

[54] **TERMINAL DEVICE FOR WELDED TERMINATION OF ELECTRICAL LEADS**

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[51] Int. Cl. H01r 11/06

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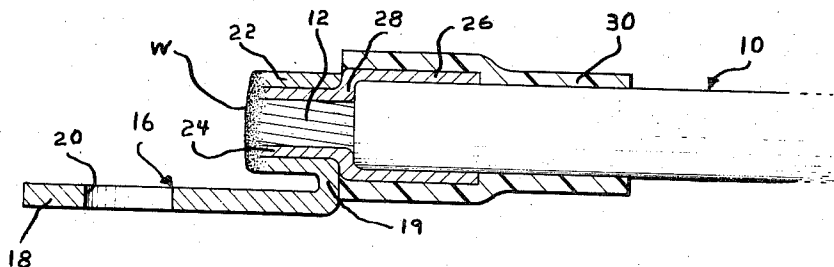
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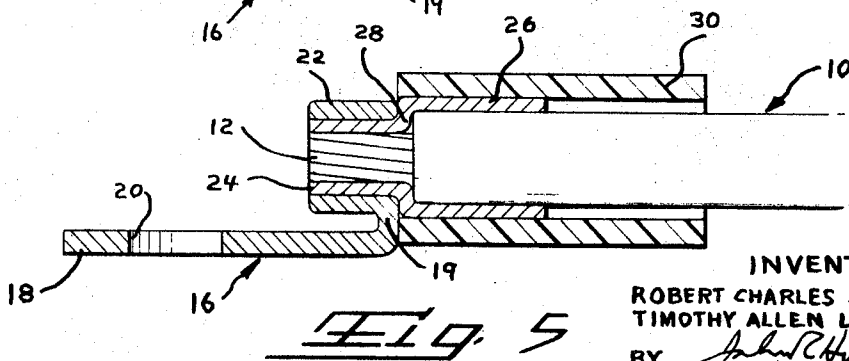
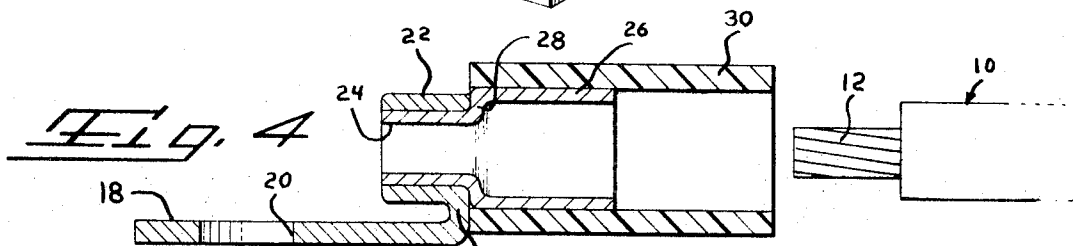
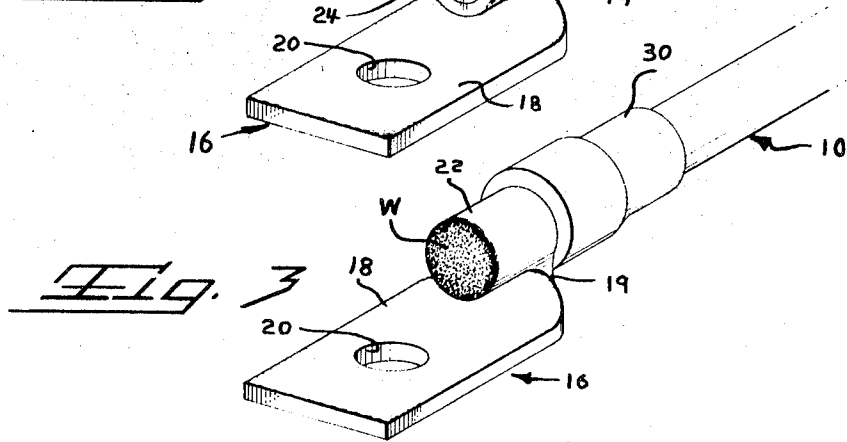
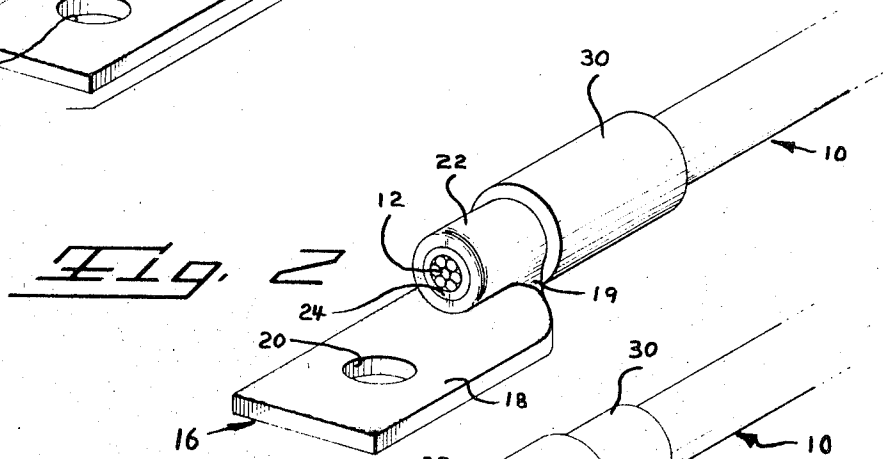
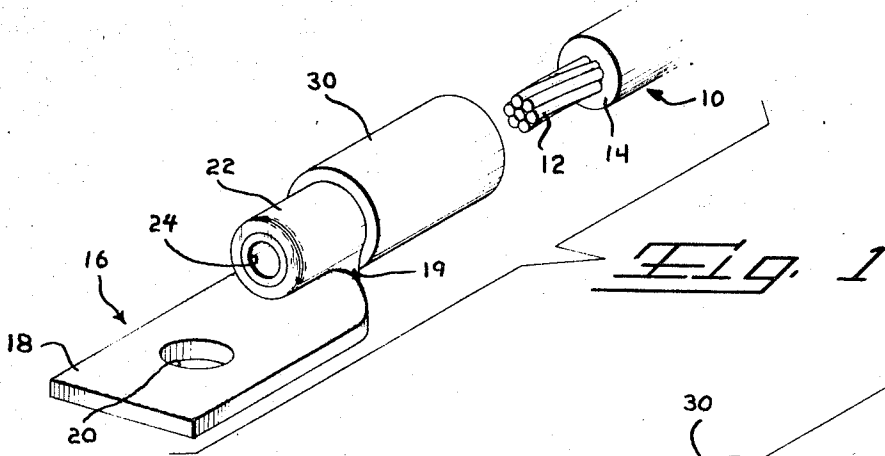
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[57] **ABSTRACT**

