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Davis et al.

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[54] **ELECTRICAL CABLE CONNECTOR**

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[21] Appl. No.: **173,837**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 20,640, March 18, 1970, abandoned.

[52] **U.S. Cl.** ..... **174/73 R**, 339/61 R, 339/268 R, 339/278 C, 339/217 R

[51] **Int. Cl.** **H02g 3/00**

[58] **Field of Search** ..... 339/59 R, 59 M, 60 R, 339/60 C, 60 M, 61 R, 61 C, 61 M, 217 R, 102 R, 268 R, 268 S, 213 R, 213 S, 213 T, 143 R, 143 C, 143 S, 275 C, 278 C; 174/73 R, 75 P, 80

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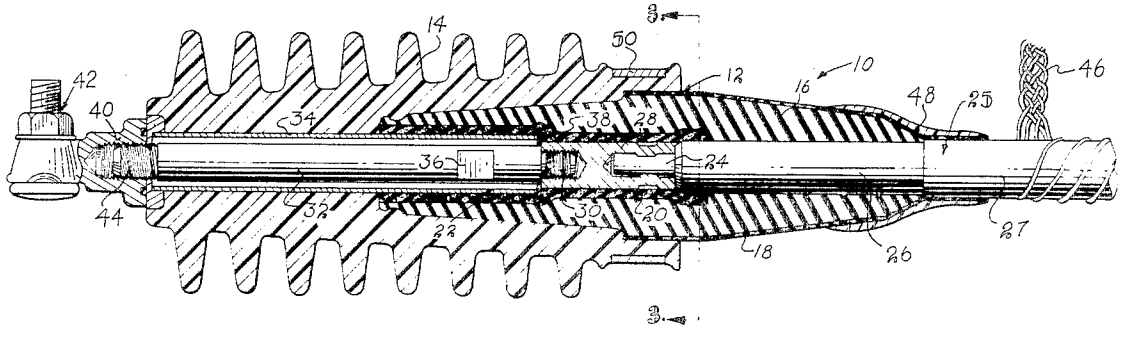
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[57] ABSTRACT

An electrical connector unit has a unitary insulating housing provided with an epoxy resin wheathershed portion integrally united with an elastomeric cable-receiving portion. One embodiment utilizes a polyolefin type solvent dispersed polymer bonding agent to join the two housing portions, while a second embodiment utilizes an epoxy resin band integrally joined with the elastomeric portion during molding of the latter, and an adhesive to bond the weathershed portion to the outer surface of the band. Each embodiment utilizes a retaining ring embedded within the housing to firmly retain components of the connecting structure within the housing once connection has been effected, thereby precluding axial movement of the cable relative to the housing.

6 Claims, 6 Drawing Figures



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SHEET 1 OF 2

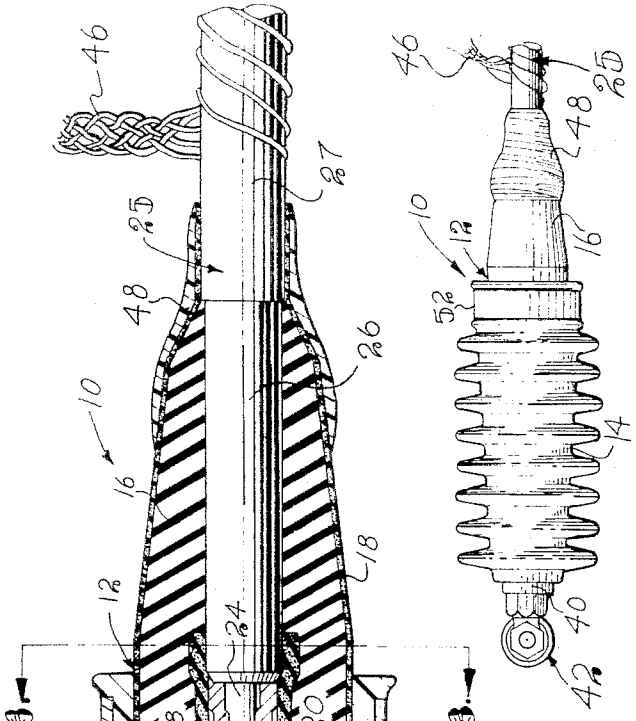


Fig. 1.

