United States Patent [19]

Cooper, Jr.

[11] **3,789,347**

[45] **Jan. 29, 1974**

[54] **INSULATION PIERCING CONNECTOR FOR UNDERGROUND INSTALLATION**

[75] Inventor: **James Joseph Cooper, Jr.**, St. Louis, Mo.

[73] Assignee: **International Telephone and Telegraph Corporation**, New York, N.Y.

[22] Filed: **Feb. 2, 1972**

[21] Appl. No.: **222,917**

[52] **U.S. Cl.** ..... **339/97 R**, 339/94 R, 339/272 U

[51] **Int. Cl.** **H01r 9/08**, H01r 11/20

[58] **Field of Search**.... 339/97, 272, 94 R, 95 R, 96, 339/98

[56] **References Cited**

UNITED STATES PATENTS

3,372,361	3/1968	Wengen	339/97 R
3,674,916	7/1972	Langella	339/97 R X
3,380,014	4/1968	Schenker et al.	339/97 R

FOREIGN PATENTS OR APPLICATIONS

455,196	10/1936	Great Britain	339/97 R
410,095	10/1966	Switzerland	339/97 R
1,665,369	3/1971	Germany	339/97 R

Primary Examiner—Marvin A. Champion

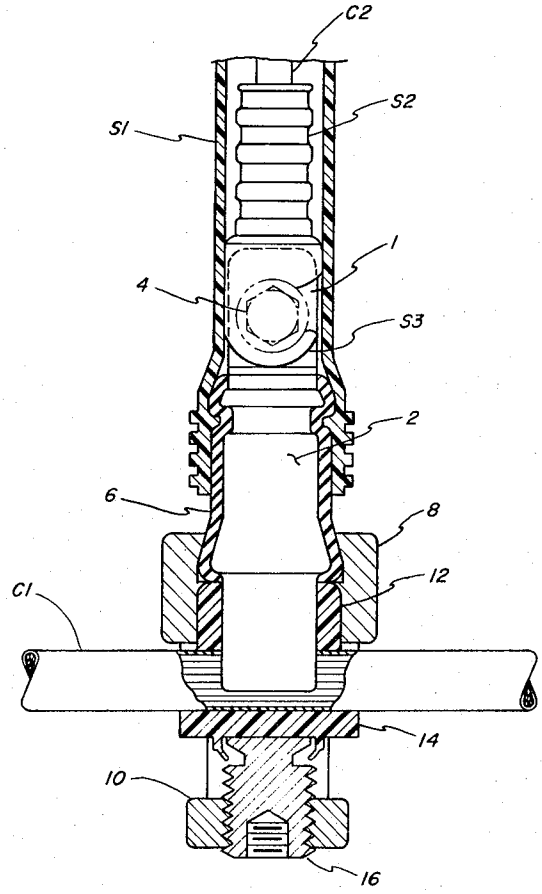
Assistant Examiner—Lawrence J. Staab

Attorney, Agent, or Firm—C. Cornell Remsen, Jr., James B. Raden, Delbert P. Warner

[57] **ABSTRACT**

An insulated connector is provided for use in making tap connections to insulated power lines. The connector incorporates an insulation and wire piercing element for establishing electrical connections between a main power line and a tap line. It includes elements which stop the piercing element from cutting beyond a preselected depth.