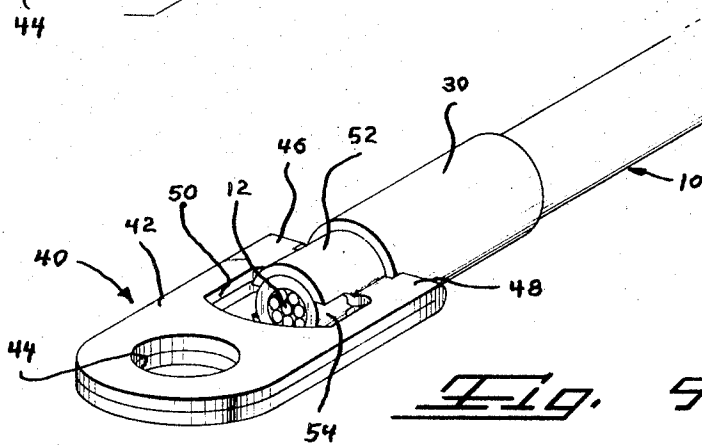
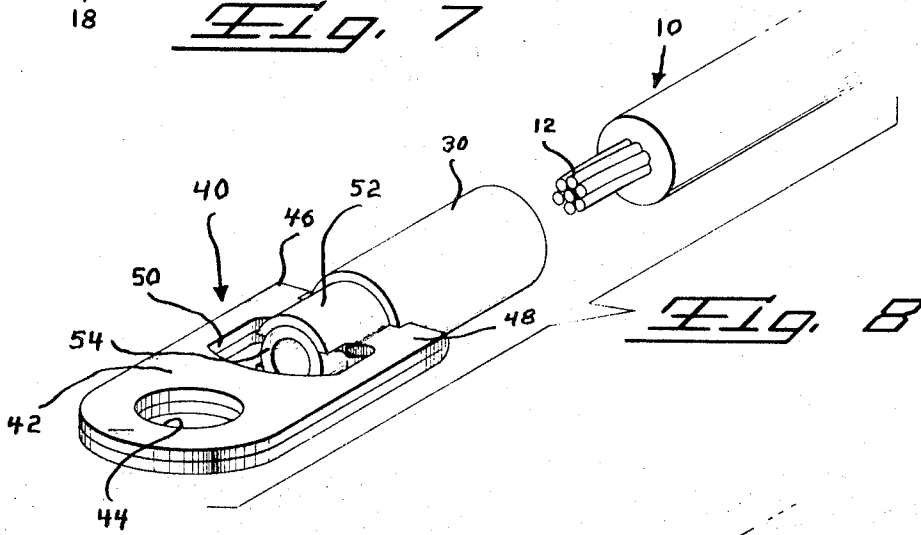
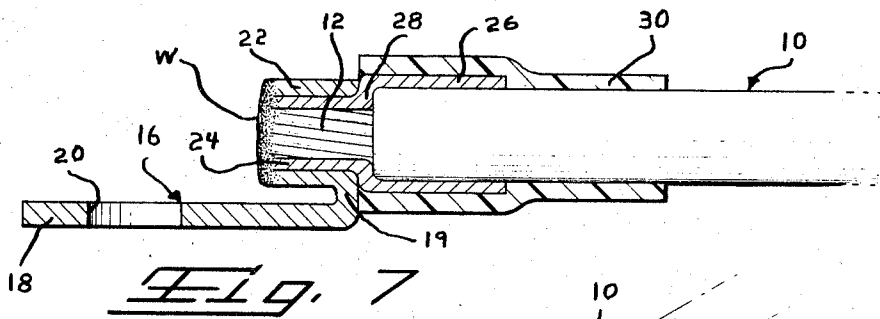
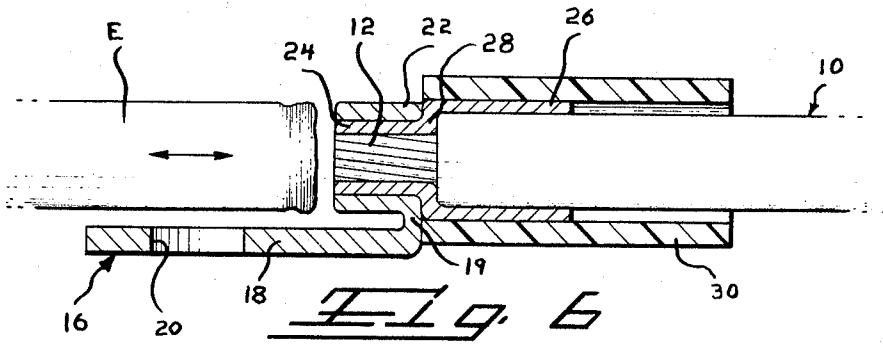
A terminal is disclosed which includes an inner sleeve portion adapted to receive a conductive lead inserted therein and an outer sleeve portion surrounding the inner sleeve portion with the sleeves arranged, relative to parts of the device which connect to other terminals, to permit a welding operation providing a weld of improved characteristics. In one embodiment for use in terminating aluminum wire the inner sleeve is made of aluminum and the outer sleeve is made of a different material such as a copper base metal alloy to provide a connection of dissimilar materials. A heat sensitive insulating sleeve is used to provide a seal of conductive interface and wire support, the sleeve being actuated by the heat of welding transferred through terminal sleeve portions.

