United States Patent [19]

Douglas, Jr.

[11] **3,717,842**

[45] **Feb. 20, 1973**

[54] **METHOD OF CONNECTING ALUMINUM WIRE TO ELECTRICAL TERMINALS**

[75] Inventor: **Richard Douglas, Jr.**, Nashville, Tenn.

[73] Assignee: **Perfection Electrical Products, Inc.**, Nashville, Tenn.

[22] Filed: **Feb. 26, 1971**

[21] Appl. No.: **119,309**

[52] **U.S. Cl.** .....**339/275 T**, 174/84 R, 174/90, 228/1, 339/276 T

[51] **Int. Cl.**.....**H01r 5/04**, H01r 5/08

[58] **Field of Search**.....339/275, 276, 278; 174/84 R, 174/90; 228/1

[56] **References Cited**

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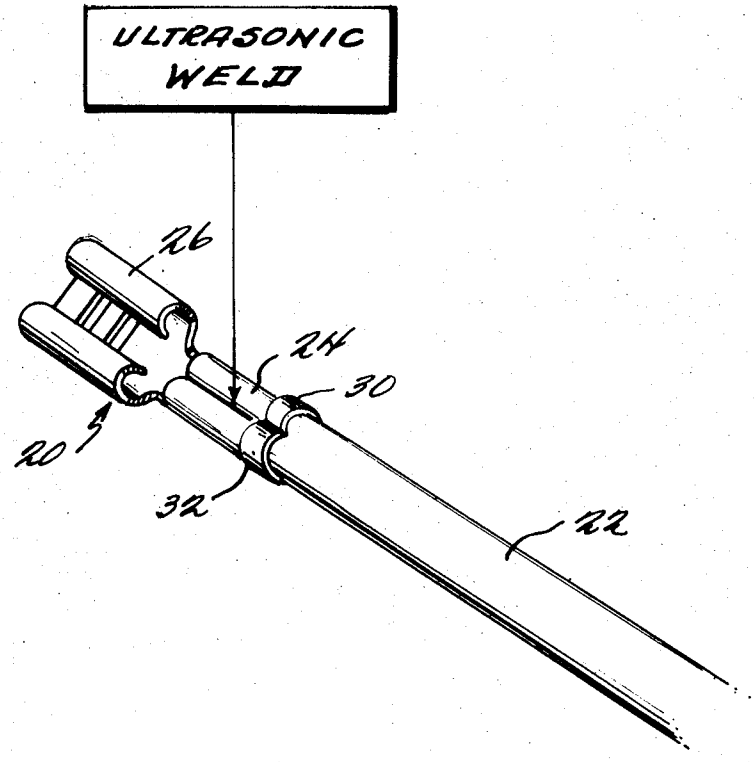
Primary Examiner—Joseph H. McGlynn
Attorney—Cushman, Darby & Cushman

[57] **ABSTRACT**

A method of connecting conventional electrical terminals having at least non-aluminum portions, such as nickel-plated steel, to solid or stranded aluminum wire so that aluminum oxide on the surfaces of the strands does not prevent a satisfactory electrical contact. Such conventional terminals have a channel portion with extending tabs so that the wire can be placed in the open channel and the tabs crimped to close the channel and hold the wire in electrical connection with the terminal. According to this invention, after the aluminum wire is held by crimping, the solid or stranded wire is then ultrasonically welded to the channel portion to remove the oxide already on the aluminum wire and preclude any further build-up of aluminum oxide.