Fig. 2.

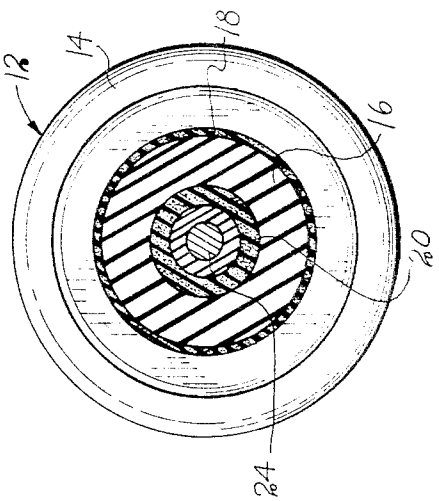


Fig. 3.

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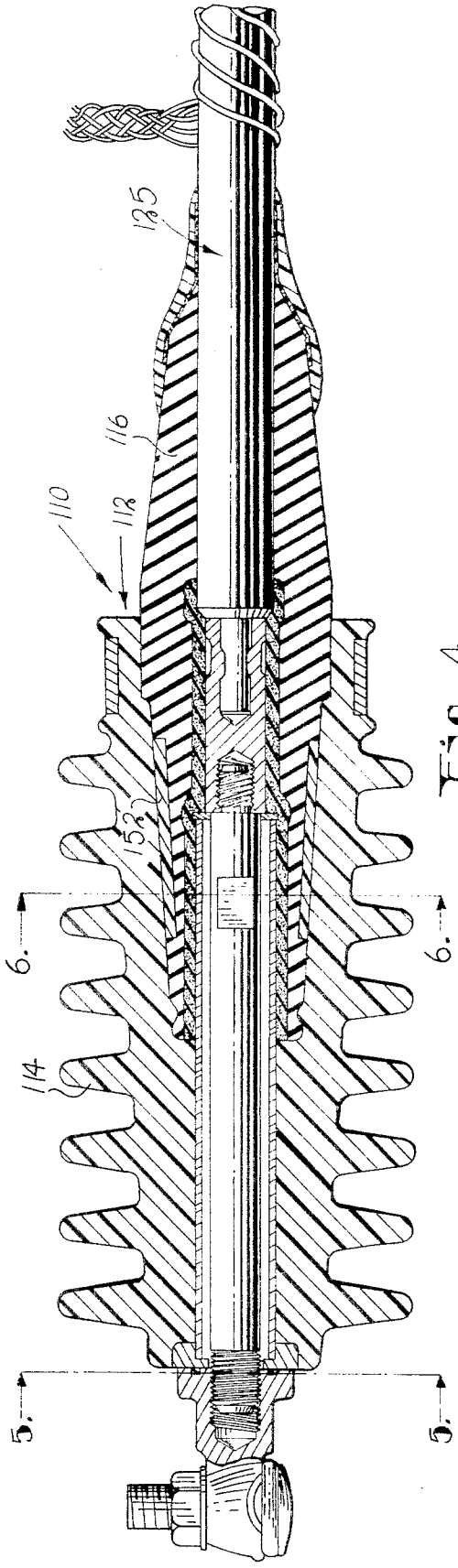


Fig. 4.

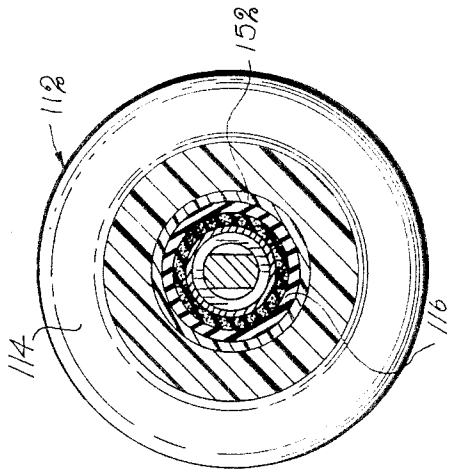
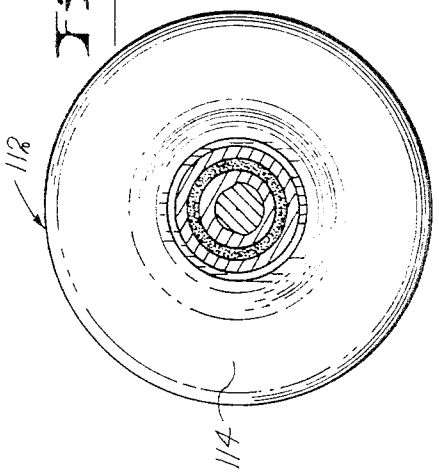


Fig. 6.