18 Claims, 15 Drawing Figures



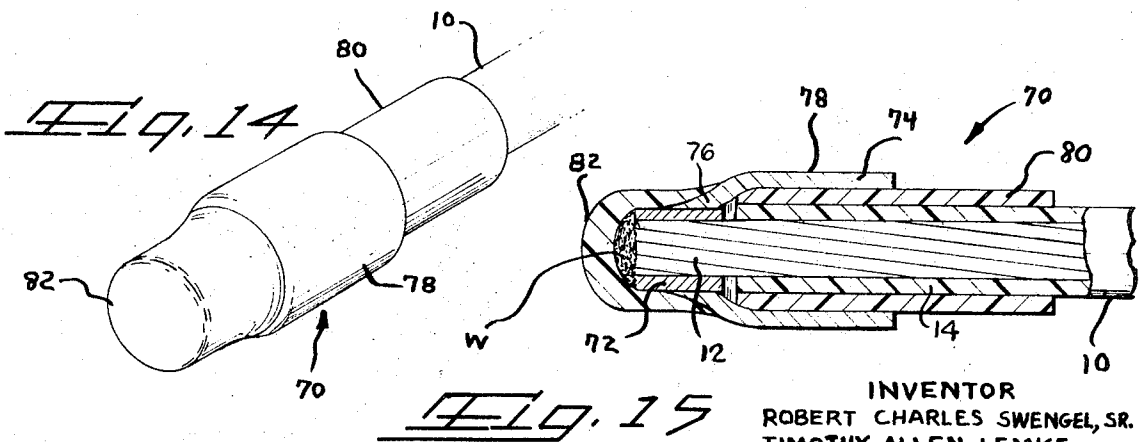
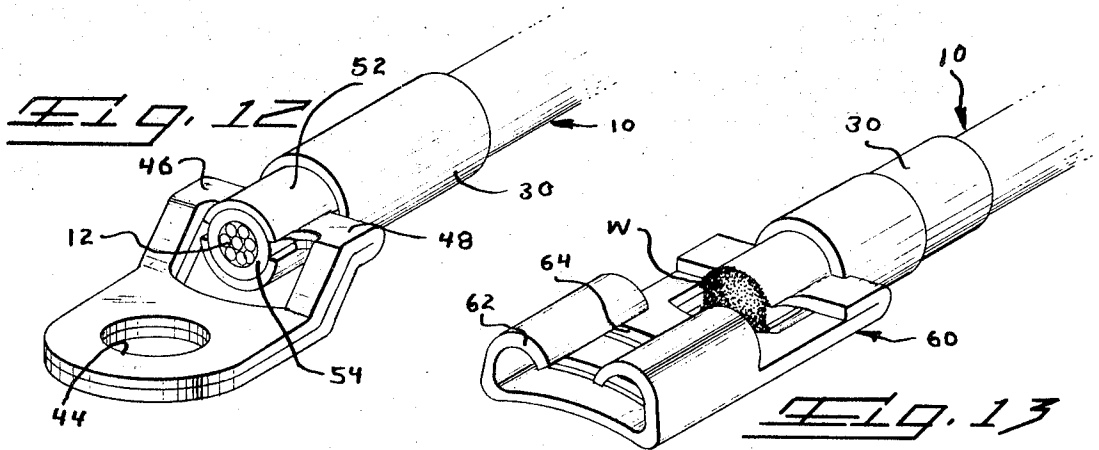
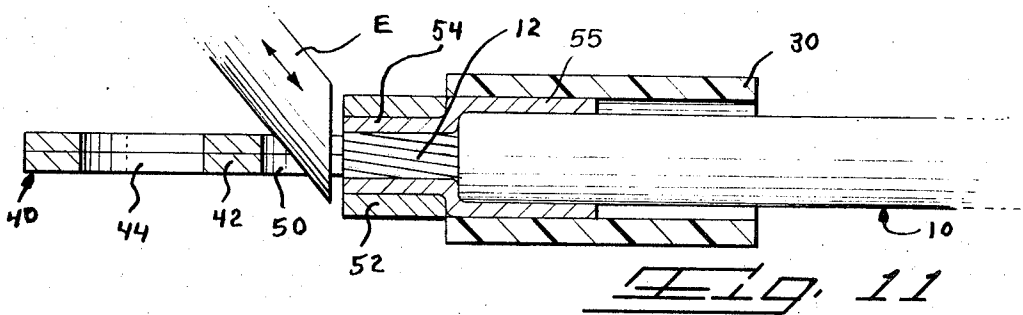
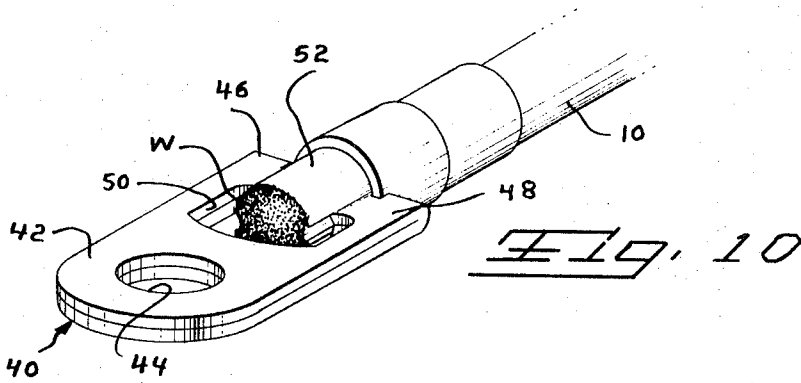


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TERMINAL DEVICE FOR WELDED TERMINATION OF ELECTRICAL LEADS

This is a continuation of application, Ser. No. 720,775 filed Apr. 12, 1968, now abandoned. cBACKGROUND OF THE INVENTION

A considerable effort has been made to provide welded terminations of electrical leads. The effort has had to face a number of problems having to do with the complexity of welding apparatus employed and the difficulty of achieving a weld which is sound and which may be quickly and easily repeated on a production basis with respect to the two elements to be welded together; namely, the terminal and the electrical lead. Underlying this latter problem is the fact that the two pieces to be welded together must be positioned and held quite accurately in a proper relationship, prior to the initial phase of the welding operation employed, during the welding operation, and thereafter until the weld material has cooled sufficiently to harden and avoid any displacement and accompanying fissure or fracture.

In U.S. Pat. No. 2,794,176 to W. A. Barnes, granted May 28, 1957, a terminal construction is disclosed which utilizes a deformable wire clamp portion of a terminal to mechanically grip a conductor wire and hold it in a proper position for tip welding, forming a union between the body of the terminal and the wire to a spur struck out of the body of the terminal and made to extend away from such body. The terminal configuration of Barnes aids in the welding process and thereafter operates to position the situs of the weld in the manner to prevent transmission of mechanical shock. The terminal is thus both crimped and welded. A review of the Barnes patent will evidence that the terminal configuration is not readily amenable to the more standard assembly procedures wherein a stripped wire is poked into a terminal sleeve, either manually or by some machine assembly apparatus. The end of the wire in Barnes is first bent up and laid against the end of the spur where the weld will be made with the portions of the terminal then being crimped down to engage the wire and/or the surrounding wire insulation.