11 Claims, 18 Drawing Figures



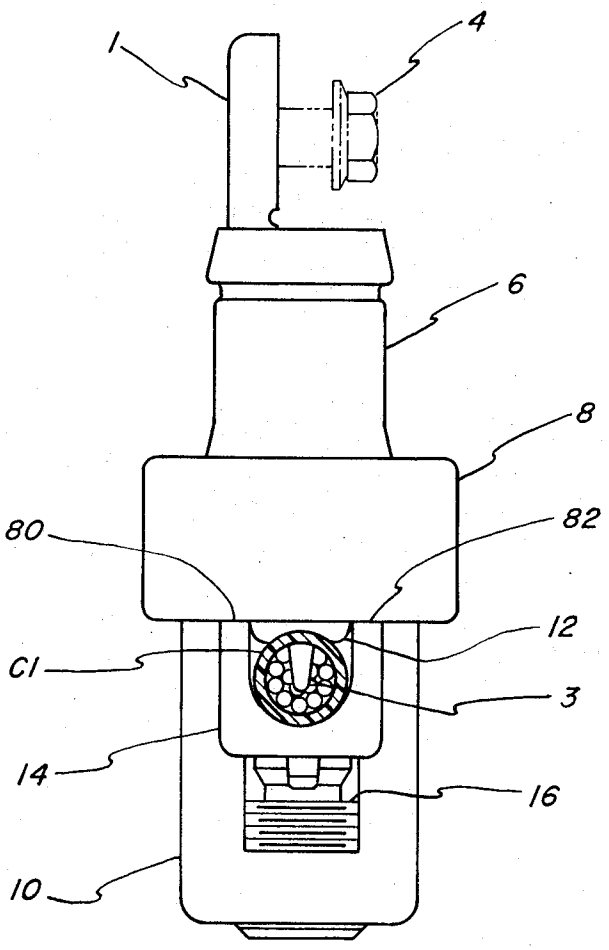


FIG. 1

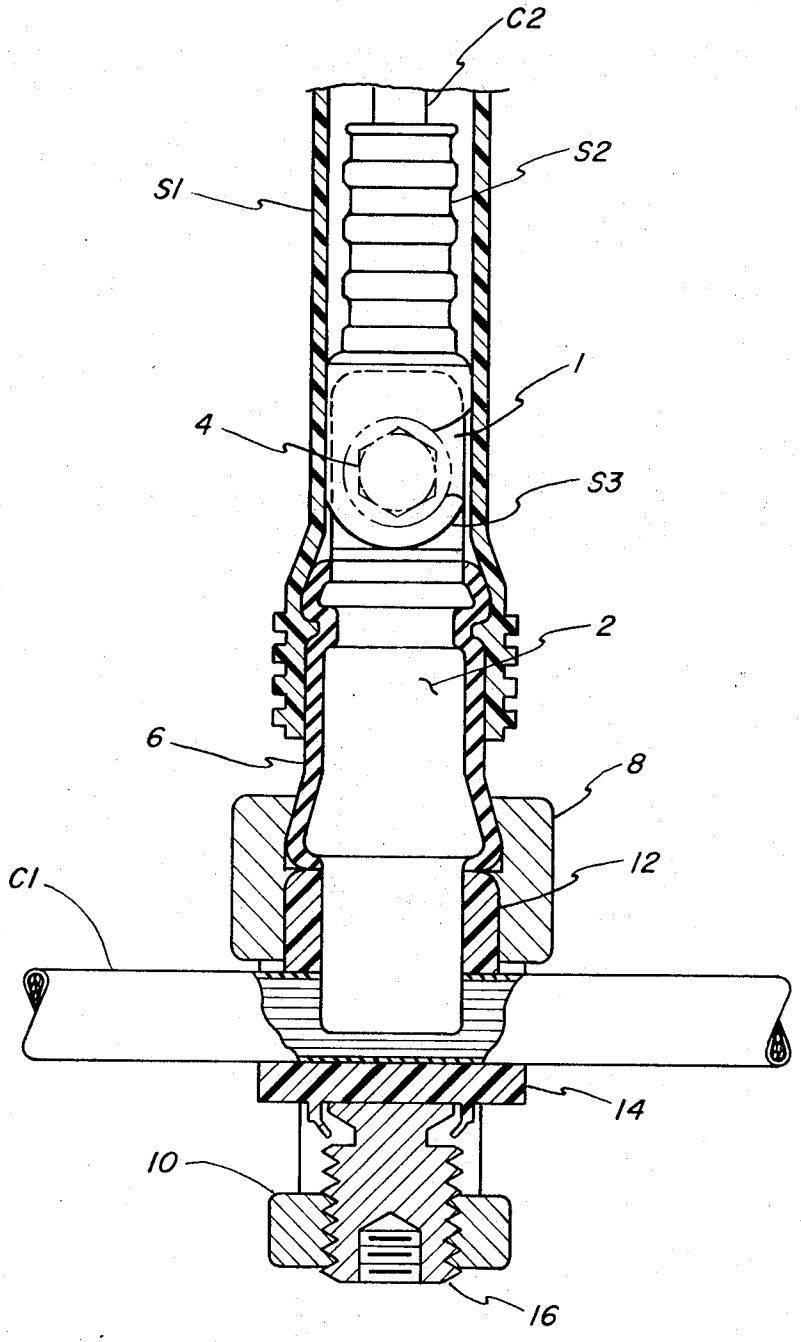


FIG. 2

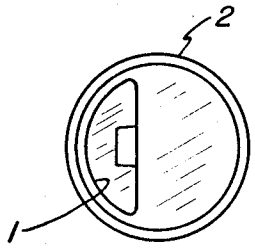


FIG 3A

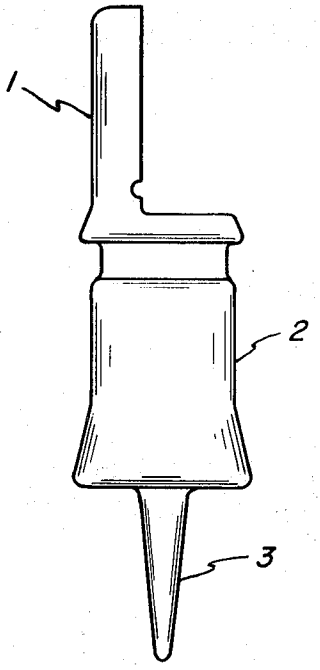


FIG 3B

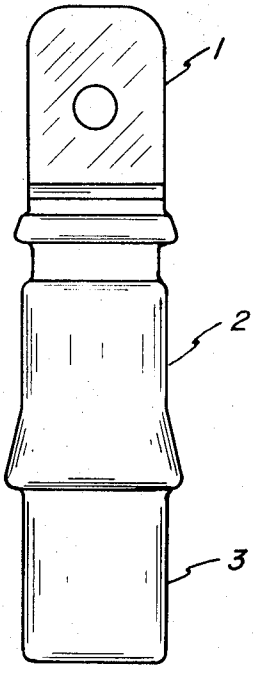


