July 16, 1957 W. A. BARNES 2,799,840

TERMINAL CONSTRUCTION

Filed June 2, 1953

FIG. 1



FIG. 2



FIG. 3

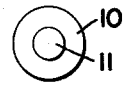


FIG. 4



FIG. 4A

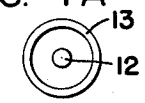


FIG. 4B



FIG. 5

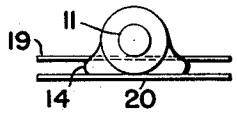


FIG. 6

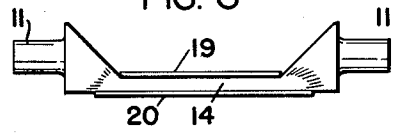


FIG. 7

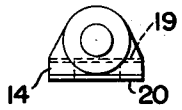
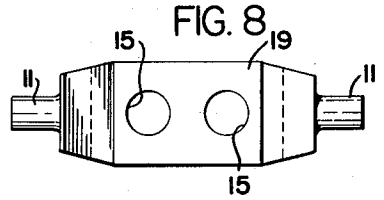


FIG. 8



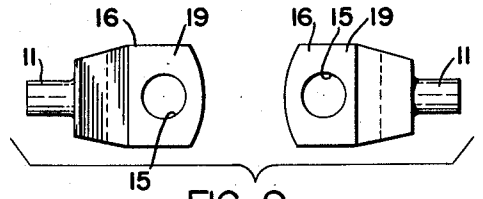


FIG. 9

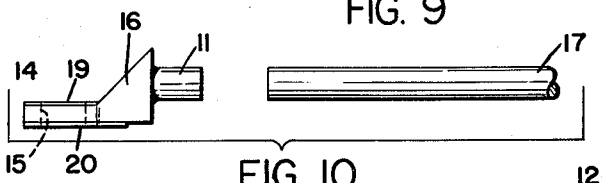


FIG. 10

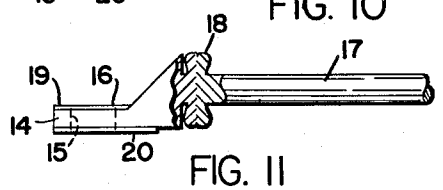


FIG. 11

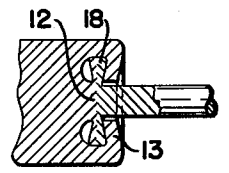


FIG. 12

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United States Patent Office 2,799,840 Patented July 16, 1957

2,799,840

TERMINAL CONSTRUCTION

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Application June 2, 1953, Serial No. 359,159

8 Claims. (Cl. 339—275)

This invention relates in general to terminal construction for electrical conductor wires, and relates more specifically to terminals adapted to be united to the conductor wire by a cold phase bond and having a thin metallic coating of another metal over the surfaces of the anchor terminal portion.

The terminal of this invention may be constructed according to the teachings set forth in application Serial Number 343,745.

An object of this invention is to provide a terminal construction adapted to be cold welded with a solid phase bond to a conductor wire.

Another object of this invention is to provide a terminal of aluminum for aluminum conductor wires, and having a copper facing on the surfaces to be attached to an electrical device.

Other objects and a fuller understanding of this invention may be had by referring to the following description and claims, taken in conjunction with the accompanying drawing, in which:

Figure 1 is an end view of a blank bar from which a terminal may be made according to the principles of this invention;

Figure 2 is a side view of the blank bar;

Figure 3 is an end view of the blank bar processed to provide a stub connected end shaft on each end thereof;

Figure 4 is a side view of the blank bar as thus processed;

Figure 4–A is an end view of an alternate connector end construction wherein a central stub shaft and a concentric ring collar is provided on each end thereof;

Figure 4–B is a longitudinal sectional view through the alternate construction;

Figure 5 is an end view of an intermediate step in the production of a terminal wherein a second metal is applied to the surface of the blank, and the blank forged to shape the portion for the anchor area and to bond the second metal to the faces of the anchor area with a solid phase cold formed bond;

Figure 6 is a side view of the intermediate step;

Figure 7 is an end view similar Figure 5, but with the surplus edges trimmed away;

Figure 8 is a top view of a finished double terminal as formed from the intermediate step of Figure 6 by trimming and punching;

Figure 9 is a top view of the terminal of Figure 8 as divided into two individual terminals;

Figure 10 is an illustration of a conductor wire and a single terminal in position to be united;

Figure 11 is a view of the wire and terminal united with a cold-weld solid phase bond; and

Figure 12 illustrates the reinforcement of the connection by folding of the concentric ring of Figure 4–B over the union.

The cold welding or uniting of metal by the production of a solid phase bond under conditions of controlled pressure and confinement of flow is set forth basically in Patent No. 2,522,408, issued to Sowter. Application Serial

No. 343,745, filed March 20, 1953, sets forth a teaching of the reinforcement of such solid phase union by the provision of a clamp member. The drawing in that application illustrates a terminal embodying some of the features illustrated in this drawing and described herein.