A particular problem raised by the expanding use of aluminum for conductors is one of welding dissimilar materials. In certain applications solid or standard aluminum wire must be terminated to a terminal made of brass or some other copper based alloy which in turn is utilized to interconnect to leads or terminal blocks having a conductive material of some copper based alloy such as brass. Alternatively, a copper wire, solid or stranded may of necessity need to be terminated into some circuit containing essentially aluminum alloy conductive terminals or wires. The problem with welding aluminum to copper based alloys is well-known.

SUMMARY OF THE INVENTION

This invention relates to electrical terminal devices, particularly adapted for use with welding techniques and also particularly adapted for use in welding dissimilar conductive materials, such as aluminum to copper.

It is an object of the invention to provide an electrical terminating device which may be quickly and easily positioned in a standard manner relative to an electrical lead for welding thereto.

It is a further object to provide an electrical terminating device having a configuration resulting in a weld of the device to an electrical lead forming a union therebetween of improved mechanical and electrical characteristics.

It is still another object of the invention to provide a terminating device of a construction and configuration particularly adapted for use in welding a device to an electrical lead wherein the device and the lead are of dissimilar conductive materials such as aluminum and copper or copper based alloys.

The invention overcomes the foregoing problems and obtains the foregoing objectives by a geometry which includes a body portion adapted to be terminated to some other connecting means. The body portion is made to extend from a sleeve

surrounding a further and nonintegral sleeve into which is fitted the lead to be terminated. The sleeves are both positioned relative to the body portion so that a weld of the ends of the sleeve and of the end of the lead may result in a weld which is generally symmetrical and evenly applied to the various sleeve and lead elements. In an embodiment for use with dissimilar conductive materials the outer sleeve and terminal body are formed of one material and the inner sleeve is formed of a material of which the lead is comprised. The sleeves are preferably joined together mechanically and electrically by forging, crimping or the like, prior to use, as in some production step when initially fabricated. The inner sleeve is of a configuration to guide insertion of the lead and to properly align the end of the lead for welding by an engagement with the lead insulating sheath. The invention terminal construction results in the ends of the sleeves and the end of the lead being flush with the resulting weld formed of materials from each of the different elements, the sleeves and the lead, providing a weld bead of a partially spherical shape with an alloy of the different materials extending fully around the weld bead.

In the drawings:

FIG. 1 is a perspective of one embodiment of the terminal device of the invention with an electrical lead positioned for insertion therewithin;

FIG. 2 is a view of the device of FIG. 1 with the lead inserted therein;

FIG. 3 is a view of the device of FIG. 2 following welding;

FIGS. 4-7 are side views in partial section showing the embodiment of FIGS. 1-3 during assembly of the device to a lead and welding of the device and lead together;

FIGS. 8-10 are perspective views depicting an alternative embodiment of a terminal in accordance with the invention showing the terminal and lead before insertion, after insertion and after welding, respectively;

FIG. 11 is a side view in partial section of the terminal embodiment of FIGS. 8-10 showing a welding electrode being applied to the device;

FIG. 12 is a perspective view of an alternative embodiment of a terminal similar to that of FIGS. 8-10 but deformed to provide axial access to the weld site;

FIG. 13 is an embodiment of a terminal adapted for welding but including a spring portion formed of the weld site;

FIG. 14 is a perspective view of a terminal embodiment having a contact area behind the weld site; and

FIG. 15 is a longitudinal section of the terminal of FIG. 14.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring to FIG. 1, an electrical lead 10 including a core of conductive strands 12 surrounded by an insulating sheath 14 is shown positioned for insertion in a terminal device 16 constructed in accordance with the invention. The terminal device 16 includes a body portion 18 having an aperture 20 therein through which may be inserted a screw member such as the screw member found on a typical terminating block. The other end of body 18 is formed upwardly as at 19 and then into a cylinder 22 which is made to extend back out over the portion of the body in spaced relation thereto. Positioned within sleeve 22 and extending therealong is a portion of a sleeve 24, the end of which is made flush with the end of 22. The sleeves 22 and 24 are preferably mechanically locked together as by forging, crimping or the like during initial assembly. As shown in FIG. 4, sleeve 24 is flared outwardly to an enlarged diameter to include a portion 26, the flaring forming an annular flange 28. An insulation sleeve 30 is positioned over the portion 26 of sleeve 24 and is made to extend rearwardly of the sleeves. Sleeve 22 is made long enough to adequately support sleeve 24 against relative movement and to hold such sleeve in a position to receive the insertion of the lead core 12. The interior diameter of the first portion of 24 is made to be approximately equal to or slightly larger than the diameter of 12 so as to slidingly receive 12. The flared portion