FIG. 3C

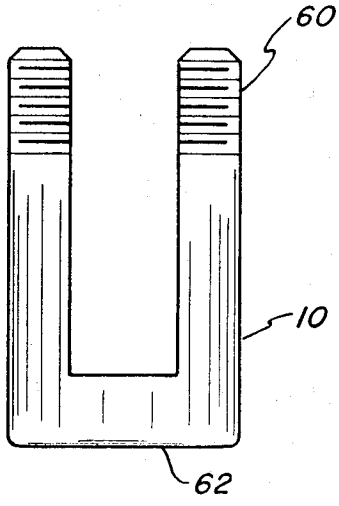


FIG. 4A

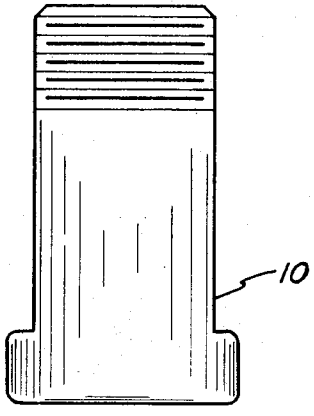


FIG. 4B

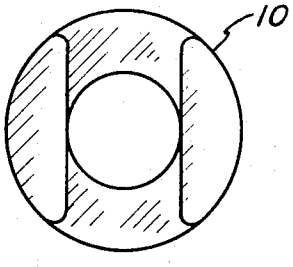


FIG. 4C

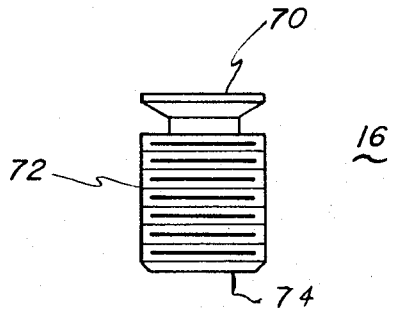


FIG. 5

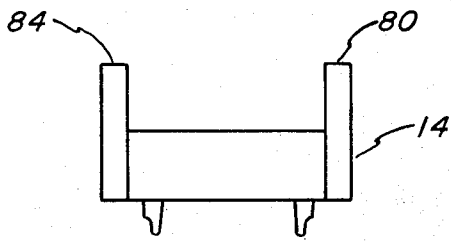