Fig. 5.



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ELECTRICAL CABLE CONNECTOR

CROSS REFERENCES

This is a continuation-in-part of our copending application Ser. No. 20,640, filed Mar. 18, 1970, and entitled "Electrical Cable Connector," now abandoned.

This invention relates generally to electrical transmission equipment and, more particularly, to an outdoor connector or terminator unit having special utility for joining the conductor of an underground cable with an exposed, overhead, pole-top conductor.

In ever increasing numbers, residential, as well as commercial buildings, are being supplied with electrical power by means of underground distribution cables as opposed to overhead cables. Such underground cables are then joined, in many instances, to pole-supported power lines, requiring a suitable terminator unit for effecting the connection between the conductor of the underground cable and the conductor from the pole-top line. Such a terminator must be insulated both electrically and against adverse weather conditions and, ideally, this may be accomplished by providing both a substantially rigid, skirted weathershed of cast epoxy or porcelain in conjunction with a molded, elastomeric receptacle at the entry of the underground conductor to the terminator. The weathershed provides highly reliable insulating and track-resistance properties, while the elastomeric receptacle about the terminus of the underground conductor is responsive to thermally caused expansion and contraction of the conductor.

In the past, a terminator having an insulating housing containing an epoxy weathershed and an elastomeric receptacle has been extremely difficult to produce satisfactorily, without the use of external constraints functioning to couple the receptacle and the weathershed together for the formation of a weathertight, insulating housing. Moreover, in many respects, such assemblies often simply do not provide the weathertight, reliable protection that is needed in terminators of this type.

Additionally, terminators in the past have not been totally effective in retaining the distribution cable within the terminator housing after connection of the underground cable conductor to the exposed, external conductor. This is particularly true where the terminator itself is carried by a crossarm or the like on a supporting pole and the distribution cable is suspended from its connection internally of the terminator such that the weight of the cable and the effects of wind and moisture tend to loosen the otherwise tight fit between the receptacle and the cable.

Accordingly, an important objects of the present invention is to provide an electrical connector unit having an outer, unitary insulating housing consisting of a substantially rigid, synthetic resin weathershed portion havin excellent track resistance properties which is integrally united with an elastomeric receptacle portion which is highly responsive to thermal expansion and contraction of the cable conductor.

Another important object of th present invention is to provide a connector unit as aforesaid having components which afford quick and easy connection of the cable conductor to the terminus of the exposed conductor, yet which preclude relative axial movement between the cable and the connector housing once the electrical connection has been effected.

In the drawings:

FIG. 1 is a plan view of an outdoor connector unit or terminator constructed in accordance with the teachings of the present invention;

FIG. 2 is an enlarged, cross-sectional view of the terminator of FIG. 1;

FIG. 3 is a cross-sectional view of the terminator taken along line 3—3 of FIG. 2;

FIG. 4 is a cross-sectional view of a second terminator embodying alternative principles of the invention;

FIG. 5 is a cross-sectional view of the second embodiment of the invention taken along line 5—5 of FIG. 4; and

FIG. 6 is a cross-sectional view taken along line 6—6 of FIG. 4.

The terminator 10 of FIGS. 1–3 has a unitary, tubular, insulating housing 12 consisting of a substantially rigid, skirted weathershed portion 14 at the left end thereof, and a resilient receptacle portion 16 at the opposite end thereof. The weathershed portion 14 is preferably constructed of a thermosetting, synthetic resinous material such as an epoxy resin, while the receptacle portion 16 is preferably constructed of a synthetic elastomeric material such as an ethylene propylene diene (modified) polymer, sold by E. I. du Pont de Nemours & Company, of Wilmington, Delaware, under the trademark "NORDEL." A conductive coating 18 of the Nordel product impregnated with carbon particles, surrounds the receptacle portion.