This application pertains principally to the terminal construction and the method of making the terminal construction rather than to the reinforcement of the juncture between two members welded by a cold formed solid phased bond.

In the process of this invention there is provided a blank bar **10** of any suitable size and shape. In the drawing of this application, the blank bar **10** is illustrated as being a round bar as readily available from many suppliers. Square bars and other shapes are equally suitable. In Figures 3 and 4, the blank bar is illustrated as having been provided with a stub shaft **11** on both ends thereof. The stub shaft may be provided by machining away metal of the blank bar, or by extruding if desired.

In Figures 4–A and 4–B, there is illustrated an alternate method of providing a stub shaft suitable for cold-weld solid phase bonding to a conductor. In these figures, a central stub shaft **12** and a concentric ring collar **13** are provided on each end of the blank bar. Shaft **12** and ring **13** are preferably provided by upset extrusion, but may be provided by machining methods if desired.

Regardless of what manner is used for providing the stub shaft **11** or the stub shaft **12**, the cold union of that shaft to a conducting wire may be carried out as explained in the application Serial No. 343,745 and may be reinforced by the ring collar **13** as also described in that application.

Terminals suitable for solid phase cold-weld bonding are preferably provided in the same material as the conductor wire to which it is intended that they be joined. In the event that the terminal is to be connected to a copper conductor then, undoubedly, a copper terminal will prove more satisfactory. In such event, the blank bar **10** is forged in the central area to provide a roughly formed anchor portion which may be trimmed to proper size and provided with suitable attachment holes. When a blank bar is provided with a stub shaft on both ends as illustrated in Figure 4 and forged into a shape substantially as illustrated in Figure 6, it may be trimmed and used as a double terminal, or divided as shown in Figure 9 to form two individual terminals. No further processing need be carried out to produce a servicable terminal.

However, copper is becoming increasingly scarce and expensive whereas, the light metals, such for example as aluminum, are becoming more plentiful. Aluminum has many other characteristics which also make it desirable for electrical conductors regardless of the comparative scarceness and cost. However, the provision of terminals for aluminum wire and a relatively loose surface contact between aluminum and copper will produce excessive corrosion. Consequently, the use of aluminum wire conductors has been hampered because of the lack of a suitable terminal.

According to this invention, the blank bar **10** is provided with opposed layers of a second metal, preferably copper, and the two metals forged together into the form illustrated in Figures 5 and 6 of the drawing. By conducting the forging under controlled conditions of pressure and flow, a solid phase bond at a temperature less than the normal welding temperature of the two metals is accomplished. Two separate pieces of the second metal, usually copper, may be placed on opposed sides of the blank bar **10** or a tube of the second metal may be slipped over the central portion of the blank bar prior to forging. In many respects the use of a tube is preferable to the use of separate pieces, as illustrated in Figure 5.

In order to produce a successful union between the two

metal layers the surface of the metals must be prepared by cleaning and roughening of the surfaces as described in the Sowter Patent No. 2,522,408.

As related with respect to the production of a solid metal terminal, for example, a copper terminal, the blank bar **10** may be provided with double stub shaft ends as illustrated, or may be provided with only one stub shaft.

When provided with stub shaft **11** or **12** on both ends, the central portion is reduced in thickness substantially less than one-half the original thickness of the blank bar **10** and then trimmed as illustrated in Figure 8. The reduced center portion, referred to by the reference character **14**, constitutes a flat anchor portion having plates **19** and **20** of copper bonded thereto. The area **14** is then provided with suitable attachment holes **15** to receive a screw for attachment of the terminal to an electrical appliance. If the terminal is to be used as a double connector, it is allowed to remain in one piece as illustrated in Figure 8, and if a single end conductor is to be produced, the area **14** is divided to produce two individual terminals **16**, as illustrated in Figure 9.

In Figure 10 of the drawing, there is illustrated a single terminal **16** and a wire conductor **17** in aligned positions ready to be joined by a suitable tool which will drive the ends of the wire **17** and shaft **11** together under conditions of confined flow and high pressure. An indication of the type of tool which may be used for this purpose is illustrated in application Serial No. 348,069. The ends of the shaft **11** and the wire **17** must be properly prepared for such solid phase bonding.

Figure 11 illustrates the terminal **16** and the wire **17** joined. The solid phase bonding by this method produces a flange **18**.

In Figure 12 of the drawing, the reinforcement of the flange **18** is illustrated. In Figure 12, the blank bar illustrated in Figure 4–B, after having been processed as described with respect to the blank bar of Figure 4, is attached to the stub shaft **12** and the collar **13** folded down around the resulting flange **18**.

The Figures 10, 11 and 12 are intended to illustrate the appearance of an aluminum wire **17** and an aluminum terminal body with the opposed flat surfaces of the anchor portion provided with covering plates **19** and **20** of copper bonded to the aluminum body by a solid phase bond.