FIG. 6A

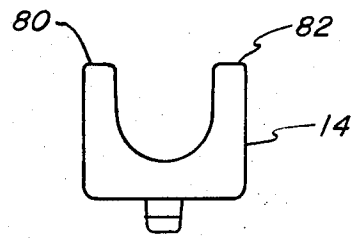


FIG. 6B

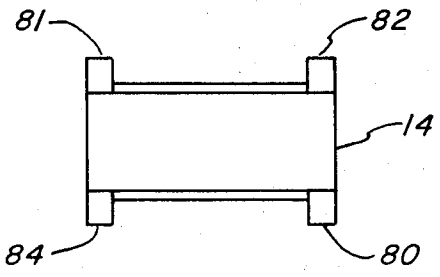


FIG. 6C

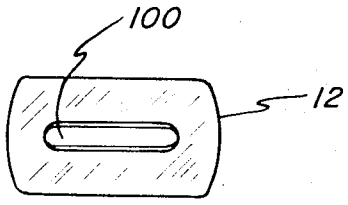


FIG. 7B

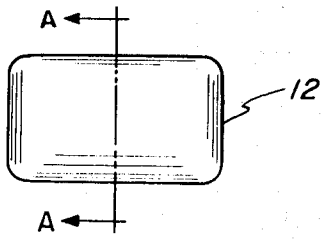
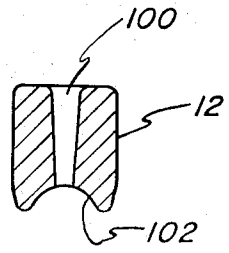


