United States Patent

Link

[15] 3,668,609

[45] June 6, 1972

[54] HOT LINE CONNECTOR

[72] Inventor: **Edwin A. Link,** Waukesha, Wis.

[73] Assignee: **RTE Corporation,** Waukesha, Wis.

[22] Filed: **Mar. 30, 1970**

[21] Appl. No.: **23,823**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 820,142, Apr. 29, 1969, abandoned.

[52] **U.S. Cl.** .....**339/97 R,** 174/71 R

[51] **Int. Cl.** **H01r 11/20**

[58] **Field of Search** 339/89, 97; 174/71

[56] **References Cited**

UNITED STATES PATENTS

3,461,419	8/1969	Link	339/89 R
3,467,761	9/1969	Plummer	174/36
3,455,336	7/1969	Ellis	138/156
3,243,211	3/1966	Wetmore	287/78

FOREIGN PATENTS OR APPLICATIONS

1,144,665	10/1957	France	138/128
505,013	5/1939	Great Britain	
524,646	4/1955	Italy	

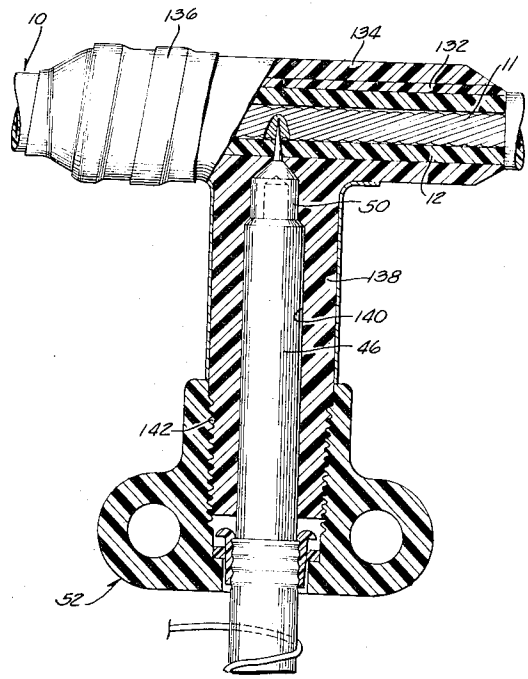
Primary Examiner—Joseph H. McGlynn

Attorney—Ronald E. Barry and James E. Nilles

[57] **ABSTRACT**

Disclosed herein is a tapping device including a resilient insulator which can be shrunk or taped into sealing engagement with the exposed cable insulation of a high voltage cable, the device including a passage to sealingly engage a cable lead, the cable tap lead having a probe to penetrate the cable insulation and electrically engage the electrical conductor for a high voltage cable, and a drive assembly to force the cable lead through the passage until the probe penetrates the cable insulation and electrically engages the cable conductor. The insulator can also be used to seal a Tee type cable splice.

