* are preferable in that only small areas engage the insulation and thereby increase the available pressure on the wire as a function of the twisting forces exerted by the user.

It will be appreciated from the above that the pawl and ratchet arrangement afforded by the pawl **58** and the buttress teeth **34** effectively provide means for limiting the cap **14** to rotation in a single direction that tends to clamp the insulated cable. When it is desired

to remove the insulated cable, a tool, such as a screw driver, nail, nail file or the like, is inserted through the opening **54** in the cap **14** and manipulated to shift the pawl **58** away from the teeth **36.** With the pawl **58** disengaged from the teeth **34,** the cap section **14** and the body section **12** may be counterrotated easily to release the wire from the confronting openings **32** and **52.**

It will be evident from the foregoing that an improved strain relief means has been provided for a heavy duty electrical connector. The strain relief means is integral with the electrical connnector comprising this invention and may be locked in place in a wire clamping mode by the pawl and ratchet arrangement. Means also is provided for disabling the locking means and returning the connector parts to an initial position that readily permits removal of the cable and subsequent reinsertion of the same on a different cable. The construction of the present invention provides interlocking means that prevents the inadvertent separation of the two housing sections, which normally limits the relative movement of the housing sections to a direction towards a clamping position and which also prevents the two housing sections from moving away from the clamping position to the wire receiving condition.

It thus will be seen that there is provided a device which achieves the several objects of the invention and which is well adapted to conditions of practical use.

As various possible embodiments might be made of the above invention, and as various changes might be made in the embodiment above set forth, it is to be understood that all matter herein described, or shown in the accompanying drawings, is to be interpreted as illustrative and not in a limiting sense.

Having now described the invention, there is claimed as new and desired to be secured by Letters Patent:

1. A heavy duty electrical connector adapted to be secured to an end of an insulated electrical cable having conductive cores, said connector comprising:

a. a body section including a transverse wall having an eccentrically disposed through opening for passing the cable therethrough;

b. a cap section telescopically associated with said body section, said cap section including a transverse wall having an eccentrically disposed through opening for passing the cable therethrough, said openings being of the same diameter and of the same radius of eccentricity, said openings in said cap section initially being in substantial alignment with said opening in said body section, said cap section being angularly rotatable relative to said body section in a first direction to progressively shift said openings out of alignment thereby to distort and clamp the insulation of the cable between opposed edges of said openings;

c. means limiting the angular rotation of said cap section to said first direction so as to lock said cap in cable clamping position, said limiting and locking means comprising a ratchet and a cooperating pawl,

d. contacts carried by said body section, said contacts including means for electrically and mechanically coupling the conductive cores of the cable thereto; and

e. manually operable means for selectively disabling the limiting and locking means.

2. The connector in accordance with claim **1** wherein said ratchet is integral with said body section and said pawl is integral with said cap section.

3. The connector in accordance with claim **1** wherein said cap section includes a slot through said transverse wall thereof for receiving a tool that is adapted to disengage said pawl from said ratchet to thereby to disable the limiting and locking means.

4. The connector in accordance with claim **1** wherein the first tooth of said ratchet normally prevents said openings from moving out of initial alignment with each other absent an angular force on said cap that moves said pawl past said first tooth.

5. The connector in accordance with claim **3** wherein said first tooth of said ratchet is enlarged with respect to the remainder of the teeth thereof.

6. The connector in accordance with claim **1** wherein at least a portion of the peripheral edge of said opening in said cap section, and at least a portion of the peripheral edge of said opening in said body section are chamfered.

7. The connector in accordance with claim **1** wherein there is further included interlocking means on said cap section and said body section for preventing inadvertent separation thereof.

8. The connector in accordance with claim **7** wherein said interlocking means comprises a pair of radially inwardly extending projections integral with said cap section and an annular groove on the peripheral surface of said body section said projections being spaced apart by an angle other than **180** degrees said body section including a pair of peripheral notches that are angularly spaced apart the same as the projections, said notches extending from an end of the body section to the groove whereby said projections are longitudinally movable through said notches to the groove and then angularly movable in said groove.

9. A heavy duty electrical connector adapted to be secured to an end of an insulated electrical cable having conductive cores, said connector comprising:

a. a body section including a transverse wall having an eccentrically disposed through opening for passing the cable therethrough;

b. a cap section telescopically associated with said body section, said cap section including a transverse wall having an eccentrically disposed through opening for passing the cable therethrough, said openings being of the same radius of eccentricity, said opening in said cap section initially being in substantial alignment with said opening in said body section, said cap section being angularly rotatable relative to said body section in a first direction to progressively shift said openings out of alignment thereby to distort and clamp the insulation of the cable between opposed edges of said openings;

c. means limiting the angular rotation of said cap section to said first direction so as to lock said cap in cable clamping position, said limiting and locking means comprising a ratchet and a cooperating pawl,

d. contacts carried by said body section, said contacts including means for electrically and mechanically coupling the conductive cores of the cable thereto; and

e. manually operable means for selectively disabling the limiting and locking means.

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