FIG. 7A



SECTION A-A

FIG. 7C

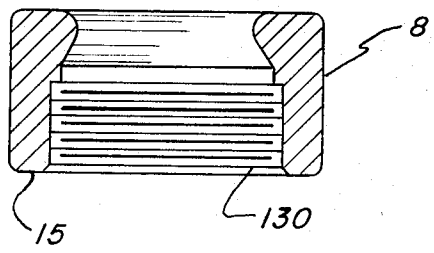


FIG. 8

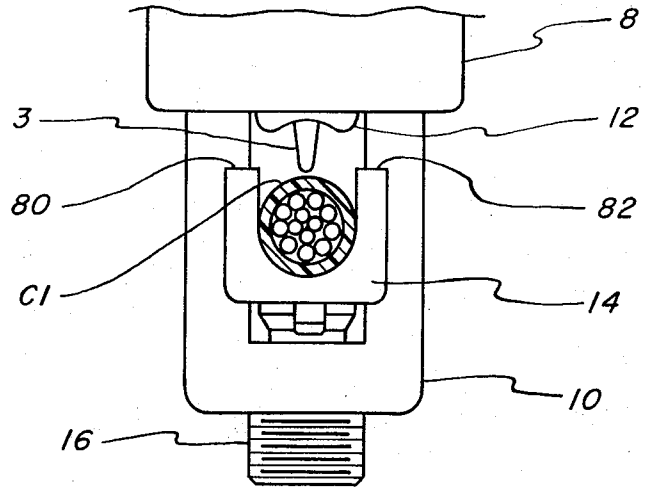


FIG. 9

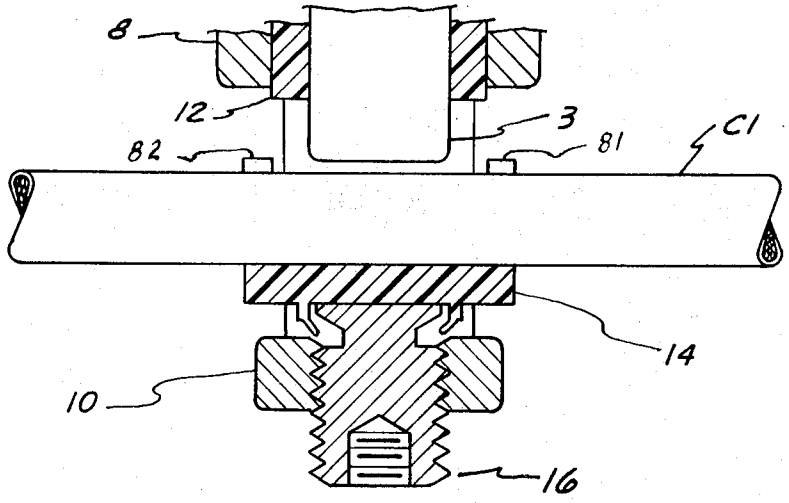


FIG. 10

INSULATION PIERCING CONNECTOR FOR UNDERGROUND INSTALLATION

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to connectors for use in the establishment of interconnections between insulated electric lines or cables. It relates particularly to connectors permitting taps or connections to be completed from insulated power cables and particularly from buried electric power distribution lines to branch lines. It involves piercing the insulation of the power lines to establish electrical connections to the branch lines while preserving the quality of insulation intact.

2. Description of the Prior Art

Among the prir art devices for use in making connections to electric power distributor lines are a number of "hot-tap" devices which enable direct connections to be made to bare power lines. Individual insulator elements are used to support the lines and isolate them electrically. The known devices usually used to tap bare wires are not useful in the environment of the underground cable or for other insulated cables where insulation and physical shielding are required over the entire length of the cable.

Prior art devices known for use with underground cables, and other insulated cables, include those requiring that insulation be removed from the primary cable and a splice be made to complete a connection and provide the necessary insulation. Other devices have included pointed elements for piercing insulation of the primary cable, but have required the application of auxiliary insulation to preserve the electrical isolation of the cable. Still other devices which have included piercing means and insulation means have acutally only provided insulation sufficient to be of use in circumstances requiring low current capacity.

SUMMAY OF THE INVENTION

It is an object therefore of the present invention to provide improved connector means enabling speedy tap connections to be made to an insulated main conductor.

It is a further object to provide insulated tap connections to insulated main conductors while avoiding the necessity of cutting insulation, splicing connections and adding insulation after splices have been made.

In keeping with the foregoing and other objects, the present invention relates to connectors of use in making connections between insulated conductors while preserving their insulator properties. An exemplary connector includes a "chisel" contact which is designed to penetrate the insulation on a conductor and to establish good electrical contact with the conductor. The chisel contact is placed through a threaded collar or cap so that it is retained by the collar or cap. A threaded yoke and the threaded cap are placed on opposite sides of the insulated main conductor with the chisel point held between them in a position pointed toward the insulation. The collar and yoke are then screwed together until full thread engagement is obtained. A set screw in the yoke is then tightened to force the chisel contact through the insulation and into the conductor underneath. An insulating body in the form of a sealing grommet placed around the chisel point is pressed at the same time into position between the insulation on the respective cables to maintain electrical isolation around the chisel point where it passes through the insulation on the cables. The depth to which the chisel point is designed to penetrate is determined by spacing provided by a pressure pad positioned between the set screw and the cap or collar.