16 Claims, 10 Drawing Figures



PATENTED JUN 6 1972

3,668,609

SHEET 1 OF 4

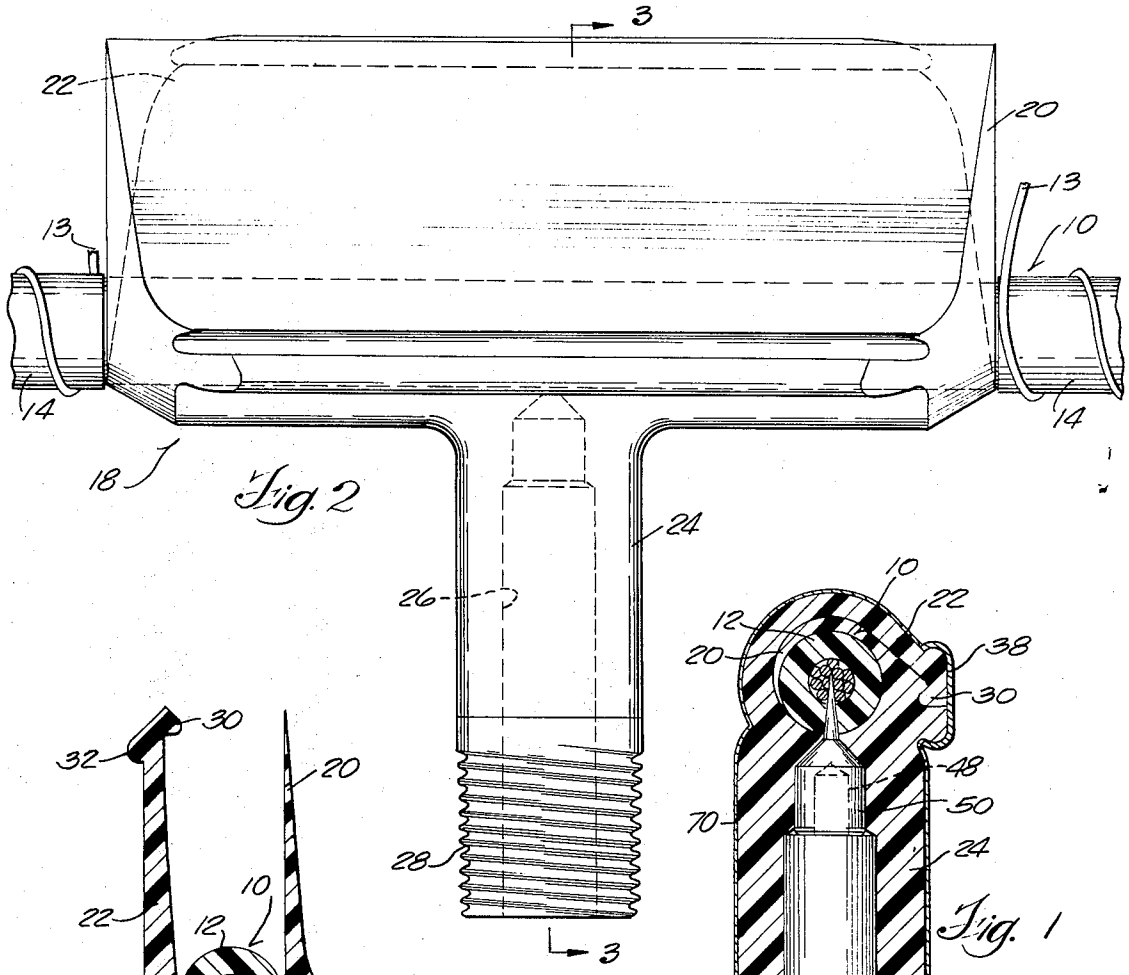


Fig. 2

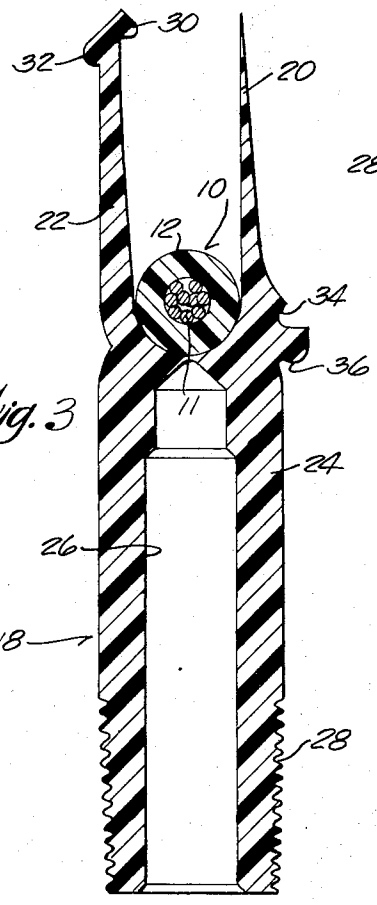


Fig. 3

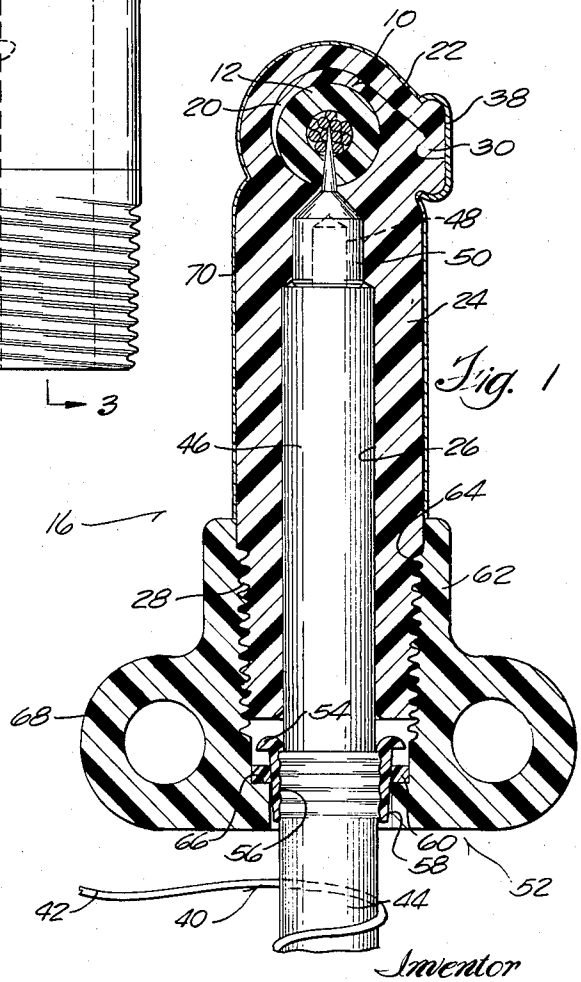


Fig. 1

Inventor
Edwin A. Link

By
Wheeler, Wheeler, House & Clemency
Attorneys

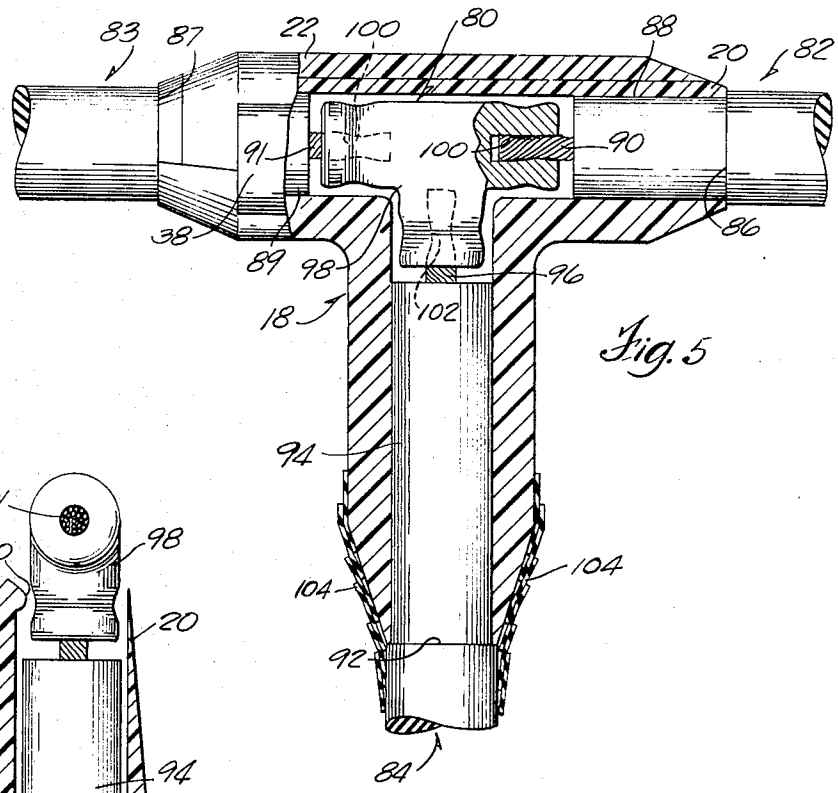


Fig. 5

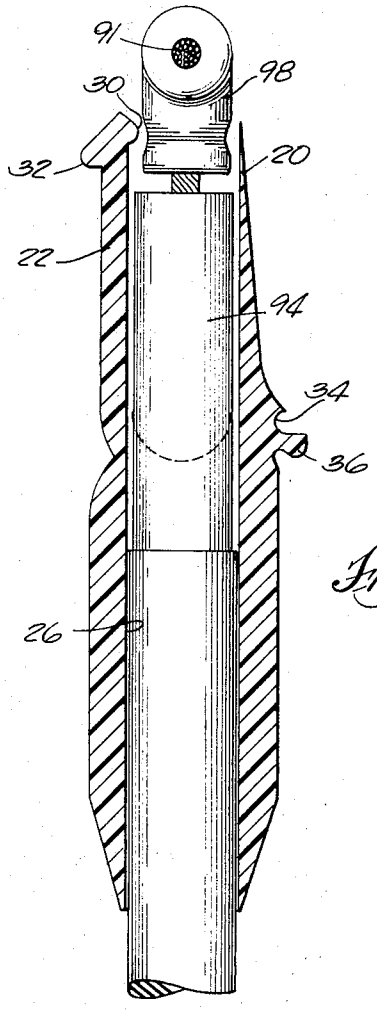


Fig. 4

Inventor
Edwin A. Link
By
Wheeler, Wheeler, House & Clemency
Attorneys

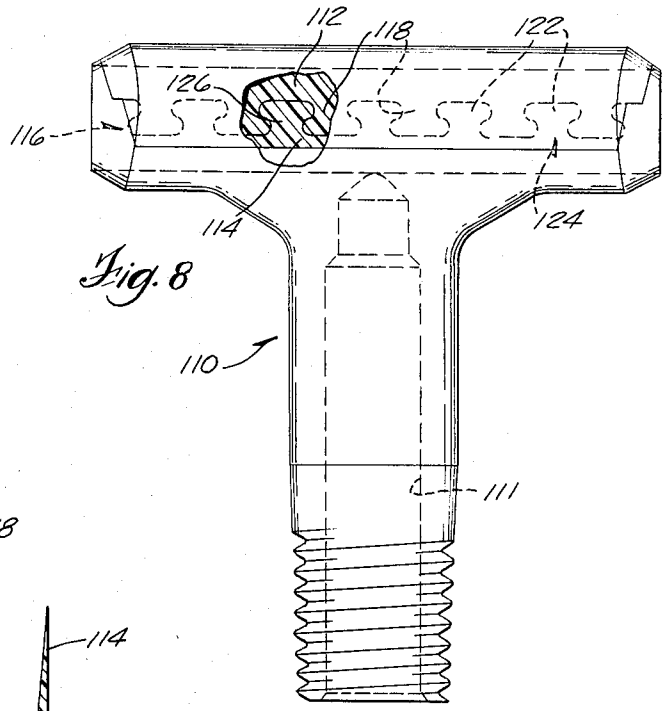


Fig. 8

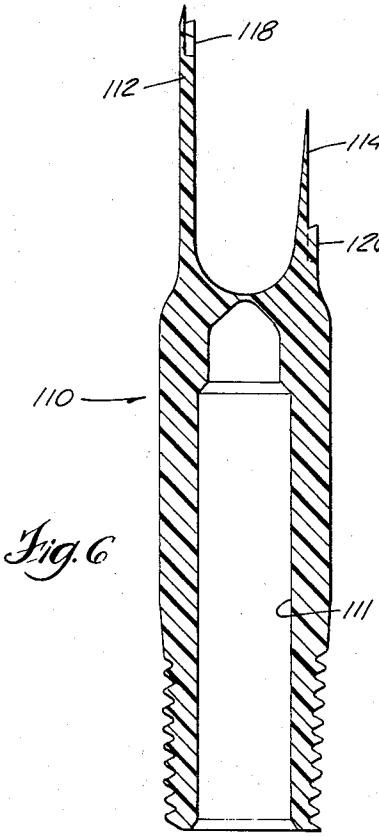


Fig. 6

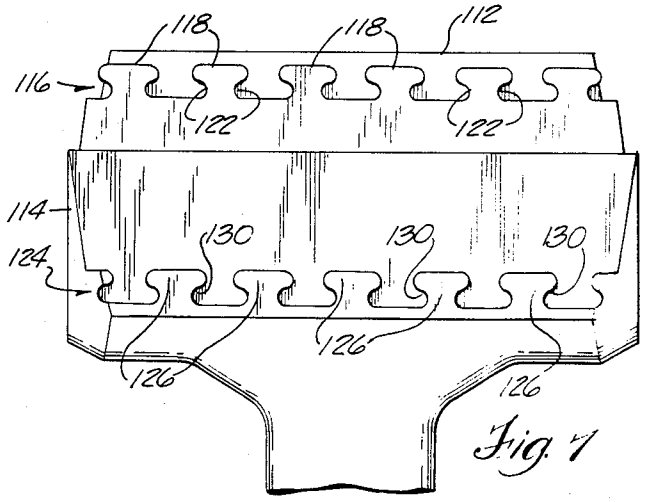


Fig. 7

Inventor
Edwin A. Link
By
Wheeler, Wheeler, House & Clemency
Attorneys

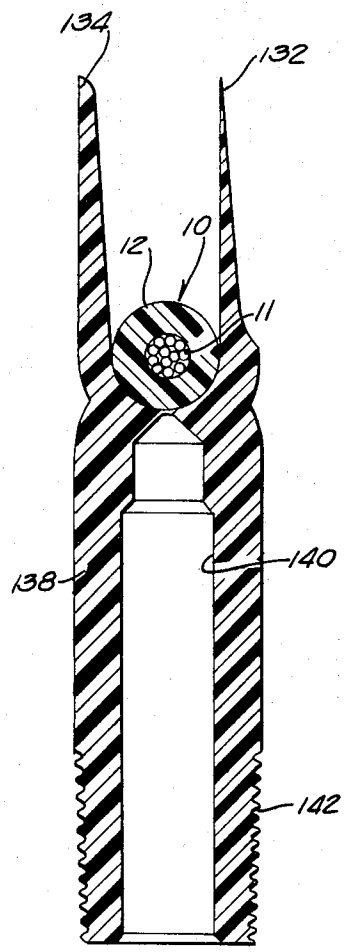
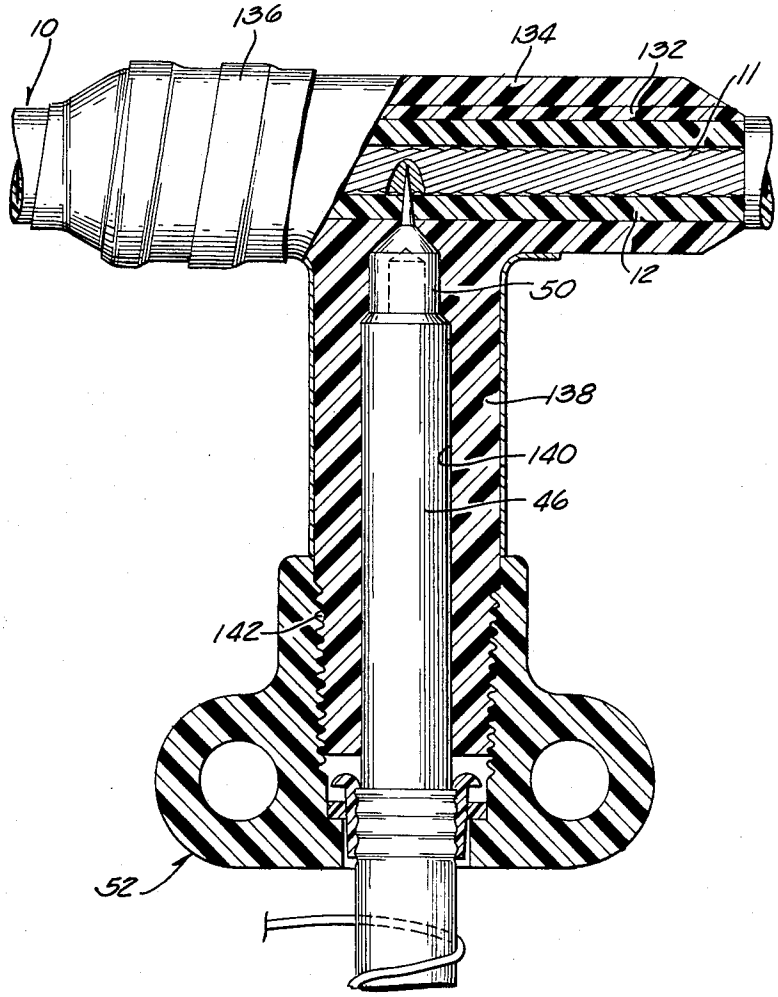


Fig. 9

Fig. 10



Inventor
Edwin A. Link
By
Ronald E. Barry
Attorney

HOT LINE CONNECTOR

RELATED APPLICATION