28 is preferably slightly beveled to guide the ends of 12 within 24. The interior diameter of 26 is made to be approximately equal to or slightly larger than the diameter of the lead sheath 14 so as to receive such sheath when inserted in the manner depicted in FIGS. 4 and 5. The lengths of the inner sleeve portion 24 and outer sleeve portion 22 are controlled relative to the stripped length of the lead 10 so that as the lead is inserted and seated within terminal 16 the end of 12 is left flush with the ends of sleeve 22 and the forward portion of sleeve 24 in the manner shown in FIGS. 4 and 5. Those skilled in this particular art will recognize that the terminal 16 calls for an insertion which is relatively standard in that there is only axial movement of the lead relative to the device required to perfect a preliminary assembly of the lead with the terminal. The configuration and dimensions of the portions of the terminal are so arranged as to assure a proper positioning of the lead in the terminal relative to a subsequent welding step.

FIG. 6 shows a welding electrode E positioned in alignment with the site to be welded, concentric or coaxial with the ends of the first and second sleeves and the end of the lead 12. FIG. 7 shows the terminal of the lead welded together by a weld bead shown as W. While a number of types of welding procedures are contemplated, a preferred technique is described in U.S. application, Ser. No. 433,350 filed Feb. 17, 1965, now U.S. Pat. No. 3,524,963, issued Aug. 18, 1970, in the name of R. C. Swengel entitled METHOD AND MEANS FOR STRIKING AN ARC, AND FOR STRIKING AN ARC FOR WELDING OR HEATING. Using the technique described in such application the power supply could be connected between the welding electrode E and the sleeve 22 through a connection to the body 18 of the terminal at any suitable point thereon. After this connection is made the electrode E is brought into contact with the face of the weld site and then drawn away therefrom with the power supply then being at a low voltage to initiate an arc across the pieces. As this arc is struck a triggering voltage is developed and utilized to discharge a capacitor developing a relatively high current flow between the electrodes and the sleeve to result in a weld.

As previously mentioned, an improved weld results when the melted materials are permitted to form a spherical shape without relative movement between the pieces being welded together. During welding the melted materials exhibit a considerable agitation down within the melt. Any movement of the part may disturb this to alter the mixing or alloying of the metals of the pieces. The configuration of the terminal of the invention enhances forming a desired shape and facilitates stabilizing the welded elements. The configuration of the body portion 18 relative to being joined to the sleeves at a point away from the weld site through the web 19 precludes a weakening of the body which might result if any of the metal thereof were melted or closely positioned relative to the weld site. Perhaps more importantly, the configuration of the terminal of the invention eliminates to a large extent the possibility of compromising the weld geometry by having a portion thereof extending out onto the body portion. FIGS. 3 and 7 represent generally the weld bead configuration resulting from the invention structure. Within the weld bead there is a mixture of the metallic materials of the different sleeves and the wire. This mixture occurs in a circular pattern and operates to fuse the sleeves and the lead together forming an electrical union therebetween. The weld bead also forms a mechanical union which very substantially resists pull-out or fracture due to mechanical stresses. Note that the wire extends through supporting portions which tends to stabilize the wire with the weld site itself located at a point relatively remote from the support portions or from any other portion from which fracture and stresses could arise. The weld acts as sort of a head which would be required to be pulled through the sleeve 22 for axial separation of the body from the lead. Note that bending of the body portion 18 which is the most frequent occurrence of bending with terminals of the type depicted, will result in a stress applied to the rear of the sleeve 22 and not at any point common with the weld bead.

In FIG. 7 the sleeve 30 is shown shrunk down on the sleeve portion 26. It is contemplated that heat shrinkable tubing may be utilized with the terminal of the invention activated by the heat of welding transmitted by the inner sleeve to the tubing. Note that in the invention embodiment the sleeve which effects the transfer of heat for such purpose is in direct contact with the weld. It is also contemplated that plastic materials of relatively low melting point may be utilized within the sleeve 24 to be activated by welding heat to bond to the insulation of the lead and seal the termination from the rear to provide additional isolation and through insulation.

In applications requiring an electrical junction between dissimilar materials the construction of the terminal device 16 may be made with the body and sleeve 22 of one material and the sleeve 24 of another material. For example, if the lead has an aluminum core 12 the sleeve 24 may be made of aluminum with the sleeve 22 and body 18 being formed of a copper based alloy such as brass, which in typical practice will be plated and in use will be mated to an electrical circuit which is of a similar material, including for example, copper leads and brass terminal posts.