BRIEF DESCRIPTION OF THE DRAWINGS

The above mentioned and other features and objects of this invention and the manner of obtaining them will become more apparent, and the invention itself will be best understood by reference to the following description of an embodiment of the invention taken in connection with the accompanying drawings, in which:

FIG. **1** is an elevation of an embodiment of the invention showing a completed connection to a main conductor,

FIG. **2** is a side view of FIG. **1** partially in section and showing connections to additional elements,

FIGS. **3A**, **3B** and **3C** are top, front and side views respectively, of an exemplary piercing terminal,

FIGS. **4A**, **4B** and **4C** are views showing details of construction of a yoke of use in securing the piercing terminal to a conductor,

FIG. **5** shows a side view of a combination set screw and head of use in adjusting the position of the yoke relative to a conductor,

FIGS. **6A**, **6B** and **6C** show three views of a pressure pad of use in maintaining spacing between the connector elements and the conductor.

FIGS. **7A**, **7B** and **7C** are views of a sealing grommet of use in establishing and maintaining electrical and waterproof seals between the elements of the piercing connector,

FIG. **8** is a sectional view showing a collar of use in fastening the elements of the piercing connector together and holding them together,

FIG. **9** shows a portion of the embodiment of FIG. **1** prior to completion of a connection, and

FIG. **10** is a side view of FIG. **9**.

DESCRIPTION OF PREFERRED EMBODIMENTS

Turning now to FIG. **1**, a view of a preferred embodiment of the invention is shown. This view, considered particularly in conjunction with the view in partial section shown in FIG. **2**, illustrates a number of features of the invention and provides an illustration of the manner in which a connection would be completed between a connector and an insulated conductor, through use of the invention.

In the view shown in FIG. **1**, one end of a piercing terminal (**2** in FIG. **2**) is indicated near the top of the figure at **1**. The terminal is a one-piece conductive element which terminates in a chisel point at **3** and serves as the conductive link between the cable indicated in cross section at Ca and a conductor C**2** (see FIG. **2**) which could be coupled directly to the portion **1** of the piercing terminal through a bolt shown in phantom at **4**.

The number **6** refers to the outer face of an insulating cover over the piercing terminal **2**. This insulating cover is partially hidden in this view by a cap at **8** which is fastened to a yoke at **10** via threads (not shown). The edge of a sealing grommet **12** is indicated between the upper side of the insulated conductor C**1** and the bottom side of cap **8**. A pressure pad is shown at **14**, which in cooperation with a set screw and head at **16**, serves

to force the chisel edge 3 through the insulation C1 into the conductor and, at the same time, prevents the chisel edge 3 from cutting into the insulated conductor C1 beyond a preselected depth.

As indicated above, FIG. 2 is a side view, in partial section, of the invention as shown in FIG. 1. FIG. 2 also shows the application of additional elements in the practice of the invention such as a cable C2, a sealing sleve S1 and a service tap S2. Corresponding parts from FIG. 1 are indicated by the same numbers in FIG. 2.

FIGS. 3A, 3B and 3C show respectively top, front and side views of the piercing terminal 2. An exemplary terminal may be made of cast aluminum. FIGS. 3B and 3C show the terminal from the same respective viewpoints as do FIGS. 1 and 2. The figures show relationships between a portion of the terminal 1 to which electrical and mechanical connections to supplemental cables are made, the body of the piercing terminal 2, and the point at 3 which is used in piercing insulated conductors and in establishing electrical connections. These figures collectively show details relating to the forms of the piercing terminal which may not be clear from FIGS. 1 or 2.

FIG. 4A is a view of the yoke 10 from the same angle as shown in FIG. 1. FIGS. 4B and 4C show the yoke from other angles. Threads are indicated at 60 for engaging internal threads (not shown) of the cap 8. Internal threads are provided in a bore through the end 62 of 10 to accommodate a combined set screw and head (FIG. 5).