This application relates to an improvement in my copending application Ser. No. 648,406, filed June 23, 1967, now U.S. Pat. No. 3,461,419 issued Aug. 12, 1969, and is a continuation-in-part of my earlier filed application Ser. No. 820,142, filed on Apr. 29, 1969, and now abandoned.

BACKGROUND OF THE INVENTION

Underground electrical systems are normally designed to include cable junctions at all points in the system where service is anticipated. However, it often becomes necessary to make additional junctions after the system has become operative. The connector described in my copending application Ser. No. 648,406 discloses one type of connector which can be used to accomplish this result.

SUMMARY OF THE INVENTION

The invention disclosed herein provides a connector having an insulator that provides a watertight seal with the high voltage cable and includes a passage for sealingly engaging a cable lead as the lead is forced into electrical engagement with the cable conductor.

This is accomplished by mounting a preformed resilient insulating member formed from a shrinkable material around a section of the cable having the cable insulation exposed. The insulating member is shrunk into sealing engagement with the exposed section of the cable to form a watertight seal. Alternatively, the insulating member can be formed with overlapping flaps which can be wrapped with tape to form a tight seal around the cable insulation.

Cable connection is made by a tap or probe electrically and mechanically secured to the end of a cable lead which is to be connected to the high voltage cable and a clamp and drive assembly secured to the cable lead at a predetermined distance from the tap or probe. The cable is then inserted into a tap or probe passage provided in the dielectric member and is forced through the passage into electrical engagement with the cable. The passage in the dielectric member is designed to sealingly engage the cable lead so that the cable lead is insulated when it is brought into engagement with the exposed section of the cable to be tapped. The tap or probe is then forced into the cable. After termination has been completed, the cable connector can be left on the energized cable and used as the insulation for the connection.

The insulator can also be sized for assembly onto a cable lead prior to connection with a Tee type high voltage cable splice. After connection of the cable lead to the high voltage cable, the insulator flaps are overlapped around the cable and the entire insulator shrunk or taped into tight sealing engagement with the cable and cable lead.

Other objects and advantages will become more readily apparent from the following detailed description when read in connection with the accompanying drawing in which:

FIG. **1** is an end view in section of the cable connector.