1 Claim, 2 Drawing Figures



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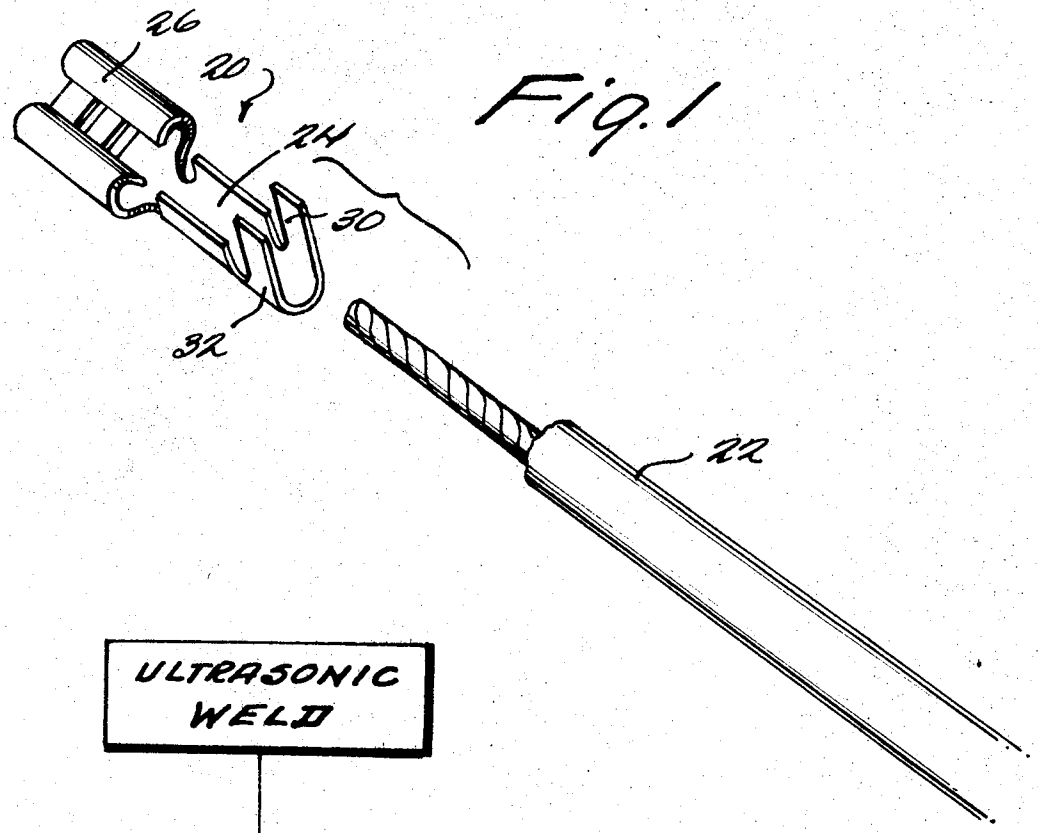

Fig. 1

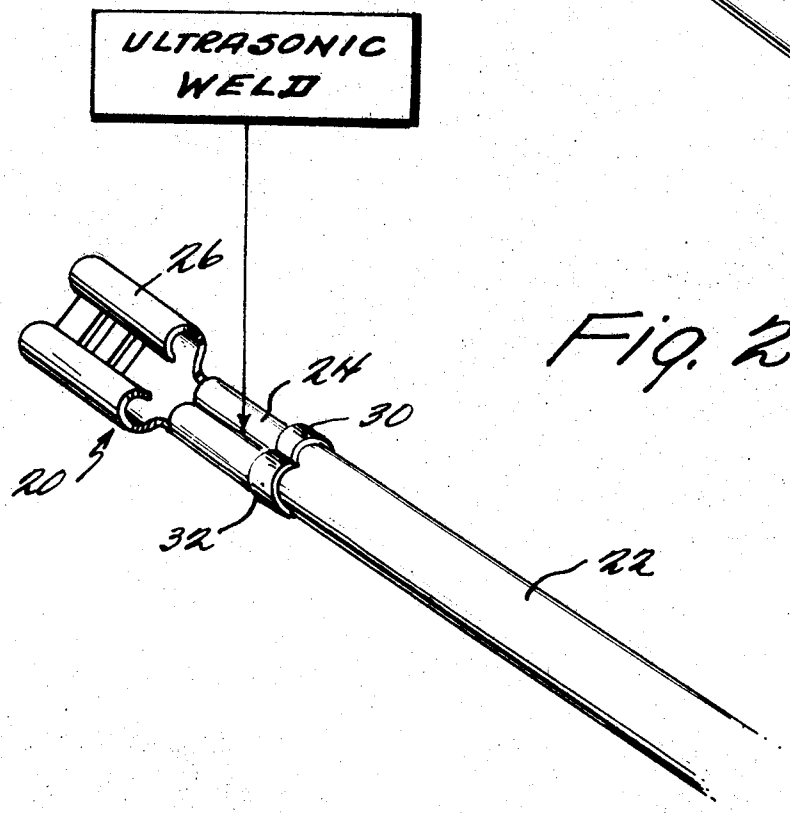

Fig. 2

INVENTOR

RICHARD DOUGLAS, JR.

BY Cushman, Darby & Cushman

ATTORNEYS

METHOD OF CONNECTING ALUMINUM WIRE TO ELECTRICAL TERMINALS

BRIEF DESCRIPTION OF THE PRIOR ART AND SUMMARY OF THE INVENTION

The invention relates to a method of connecting conventional electrical terminals having at least non-aluminum portions to solid or stranded aluminum wire.

Aluminum wire has been used for many years in certain limited applications. Recently new alloys such as triple E aluminum made by the Southwire Corporation have been developed which retain many of the desirable characteristics of aluminum wire and at the same time have other physical qualities which are much superior to conventional EC grade aluminum and which make such wire acceptable for general use in housing, vehicles, appliances, etc.