The unitary housing 12 is produced by initially molding the receptacle portion 16 about a tubular, conductive insert 20 of the Nordel rubber and forming a central passage therethrough for the connector structure which will hereinafter be described in more detail. At this point, in the past it has been necessary to utilize external constrains in the nature of threaded fasteners or the like to combine the receptacle 16 with the weathershed portion 14 in order to complete housing 12. This is true primarily because of the nature of the Nordel rubber which resisted direct adhesion to epoxy resin articles and the fact that there was no practical way to mold the receptacle portion 16 to the weathershed portion 14. However, it is now possible to integrally unite the two portions by means of a polyolefin type, solvent dispersed polymer bonding agent, preferably a polyethylene and/or polypropylene polymer combined with a carbon material such as carbon black dispersed in a solvent such as heptane, hexane, or a similar aliphatic solvent. Such a product is commercially available from the Whittaker Corporation, Dayton Chemical Products Division, West Alexandria, Ohio, under the trademark "THIXON AP 1442." Therefore, in completing the production of the housing 12, once the molded receptacle portion 16 has been prepared, the insert end 16*a* thereof is covered with the Thixon bonding agent and enclosed within a second mold for the weathershed portion 14, whereupon the epoxy resin is added to the mold and allowed to cure, causing integral joining of the two portions and formation of a passage in the weathershed portion 14 in alignment with the corresponding passage through insert 20 and receptacle portion 16. After the weathershed portion 14 has been formed, the unitary housing 12 is stored as a single item in readiness for use in the field.

The terminator 10 further includes connecting structure broadly denoted by the numeral 22, within housing 12 which joins the conductor 24 of an insulated cable 25 with an external conductor (not shown) such as on

a line pole or the like and which firmly retains the cable **26** within the housing **12.** In addition to the inner conductor **24,** cable **25** has a nonconductive sheating **26** surrounding conductor **24** and an outer conductive covering **27** which is removed to such an extent that sheathing **26** is within portion **16,** creating an aubtting shoulder effect between the respective ends of portion **16** and outer covering **27.** Such structure **22** includes a link in the nature of a conductive ferrule **28** disposed within insert **20** and crimped at one end thereof about the conductor **24,** the ferrule **28** being adapted the threadably receive the complementally threaded end **30** of a conductive rod **32** disposed within a rigid, cylindrical conductive core **34.** The rod **32** is provided with wrench flats **36** for effecting the threaded engagement of rod **32** with ferrule **28,** and a rigid, annular ring **38** embedded within the insert **20** projects into the passage therewithin for engagement with rod **32,** core **34** and ferrule **28** to preclude axial movement of the same relative to housing **12** once the connection has been effected between rod **32** and ferrule **28.**

Ring **38** has an inner diameter greater than the diameter of rod **32** but less than the diameter of ferrule **28,** while it has an outer diameter greater than that of core **34.** Thus, the rod **32** extends through ring **38,** while the core **34** abuts one side of the latter with the end of ferrule **28** abutting the opposite side thereof. A cap **40** of the terminal connector **42** at the left end of housing **12,** threadably receives a second end **44** of rod **32** and bears against the core **34** such that the latter may be forced tightly against the embedded ring **38** by the interaction of end **44** and cap **40.** With the connecting structure **22** in the relationship as above described, the ring **38** thereby functions as a stop component such that when cable **25** attempts to move axially in a leftward direction relative to housing **12,** the end of ferrule **28** bears against ring **38,** while movement of cable **25** in the opposite direction is prevented by the engagement of core **34** against the opposite face of ring **38.**

Strands of conducting wire **46** surround the cable **25** at the right end thereof to form a concentric neutral for cable **25** leading to ground, while windings **48** of a semi-conductive tape surround the zone of junction between cable **25** and receptacle portion **16.** A clamping ring **50** about housing **12** is provided to mount the terminator **10** on a crossarm or other supporting structure on a line pole or the like.