FIG. **2** is a side view of the insulator mounted on the high voltage cable with the flaps extended for sealing engaging the cable on each side of the cable.

FIG. **3** is an end view in section of the insulator taken on line 3—3 of FIG. **2**.

FIG. **4** is a side view of the insulator mounted on a cable lead for a Tee spliced cable.

FIG. **5** is a front view partly in section showing the insulator shrunk into tight sealing engagement with a Tee spliced cable.

FIG. **6** is an end view in section of a modified type insulator having self-locking flaps.

FIG. **7** is a front view of the modified insulator of FIG. **6** showing the flaps opened.

FIG. **8** is a front view of the modified insulator of FIG. **6** with the flaps interlocked.

FIG. **9** is a side view of an insulator which is to be taped to the high voltage cable.

FIG. **10** is a front view of the insulator taped into tight sealing engagement with the cable.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawing, a high voltage cable **10** is shown having an electrical conductor **11** enclosed within cable insulation **12**. The semi-conductive neutral **13** has been cut and unwound from a section of the cable to expose the cable sheath **14**. The semi-conductive neutral should be bridged across the section of the cable to be tapped before the cable sheath is cut. The cable sheath **14** is then stripped from the cable insulation leaving the insulation exposed in the section where the tap is to be made. The cable **10** is shown with a semi-conductive neutral and a cable sheath, however, the cable could have an insulation only.

In accordance with the invention, the cable connector **16** includes means for sealingly engaging the exposed cable insulation **12** for a high voltage cable **10** prior to tapping the cable. Such means is in the form of an insulator **18** formed from a shrinkable dielectric elastic material. Materials which are known to have these characteristics are radiated or cross linked polyethylene and ethylene-propylene terpolymer, however, other materials having similar characteristics could also be used. This type of material is capable of being stretched after molding to a desired shape, cooled and then heated to shrink back to its molded shape. This material can also be soaked in a solvent such as toluene to swell the insulator and then allowed to air dry to shrink into tight sealing engagement with the high voltage cable and cable lead.

More specifically, the insulator **18** includes an inside flap **20**, an outside flap **22** and a tubular extension **24** having a guide passage **26** and a threaded section **28** on the outer periphery of the tubular extension **24**. The flaps **20** and **22** are molded to their final dimensions and then elongated or stretched from their molded dimensions after the insulator **18** has been removed from the mold. In order to stretch the flaps, they are heated, stretched and allowed to cool. The exposed section of cable insulation **12** is sealed to the insulator by means of the flaps **20** and **22** which are overlapped on the cable and heated to shrink back to their molded dimensions.

In order to maintain a tight fit between the flaps **20** and **22** and the cable **10**, means are provided for interlocking the flaps **20** and **22** when overlapped on the cable **10**. This means includes a rib or bead **30** and a shoulder **32** provided on the outer edge of flap **22**, a groove **34** and a shoulder **36** provided along the inner edge of flap **20** and a clip **38** mounted on the shoulders **32** and **36** to connect the outer flap **22** to the inner flap **20**. In assembly the bead **30** is placed in the groove **34** and the clip **38** is snapped onto the shoulders **32** and **36** and retained thereon by the inherent resiliency of the heat shrinkable material. After the flaps **20** and **22** have been interlocked, they are shrunk back to their molded dimensions providing a tight seal with the exposed cable insulation **12**. Shrinking may be accomplished by heating the flaps or, if soaked in a solvent, air dried. The final dimensions of the flaps **20** and **22** should be slightly smaller than the contemplated diameter of the cable insulation **12** in order to obtain a watertight fit.

After the flaps **20** and **22** have been sealed around the exposed section of cable insulation **12**, a cable lead **40** can be connected to the cable **10**. The cable lead **40** is prepared for connection to the cable **10** by removing the semi-conductive neutral **42** and the cable sheath **44** from the cable insulation **46**. A portion of the cable insulation **46** is removed to expose the conductor **48** and an electrically conductive probe or tap **50** is crimped to the conductor **48**. The probe **50** can then be pushed into the guide passage **26**.

Means are provided for driving the cable lead **40** through the passage **26** in the insulator **18** in the form of a clamp and drive assembly **52**. This assembly includes a collet or split ring **54** having a grooved inner surface **56** and a tapered outer surface **58** positioned on the end of the cable sheath **44**. A bearing ring or washer **60** is pushed upwardly onto the tapered sur-

face 58 of the collet 54 to seat the grooved inner surface 56 into the cable sheath 44. A drive nut 62 having a threaded central cavity 64 terminating at a shoulder 66 is positioned on the end of the cable sheath 44 with the shoulder 66 abutting the washer 60. The drive nut 62 is threadedly received on the threaded section 28 on the insulator 18. Rotation of the drive nut 62 on the insulator 18 will move the shoulder 66 into engagement with the bearing ring 60 forcing the probe 50 into the cable 10. The drive nut 62 is provided with ears 68 for rotation by a "Hot Stick."