A side view of the set screw and head 16 is shown in FIG. 5. In this view a substantially flat surface at 70 is provided to engage the pressure pad 14. Threads indicated at 72 are provided to engage the internal threads in the end of the yoke 10 and thus provide means for adjusting the spacing between various elements of the connector. The surface indicated at 74 may be pierced by an opening of hexagonal or other shape to accept a wrench which can be used to turn the set screw.

The pressure pad is shown in detail in FIGS. 6A and 6B from the same respective viewpoints as shown in FIGS. 2 and 1, respectively. Stops or gauges are indicated at 80, 82 and 84 which bear against the face 15 of the cap 8 to establish the minimum spacing available for the cable C1. FIG. 6C is a top view of FIG. 6A showing stops at 80, 81, 82 and 84 and further illustrating the form of the pad.

Side, top and sectional views of the sealing grommet 12 are shown respectively in FIGS. 7A, 7B and 7C. FIG. 7A shows a side view of the grommet from the same viewpoint as in FIG. 2. A tapered opening at 100 is indicated in FIGS. 7B and 7C to receive the chisel point 3 of the piercing terminal 2. A rounded depression is indicated at 102 in FIG. 7C which accommodates and cushions the outer insulated surface of the cable C1. The grommet is gently rounded, as indicated, and is formed of a plastic substance selected to provide a water tight seal between the various surfaces with which it comes in contact.

FIG. 8 shows a vertical section through the center of the cap 8. Internal threads at 130 are provided for the cap 8 to engage the threads 60 on the yoke 10 (FIG. 4A). Turning the cap 8 to engage the threads enables the yoke and cap to be pulled toward each other and affect piercing by the point 3 of the insulation and metal conductor on cable C1.

The invention will perhaps be clearer if a preferred mode of installation is described next. To install a tap line, such as C2 to a main power line, such as C1, the yoke 10 is first placed over the insulated conductor C1. The threads of the yoke are engaged with the cap 8 and the cap is tightened until full thread engagement is obtained. This phase of installation is accomplished with the pressure pad 14 and the set screw 16 sub-assembly in full open position, as indicated in FIGS. 9 and 10. With the set screw and pressure pad assembled to the conductor in the open position there is clearance for the conductor between the pressure pad and the leading edge of the chisel contact as indicated in FIGS. 9 and 10. The set screw with pressure pad attached is then tightened until stops 80, 81, 82 and 84 on the pressure pad 14 seat against the face 15 of the collar 8. The torque applied to the set screw 16 working in conjunction with pressure pad 14 causes the chisel contact 3 to pierce the insulation of the conductor and make electrical contact with the conductor. There is no pressure on the insulated conductor until the set screw is tightened sufficiently to take up the clearance shown in FIGS. 9 and 10.

The design of the terminal 2, with the chisel shaped contact 3, and the yoke 10 are such that the unit is self-aligning to assure proper entry of the chisel contact into the stranding of the insulated conductor C1. During assembly, the sealing grommet 12, which is slotted and surrounds the chisel contact is compressed and by design is caused to seal the pierced area of the conductor as well as the chisel contact. To complete a connection, a service tap conductor S2 with a lug S3 crimped into place is attached under the terminal screw 4 and a sealing sleeve S1 is extended over the insulating cover 6 to complete an insulating seal around the metallic connection between the conductors C1 and C2.

I claim:

1. A connector for use in electrically interconnecting insulated electrical conductors and for providing and maintaining watertight and electrically insulated connections around the resulting electrical path comprising

contact means connectable to a terminal of a first electrical conductor,

said contact means including piercing means for cutting through insulation on a second conductor and establishing electrical contact with the second conductor,

first insulating means formed to insulate a first part of said contact means,

deformable insulating means shaped as a sleeve through which said piercing means extends,

said deformable insulating means making it possible in cooperation with the first insulating means to establish and maintain electrical insulation around the contact means and to provide a water tight seal between said piercing means and insulation of said second conductor,

a yoke and a cap each having a threaded portion cooperative with each other to initially assemble the connector around the second conductor, and

means adjustable in cooperation with said yoke, after said connector is initially assembled around the second conductor, for forcing said piercing means through the insulation of the second conductor and into contact with the second conductor.