The terminator **10** may be easily assembled in the field by initially crimping the ferrule **28** onto the cable conductor **24,** threading the rod **32** into ferrule **28,** and then forcing the assembly through the right end of receptacle portion **16** which has the passage thereof coated with a suitable sealing grease. The rod **32** will pass through the opening of ring **38** until the ferrule **28** strikes the latter, whereupon the addition of the core **34,** cap **40,** and the tape windings **48** complete the assembly of the terminator **10.** Once the terminator **10** is assembled and is in operation, the conductive insert **20** electrically shields any entrapped air to eliminate corona within the receptacle portion **16** as the conductive core **34** serves a similar purpose within the weathershed portion **14.**

In the embodiment of FIGS. **4–6,** the terminator **110** is substantially identical to that of FIGS. **1–3** except for the manner in which the unitary housing **112,** having weathershed and receptacle portions **114** and **116** respectively, is obtained. Thus, the details of construction relating to the connecting and retaining structure **122** for cable **125** will not hereinafter be described.

Weathershed portion **114** is again preferably constructed of epoxy resin, while the receptacle portion **116** is constructed of Nordel rubber. Accordingly, the same basic problem is presented of properly uniting the two portions in an integral manner to produce the desired unitary housing **112.** In this instance, the problem is solved not through the use of the Thixon bonding agent, but rather through the provision of an epoxy resin band **152** which is integrally joined with the receptacle portion **116** during formation of the latter by molding. While the band **152** could not be suitably bonded to the finished receptacle **116** without the use of a special bonding agent such as Thixon, nonetheless, during the molding process of receptacle portion **116,** the band **152** is readily accepted into the body of the latter.

The band **152** is disposed within receptacle portion **116** in such a manner as to expose the outer surface of band **152** such that the weathershed portion **114** may then be bonded directly to band **152** by means of additional epoxy resin. Thus, once the resin has cured, the weathershed portion **114** and receptacle portion **116** are integrally united to present the unitary housing **112.** In this manner, the favorable attributes of each portion, including excellent resistance to tracking by the epoxy resin weathershed portion **114** and excellent resistance to corona, ozone, weather, ground chemicals, water and heat inherent in the receptacle portion **116,** are obtained within a sinle unitary housing **112.**

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

1. An electrical connector assembly for joining the conductor of an insulated cable with the terminus of an external conductor, said assembly comprising:

conductive coupling structure adapted for interengagement with said terminus and the cable conductor; and

an electrical insulating housing disposed in covering relationship with said structure for protecting the latter from environmental conditions, said housing including,

a substantially rigid, tubular weathershed portion at one end thereof normally adjacent said terminus and constructed of electrical insulating, thermosetting, synthetic resinous material,

a flexible, tubular expansion portion at the opposide end thereof constructed of electrical insulating elastomeric material, at least partially disposed within said weathershed portion, and adapted to receive said cable; and

a substantially rigid element constructed of said resinous material molded into said elastomeric portion and having an exposed outer surface, and an adhesive bonding the outer surface of said element to th rigid portion, thereby integrally uniting said rigid and elastomeric portions to produce a unitary housing wherein the rigid portion thereof exhibits insulating and track resistance properties while the elastomeric portion is sufficiently elastic to provide environmental integrity with the cable under varying temperature and weather conditions.

2. The assembly as claimed in claim **1,** wherein said element is tubular in configuration and completely surrounds said elastomeric portion.

3. The assembly as claimed in claim 1, wherein said resinous material consists of an epoxy resin.

4. The assembly as claimed in claim 1, wherein said elastomeric material consists of an ethylene propylene diene (modified) polymer.

5. The assembly as claimed in claim 1, wherein said structure includes a conductive component connected to said terminus, extending through the rigid portion, and into said elastomeric portion; a conductive link secured at one end thereof to said conductor and at the opposite end thereof to said component; and a rigid stop on said elastomeric portion clamped between the component and the link for preventing axial movement of the cable relative to the housing.

6. In a connector assembly for an electrical cable having an inner conductor,

a conductive element adapted to be secured at one end thereof to the conductor and having a threaded opening in the opposite end thereof;

a tubular housing, at least a portion of which is of insulating material and having a passage therein adapted to receive said element and the proximal portion of the cable in surrounding protecting relationship;

a rigid, annular stop component projecting from said housing into the passage in a location abutting the conductive element;

a rigid, tubular conductive core housing said conductor rod and abutting said stop component on the opposite side of said component from the conductive element; and

an elongated conductor rod provided with a complementally threaded end portion and extending through said stop component, said end portion being received within said threaded opening whereby engagement of said element and said conductive core housing with the stop component precludes axial movement of the cable within the housing.

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