One terminal which has been used widely for many years for copper wires has a channel portion into which the copper wire can be placed and tabs which can be crimped to close the channel portion and hold the wire firmly in electrical connection with the channel portion. These terminals have conventionally been made of such materials, brass, tin-plated or silver-plated brass, cadmium-plated or nickel-plated steel, bronze and phosphorus bronze. Because of their widespread use, manufacturers of these types of terminals have very large investments in equipment to apply these terminals to wire and for producing these terminals cheaply and on a large scale.

Unfortunately, this conventional method of connecting strands of wire or solid wire to these types of terminals is not satisfactory for aluminum or aluminum alloy wires because aluminum oxide tends to build up on the surface of the aluminum before and after crimping and acts as an insulator rather than a conductor. In order to overcome this problem, special terminals have been developed. In one terminal a plurality of sharp prongs or pyramids are formed on the interior of the channel so that, when the tabs are crimped to hold the strands in place, these prongs or pyramids penetrate through the oxide on the wire and into the aluminum below to provide a good electrical connection. While satisfactory as terminals, new and expensive machines must be developed to produce the special terminals required for aluminum wire and to apply them to the aluminum wire.

The present invention relates to a method whereby coventional terminals can be used for aluminum wire, thus obviating the necessity for new and expensive tooling and other equipment to both produce and apply the terminals to the wire. This is accomplished as discussed below by ultrasonically welding the solid aluminum or strands to the closed channel portion after the wire has been placed in the channel and conventionally crimped. Ultrasonic welding has been employed in the past for welding aluminum wire as discussed, for example, in Haigler U.S. Pat. No. 3,314,582.

Such terminals may be nickel-plated steel or other conventional material. Alternatively, an aluminum alloy terminal having a non-aluminum coating, such as nickel, may be employed. An aluminum terminal with a non-aluminum coating may be particularly satisfactory because no galvanic action can occur between the aluminum portion of the terminal which contacts the aluminum wire and the wire. Further, welding between the aluminum portion of the terminal and the wire may be more satisfactory than welding the aluminum wire to a non-aluminum terminal portion.

Many other objects and purposes of the invention will be clear from the following detailed description of the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a perspective view of a conventional terminal with an open channel and an aluminum wire to be placed in the channel portion.

FIG. 2 shows a perspective view of the terminal of FIG. 1 with the aluminum wire crimped in and ultrasonically welded to the channel portion.

DETAILED DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a perspective view of a non-aluminum terminal **20**, for example, nickel-plated steel, and an aluminum or aluminum alloy wire **22** which may comprise a plurality of strands as shown which are about to be placed in the open channel portion **24** of terminal **20** or alternately a solid wire. While nickel-plated steel may be unsatisfactory for other reasons, it can be successfully welded to the aluminum wire. Galvanic reaction may be a problem for many terminal materials. As mentioned above, an aluminum terminal with a non-aluminum coating may also be employed. As shown, the interior of channel portion **24** is substantially smooth. Terminal **20** also includes portions **26** which attach terminal **20** to a further electrical contact or wire and portions **26** may be of any desired configuration. Any number of wires can be connected to a single terminal and two wires are frequently so connected.

Channel portion **24** includes two tabs **30** and **32** which extend along the open side of portion **24** which receives a wire. To attach an aluminum wire to terminal **20**, the wire is first placed in channel **24** and then the tabs **30** and **32** are conventionally bent or crimped down on the wire **34** to the position shown in FIG. **2** to hold the wire in channel portion **24**. If nothing further is done, the aluminum oxide already on the surfaces of the strands of aluminum or solid wire **34** and that which accumulates thereafter will electrically insulate the terminal from the wire and provide an unsatisfactory connection.

However, after wire **34** is crimped in the channel portion **24**, according to this invention the aluminum wire **34** is ultrasonically welded to the non-aluminum channel portion **24**, and this connection, it has been found, provides a continuing electrical connection which is satisfactory. This welding tends to break down the oxide on the wire and prevent formation of further oxide between the terminal and wire. Any conventional ultrasonic welding apparatus and/or method can be employed.

Many changes and modifications in the above embodiment of this invention can, of course, be made without departing from the scope of the invention and accordingly that scope is intended to be limited only by the scope of the appended claims.

What is claimed is:

1. A method of connecting aluminum wire to a non-aluminum unitary electrical terminal of the type having a channel portion with a relatively unbroken internal surface for receiving one or more conductor wires

without portions of the terminal extending into said wire and tabs forming part of said channel portion comprising the steps of:

placing said wire in said channel portion of said terminal without any part of said terminal extending into said wire,

crimping said tabs to close said channel portion with said internal surface of channel portion in electrical contact with said wire, and

ultrasonically welding said wire to said channel portion so as to form a bond without aluminum oxide.

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