2. A connector as claimed in claim 1, including means for limiting the depth to which said piercing means penetrates the second conductor.

3. A connector as claimed in claim 2, in which the means for limiting the depth includes a pressure pad selected to place a minimum limit on the spacing between the means adjustable in cooperation with said yoke and the piercing means.

4. A connector as claimed in claim 1, including

means for controlling the depth to which said piercing means penetrates the second conductor,

said means for controlling the depth including a pressure pad, said pressure pad including a first face for directly contacting the insulation of a conductor to be pierced, and

said means adjustable in cooperation with said yoke including a set screw in engagement with the yoke for contacting a second face of the pressure pad to enable closure of the space between the deformable insulating means and said pressure pad.

5. A connector as claimed in claim 1, including

means for controlling the depth to which said piercing means penetrates the second conductor,

said means for controlling the depth including a pressure pad,

said pressure pad including a first face for directly contacting insulation of the second conductor, and

said means adjustable in cooperation with said yoke including a set screw in engagement with the yoke,

said set screw contacting a second face of the pressure pad to enable adjustment of the spacing of the yoke and said pressure pad against the conductor, and

said cap contacting a set of gauges formed by the pressure pad to limit the minimum spacing between the yoke and the pressure pad.

6. A connector as claimed in claim 1, in which

said piercing means consists of a chisel-shaped point formed on one end of said contact means.

7. A connector as claimed in claim 1, in which

said deformable insulating means includes a sealing grommet formed to accept said piercing means,

said sealing grommet forming an insulating seal between the first insulating means and insulation over a conductor into which the piercing means has penetrated.

8. A connector as claimed in claim 1, in which

the cap responds to rotation about the axis central to its threaded portion to fasten the yoke and cap about the second conductor.

9. A connector as claimed in claim 1, in which said yoke has two legs forming a U shape,

a pressure pad for limiting the depth to which said piercing means penetrates a second conductor,

said means adjustable in cooperation with said yoke includes a set screw,

said pressure pad including arms and spaces enabling it to nest within the U of the yoke against the face of a set screw threaded into the U of the yoke,

said cap including threads for engaging threads on the legs at the open end of the yoke, and

said set screw responding to rotary forces to push the piercing means into a conductor positioned within the U of the yoke.

10. A connector as claimed in claim 1, including

means for controlling the depth to which said piercing means penetrates the second conductor,

said means for controlling the depth including a pressure pad, said pressure pad including a first face for directly contacting a conductor to be pierced, and

said means adjustable in cooperation with said yoke including a set screw in engagement with the yoke for contacting a second face of the pressure pad to enable adjustment of the spacing of the yoke and said pressure pad against the conductor.

11. A connector for use in interconnecting insulated electrical conductors and maintaining an insulated path through the resulting connections comprising

contact means connectable to a terminal of a first electrical conductor,

said contact means including piercing means for cutting through insulation on a second conductor and establishing electrical contact with the second conductor,

insulating means associated with said contact means to establish and maintain insulation around the piercing means and contiguous with the insulation on the second conductor,

a yoke for forming a binder along at least one side of the conductor,

means cooperative with said yoke for forcing said piercing means through the insulation of the second conductor and into contact with the second conductor,

means for controlling the depth to which said piercing means penetrates the second conductor,

said means for controlling the depth including a pressure pad,

said pressure pad including a first face for directly contacting insulation of the second conductor,

a set screw and a cap in engagement with the yoke,

said set screw contacting a second face of the pressure pad to enable adjustment of the spacing of the yoke and said pressure pad against the conductor, and

said cap contacting a set of gauges formed by the pressure pad to limit the minimum spacing between the yoke and the pressure pad.

* * * * *