The connection may be shielded by a conductive paint 70 applied to the outer surface of the insulator 18 or by a conductive housing as described in my copending application Ser. No. 648,406.

In the embodiment of the invention shown in FIGS. 4 and 5, the insulator 18 is used to insulate a Tee splice 80 formed between solid insulated high voltage cables 82 and 83 and a cable lead 84. Each of the cables 82 and 83 has been prepared by stripping a portion of the semicon 86 and 89, respectively, from the cable to expose a portion of the cable insulation 88 and 89, respectively. The cable insulation 88 and 89 is cut back to expose the electrical conductors 90 and 91. The cable lead 84 is also prepared by stripping a portion of the semicon 92 from the cable to expose the cable insulation 94 and a portion of the insulation 94 to expose the end of the electrical conductor 96.

The cable lead 84 is secured to the cables 82 and 83 by means of a Tee splice type connector 98. The Tee connector is provided with apertures 100 to receive the electrical conductors 90 and 91 and an aperture 102 to receive the conductor 96. The connector 98 is crimped to the conductors 90, 91 and 96 to complete the connection.

The electrical connection between the cables 82 and 83 and the cable lead 84 is insulated by means of the insulator 18. More specifically, the insulator 18 is in the form of a resilient shrinkable member having a passage 26 to receive the cable lead 84 and flaps 20 and 22 to overlap the cables 82 and 83. The insulator 18 is enlarged prior to use to expand passage 26 and elongate flaps 20 and 22. This can be accomplished either by heating the insulator 18 after molding and stretching the passage 26 and flaps 20 and 22 or by soaking the insulator in a solvent such as toluene to swell the passage 26 and flaps 20 and 22. If the insulator is expanded by heating and stretching, it is then reheated to shrink back to its original dimensions. If soaked in a solvent, the insulator is allowed to air dry in order to shrink back to its original dimensions.

In assembly, the electrical connector 98 is crimped to the conductors 90 and 91. Cable lead 84 is inserted into the enlarged passage 26 and the electrical conductor 96 crimped in the opening 102 in the connector 98. The insulator 18 is then moved upward until the exposed cable insulation 88 and 89 on the cables 82 and 83 is seated in the insulator 18 between the flaps 20 and 22. The flaps 20 and 22 are overlapped and clip 38 placed on the head 32 and bead 36 to hold the flaps in position. In order to form a tight seal between the insulator 18 and the covers 82, 83 and the cable lead, the insulation is shrunk by either applying heat or allowing the insulator to air dry depending on the procedure used to expand the passage 26 and flaps 20 and 22 in the insulator 18. The connection can be shielded by providing a conductive material on the outer surface of the insulator and wrapping the ends with a conductive tape 104.

In FIGS. 6, 7 and 8, an insulator 110 having a passage 111 is shown having a modified means for interlocking the flaps 112 and 114 which is self locking. This means is in the form of a row 116 on flaps 112 of T-shaped members 118 separated by inverted T-shaped recesses 122 and a row 124 on flap 114 of T-shaped members 126 separated by inverted T-shaped recesses 130. The members 118 and 126 are alternately offset and are interconnected by pressing the T-shaped member 118 on flap 112 into the T-shaped recesses 130 on flap 114 or conversely pressing T-shaped recesses 122 in flap 112. The flaps 112 and 114 are elongated as described above and assembled on the cable. After assembly, the flaps are shrunk into a tight fit with the cable. The T-shaped members are undercut as seen in FIG. 6 approximately 10° to provide an interlock between the flaps 112 and 114. The T portion of each of the T-shaped members 118 and 126 will interlock preventing the flaps from being pulled apart during shrinking. It should be apparent that the shape of the members 118 and 126 is immaterial so long as there is a physical connection that will prevent the flaps from being pulled apart. This self-locking arrangement of the rows 116 and 124 can be used in any of the forms of the insulators described above.

In FIGS. 9 and 10, another form of the invention is shown wherein the flaps 132 and 134 are overlapped and are taped by means of a tape 136 into tight sealing engagement with the exposed section of the cable 10. In this regard, the flaps 132 and 134 are formed as integral parts of an insulator 138. The insulator is formed of a resilient dielectric material and includes a passage 140 for the cable lead 46 and the tap or probe 50 and a threaded section 142 for the clamp and drive assembly 52. The inner flap 132 tapers outwardly to a point and is wrapped around the cable insulation 12. The outer flap 134 also tapers slightly and overlaps the inner flap 132. The flaps 132 and 134 are then tightly secured to the cable 10 by wrapping the tape 136 around the flaps 132 and 134.