The mechanical contact of copper and aluminum, regardless of how tightly they are held in contact, tend to set up a galvanic action which produces corrosion. Thereby, the direct connection of an aluminum terminal to a copper connector body is undesirable. Furthermore, there are other well-known reasons why copper is preferred for a face-to-face connector surface. By providing the plates **19** and **20** on the surface of the aluminum terminal body by a cold-phase bond, the galvanic action is materially reduced to a practical level. The terminal then has the advantage of copper contact faces for mechanical contact with connector bodies.

Although this invention has been described in its preferred form with a certain degreee of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and scope of the invention as hereinafter claimed.

What is claimed is:

1. An electrical terminal, comprising, a terminal body of a first metal, said terminal body having a contact portion and connector portion adapted to be connected to a conductor wire, an external layer of another metal over the surfaces of the contact portion of said body, said external layer united to said body solely by a cold weld solid phase bond produced by pressure and characterized by the absence of third substance bonding agents.

2. An electrical terminal, comprising, a terminal body of aluminum, said body having a flat anchor portion, an external layer of copper on opposed sides of said anchor portion, said copper united to said anchor portion solely by a cold-weld solid phase bond.

3. The method of producing electrical terminals, comprising the steps of, providing a blank bar of a first metal, providing a stub shaft on said blank bar suitable to be welded to the size of wire to be joined to said terminal, cleaning and preparing the surface from a portion of said blank bar suitable for solid phase bonding, placing said prepared portion within opposed layers of a second metal, compressing said prepared portion and layers of the second metal under forging pressure and at a temperature less than normal welding temperature for said first and second metals until a portion of said blank bar is flattened into a flat anchor portion of a thickness less than half the thickness of the blank bar, said second metal thereby being bonded to the surface of the first metal on said anchor portion by a cold weld solid phase bond.

4. The method of producing an electrical terminal, comprising the steps of, providing a blank bar of aluminum, providing a stub shaft on said blank bar suitable to be welded to the size of wire to be joined to said terminal, cleaning and preparing the surface from a portion of said blank bar suitable for solid phase bonding, placing said prepared portion within opposed layers of copper, compressing said prepared portion and layers of the copper metal under forging pressure and at a temperature less than normal welding temperature for said aluminum and copper metals until a portion of said blank bar is flattened into a flat anchor portion of a thickness less than half the thickness of the blank bar, said copper metal thereby being bonded to the surface of the aluminum metal on said anchor portion by a cold weld solid phase bond.

5. The method of producing an electrical terminal, comprising the steps of providing a blank bar of a first metal, providing first and second stub shafts on opposite ends of said bar suitable to be welded to the size of wire to be joined to said terminal, cleaning and preparing the surface from a portion of said blank bar between said stub shafts suitable for solid phase bonding, placing said prepared portion within opposed layers of a second metal, compressing said prepared portion and layers of the second metal under forging pressure and at a temperature less than normal welding temperature for said first and second metals until said portion of the blank bar is flattened into a flat anchor portion of a thickness less than half the thickness of the blank bar, said second metal thereby being bonded to the surface of the first metal on said anchor portion by a cold weld solid phase bond.

6. The method of producing electrical terminals, comprising the steps of, providing a blank bar of aluminum metal, providing first and second stub shafts on opposite ends of said bar suitable to be welded to the size of wire to be joined to said terminal, cleaning and preparing the surface from a portion of said blank bar between said stub shafts suitable for solid phase bonding, placing said prepared portion within opposed layers of copper metal, compressing said prepared portion and layers of the second metal under forging pressure and at a temperature less than normal welding temperature for said aluminum and copper metals until said portion of the blank bar is flattened into a flat anchor portion of a thickness less than half the thickness of the blank bar, said copper metal thereby being bonded to the surface of the aluminum metal on said anchor portion by a cold weld solid phase bond.

7. The process of making a terminal for uniting to a conductor wire comprising the steps of, providing a bar of aluminum, extruding a central stub shaft and con-

centric ring collar on each end of said bar preparing a portion of the surface of said bar suitable for solid phase bonding, placing said prepared portion within opposed layers of copper, compressing said prepared portion and layers of the copper metal under forging pressure and at a temperature less than normal welding temperature for said aluminum and copper metals until a portion of said blank bar is flattened into a flat anchor portion of a thickness less than half the thickness of the blank bar, said copper metal thereby being bonded to the surface of the aluminum metal on said anchor portion by a cold weld solid phase bond, and finally dividing the forged center portion to produce two individual terminals.

8. An electrical terminal comprising a terminal body having a solid stub shaft and concentric collar encompassing said stub shaft, a solid conductor rod aligned with said stub shaft within the confines of said collar and united with said stub shaft by a cold weld solid phase bond to form a flash flange at the joint formed by said union, and said collar being pressed tightly against said flash flange in supporting engagement therewith.

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