Alternatively, if the core of the lead is of tinned copper and the terminal must be utilized to mate with a system which is essentially of aluminum or some alloy thereof, sleeve 24 may be made of a copper based material such as brass with the body 18 and sleeve 22 formed of aluminum. In either of the two preceding examples there will occur in the weld bead an interface of similar materials toward the center of the weld zone welding the lead core to the inner sleeve. There will also occur an annular interface of dissimilar materials between the outer sleeve, the inner sleeve and perhaps a limited amount of the core. The interface between dissimilar materials will not, of necessity, be clearly defined but will be limited with some band of alloys of the dissimilar materials extending around the weld bead. The resulting structure has a mechanical configuration which causes the weld bead to better resist fracture and pull-out than is the case in applications wherein the two members to be welded are merely placed together in an abutting relationship.

FIG. 8 shows an alternative embodiment including a terminal device 40 having a body 42 extending outwardly carrying an aperture 44 for use with a screw type terminal post or the like. The body 42 is branched to include two legs 46 and 48, and a relief 50 providing access to the weld site. Between legs 46 and 48 is an integral outer sleeve portion 52 which extends back out toward body 42 and which effectively surrounds a further sleeve 54. The sleeve 54 is of a geometry better shown in FIG. 11. A sleeve portion 55 flared outwardly from sleeve 54 extends to the rear of 54 in the manner shown in FIG. 11. The terminal 40 achieves the advantages above described relative to the terminal 16 through a slightly different structure. FIG. 10 shows 40 welded to a lead and FIG. 11 shows 40 in use with a lead installed therein and an electrode E being positioned to effect a weld.

FIG. 12 shows a terminal like 40, but including a bend in the legs 46 and 48 which position the main body 42 and aperture 44 clear of the end of the sleeves to facilitate access to the weld site by the welding electrodes. FIG. 13 shows still a further embodiment of a terminating device in accordance with the invention and is included to evidence that the outer sleeve and the body portion may be formed of spring stock so as to provide an interconnection requiring spring action. The terminal shown as 60 includes forward portions curled over as at 62 which provide a limited spring movement tending to force a space lug inserted therewithin in engagement with contacting ribs shown as 64. It will be understood that the embodiments shown in FIGS. 12 and 13 both have the same interior construction as the terminal device 40 shown in cross section in FIG. 11 to the right of electrode E.

The embodiment of FIG. 13 also demonstrates another advantage of the invention. It may be that the material of a particular lead of use has characteristics which are not compatible with a terminal material permitting a forming of terminal

devices which require spring characteristics. For example, aluminum alloys which are utilized for solid or stranded wire do not readily permit forming of members which have spring characteristics which are adequate for most electrical applications. In accordance with the invention the inner sleeve can be made of an appropriate aluminum alloy with the outer sleeve being made of spring grade brass to provide the required function. As a further point, the forward terminating portion in any terminal may, in certain applications, be required to be frequently connected and disconnected. In this event it is important that the material be kept free of insulating oxidation or corrosive action which will develop insulating materials on the surface thereof. Oxidation occurs in aluminum very quickly and aluminum oxide is an insulator. The invention concept facilitates using a composite structure having one portion of a proper material to be terminated to the lead and the other portion of a material which either itself or through a plating deposited thereon is intended to provide a low resistance mating contact in repeated use and exposure.

In the embodiment represented in FIGS. 14 and 15 the foregoing advantage is illustrated as applied to a pin type terminal which is plugged into a socket (not shown) to provide a mateable connection. The terminal device 70 includes an inner sleeve 72 which is dimensioned to receive the wire core 12 of lead 10. An outer sleeve 74 is fitted over 72 and joined thereto by crimping or the like as at 76. The sleeve 72 is made to extend well forward of outer sleeve 74 and 74 is made to provide a contact surface 78 of larger diameter so that terminal device 70 may be plugged into a contacting engagement in a contact receptacle without disturbing the sleeve 72 or the weld bead W. The device 70 would be welded in accordance with the technique previously described. The device 70 may include a rear insulating sleeve 80 fitted beneath sleeve 74 and out over the lead sheath 14 and also a snap or insulating cap 82 fitted over a weld site to seal the weld site from an environment of use. The device 70 is contemplated as having a utility for copper to copper or brass, aluminum to aluminum or aluminum to copper terminations. For example in a termination of aluminum wires the sleeve 72 would preferably be of aluminum with sleeve 74 being of copper or brass. The sleeve 74 could be plated with nickel or gold in the contact area 78 to provide a low resistance interface with a mating contact receptacle. In such event the use of the sleeve 80 and cap 82 would be preferred and, additionally, such caps should be made to either contain a sealant or be melted to seal the aluminum-copper interface between sleeves 72 and 74. The sleeve 80 may be made of heat sensitive plastic so as to shrink down over the sheath of the wire to provide mechanical support and/or expand within 74 to provide a seal of the interface between 72 and 74 responsive to the heat of welding.