Although a number of embodiments of the present invention have been shown and described, it should be apparent that various changes and modifications can be made herein without departing from the scope of the appended claims.

What is claimed is:

1. A cable connector for electrically connecting the end of the electrical conductor of a cable lead to the electrical conductor of a high voltage cable having a portion of the cable insulation exposed, said connector comprising
- an electrically conductive probe secured to the electrical conductor of the cable lead,
- a dielectric insulator formed from a resilient material and having a passage terminating at the cable for sealing engagement with the cable lead,
- means for sealing said insulator to the exposed section of the cable insulation, said sealing means including a set of over-lapping flaps adapted to be wrapped about the exposed cable insulation,
- and means for driving the cable lead through said passage until said probe penetrates the cable insulation and electrically engages the electrical conductor in the cable.

2. A cable connector according to claim 1 including an electrically conductive paint on the outer surface of said dielectric insulator.

3. A cable connector according to claim 1 wherein said drive means includes a clamp and drive assembly having a split ring mounted on the cable lead,
- a bearing ring mounted on said split ring and
- a threaded collar positioned on the cable lead to engage said bearing ring, and
- a threaded section on said dielectric insulator to threadedly receive said collar.

4. A cable connector according to claim 1 wherein said insulator is formed of a shrinkable material which is shrunk into tight sealing engagement with the exposed cable insulation.

5. A cable connector according to claim 1 wherein said sealing means includes a tape wrapped around said flaps.

6. A tap connector for electrically connecting a cable lead to an insulated high voltage cable having a section of the cable insulation exposed, said connector comprising
- a preformed insulator molded from a resilient dielectric material and mounted on the exposed cable insulation and including a pair of overlapping flaps for sealingly engaging the exposed insulation,
- an electrically conductive probe mechanically and electrically secured to the cable lead and,
- mechanical drive means connected to said insulator for driving the cable lead through said insulator until said probe electrically engages said high voltage cable.

7. A tap connector according to claim 6 wherein said mechanical drive means includes a split ring mounted on the cable lead, a bearing ring mounted on said split ring,

and a threaded collar positioned on the cable lead in a position to engage said bearing ring,

said collar being connected to said insulator to force the probe into electrical engagement with said cable.

8. A tap connector according to claim 6 wherein said insulator is formed of a shrinkable material.

9. A tap connector according to claim 6 including a tape wrapped about said flaps for sealing said flaps to the cable.

10. A cable connector for connecting the end of a cable lead to an insulated high voltage cable having a section of the cable insulation exposed, said connector comprising

a resilient shrinkable insulating member mounted in sealing engagement with the exposed section of the high voltage cable and having a passage intersected by the cable,

an electrically conductive cable penetrating probe electrically and mechanically connected to the end of the cable lead and disposed in sealing engagement within said passage in said insulating member in a position to be forced into the high voltage cable,

means mounted on the cable lead and connected to said member for forcing the end of the cable lead through said passage in said insulating member until said penetrating probe electrically engages the high voltage cable.

11. A cable connector according to claim 10 wherein said means for forcing said probe through said passage comprises a tapered split ring mounted on the cable lead,

a washer to clamp said tapered ring onto the cable,

and a threaded collar positioned to engage said washer.

12. An insulated Tee splice for high voltage solid insulated cable and cable tap lead comprising

a Tee connector for forming an electrical junction between the cable and lead,

an insulating body preformed of shrinkable elastic material sized to be assembled onto the cable tap lead and over the Tee connector,

said preformed insulating body being shaped to be mounted on the cable tap lead prior to the making of the electrical connection between the Tee connector and the cable lead and including at least one flap adapted to be wrapped around the insulated cable and Tee connector, and means for interlocking said flap about the cable to complete the integrity of insulation before shrinking the insulating body to tightly engage the cable and cable lead.

13. An insulator for insulating an electrical connection formed between a high voltage solid insulated cable and a cable lead,

said insulator comprising a resilient shrinkable member adapted to be mounted on the cable lead prior to electrically connecting the cable lead to the cable and to be wrapped around the electrical connection,

means including a pair of flaps to overwrap the cable for holding said member on the cable while said member is shrunk into tight sealing engagement with the cable and the cable lead.

14. An insulator according to claim 13 wherein said holding means comprises a clip.

15. An insulator according to claim 13 wherein said holding means comprises a number of self-locking members on each of said flaps.

16. An insulator according to claim 13 wherein said member includes a passage to receive the cable lead.

* * * * *