Having now disclosed the invention in terms intended to enable a preferred mode of practice thereof, we define it through the appended claims.

What is claimed is:

1. A terminal device welded to a lead end comprising:
 - an outer conductive sleeve,
 - an inner conductive sleeve within and contacting said outer conductive sleeve,
 - the ends of said sleeves being flush with each other,
 - a lead end received in said inner sleeve and flush with the ends of said sleeves,
 - a terminal body extending longitudinally of said sleeves and in spaced relationship from said flush ends of said lead and said sleeves,
 - means spaced from said flush ends of said lead and said sleeves and connecting said terminal body and said outer sleeve for exposing said flush ends of said lead and said sleeve in spaced relationship from said terminal body, and
 - a weld entirely over and electrically connecting said exposed flush ends of said lead and said sleeves, said means and said terminal body being spaced from said weld, whereby said weld is capable of being formed by a welding electrode contacting only said exposed flush ends of

said lead and said sleeves without contacting said means or said terminal body.

2. The structure of claim 1 wherein, said terminal body extends generally coplanar with the longitudinal axis of said outer sleeve.
3. The structure as recited in claim 1, wherein, said terminal body is laterally offset from the longitudinal axis of said outer sleeve.
4. The structure of claim 1, and further including:
 - a flange portion on said inner sleeve engaged against said outer sleeve for registering the ends of said inner and outer sleeves in said flush relationship.
5. The structure as recited in claim 4, wherein, said lead includes an insulation sheath terminating at said lead end and engaged against said flange.
6. The structure as recited in claim 1, wherein, said means includes at least one leg integral with said terminal body and connected laterally to said outer sleeve in spaced relationship from the flush ends of said inner and outer sleeves.
7. The structure as recited in claim 6, wherein, said terminal body extends generally coplanar with the longitudinal axis of said outer sleeve.
8. The structure as recited in claim 6, wherein, said terminal body is laterally offset from the longitudinal axis of said outer sleeve.
9. The structure as recited in claim 1, wherein, said means includes a pair of legs extending from said terminal body and attached laterally to and on opposed sides of said outer sleeve and further including: a relief portion defined between said legs, said flush ends of said lead and said sleeve projecting into said relief and thereby permitting contact of said flush ends by a welding electrode without contacting the legs or the terminal body.
10. The structure as recited in claim 9, wherein, said legs include bevel portions, said terminal body being connected off-set laterally of said outer sleeve longitudinal axis by said legs.
11. The structure as recited in claim 10, wherein, said terminal body, said legs and said outer sleeve are formed from a single piece of metal, two portions of said metal being doubled back one over the other with both of said metal portions being formed with adjacent semi-cylindrical configurations defining said outer sleeve.
12. The structure as recited in claim 11, wherein, both of said metal portions additionally define said legs.
13. The structure as recited in claim 11, wherein, said metal portions additionally define said legs and said terminal body.
14. The structure as recited in claim 9, wherein, said terminal body extends generally coplanar with the longitudinal axis of said outer sleeve.
15. The structure as recited in claim 9, wherein, said terminal body is laterally offset from the longitudinal axis of said outer sleeve.
16. An electrical connection comprising:
 - a lead end portion,
 - an inner sleeve receiving said lead end portion with the end of said sleeve being flush with the lead end,
 - an outer sleeve receiving and contacting said inner sleeve along an interface with the flush ends of said inner sleeve and said lead projecting from said outer sleeve,
 - a contact surface of relatively large diameter on said outer sleeve and in spaced relationship from the flush ends of said inner sleeve and said lead, and
 - a reduced diameter terminal means in the form of a cap covering the projecting flush ends and also covering said inner sleeve and the interface between said inner and outer sleeves.
17. The structure as recited in claim 16, and further including: an insulating sleeve received in said outer sleeve and encircling said lead.
18. A terminal device welded to a lead end portion, comprising:
 - an outer conductor sleeve,
 - an inner conductor sleeve within and contacting said outer conductor sleeve,

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the ends of said sleeves being flush with each other,
a lead end received in said inner sleeve and flush with the
ends of said sleeves,
a terminal body in spaced relationship from said flush ends
of said lead and said sleeves,
means connected between said terminal body and said outer
sleeve for attaching said terminal body to said outer
sleeve in spaced relationship from the flush ends of said
lead and said sleeves, and

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a weld extending entirely over and electrically connecting
said flush ends of said lead and said sleeves, said means
and said terminal body being spaced from said weld, and
said weld capable of being formed by a welding electrode
contacting only said exposed flush ends of said lead and
said sleeves without contacting said means or said ter-
minal body.

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