United States Patent

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[54] **ELECTRICAL CONNECTOR WITH SPRING BIASED SOLDER INTERFACE**
5 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** ..... **339/223 R,** 339/213 T, 339/250, 339/255 R, 339/275 T
[51] **Int. Cl.** **H01r 15/12,** H01r 5/04
[50] **Field of Search** 339/30, 95, 102, 210, 223, 250, 255, 258, 275, 213; 174/81; 228/56

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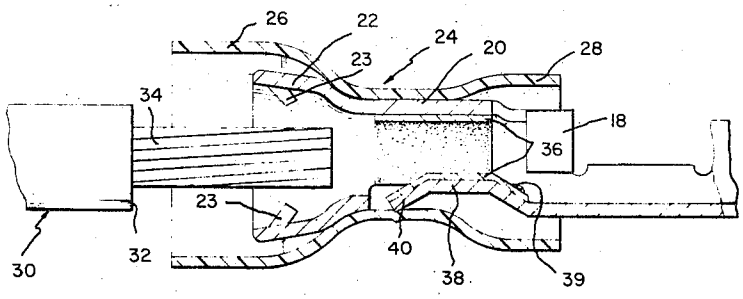
ABSTRACT: An electrical connector-terminal device is disclosed which features a conductor lead receiving barrel lined with solder and containing spring means adapted to be loaded by lead insertion to force the lead into engagement with the solder prior to and during solder reflow as effected by heat applied to the device. The barrel includes a stop and projections which operate in conjunction with the spring means to mechanically stabilize the lead during solder reflow. A heat shrinkable sleeve is applied over the region of joint between the lead and the device to prevent solder escape and to seal the joint relative to the insulating sheath of the lead terminated thereby.



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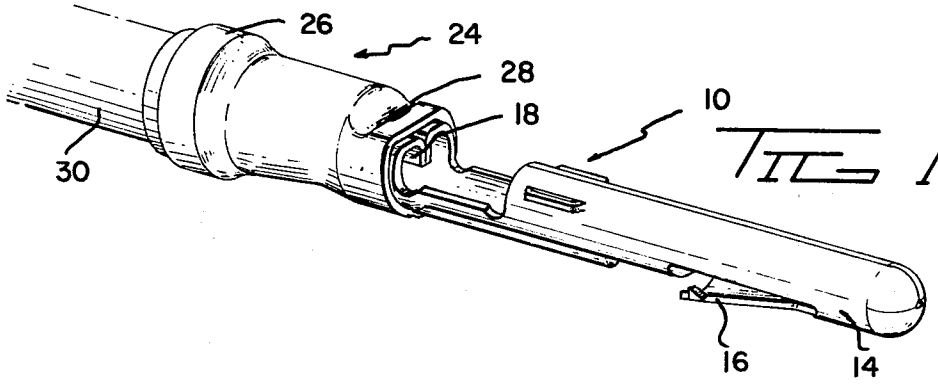

FIG 1

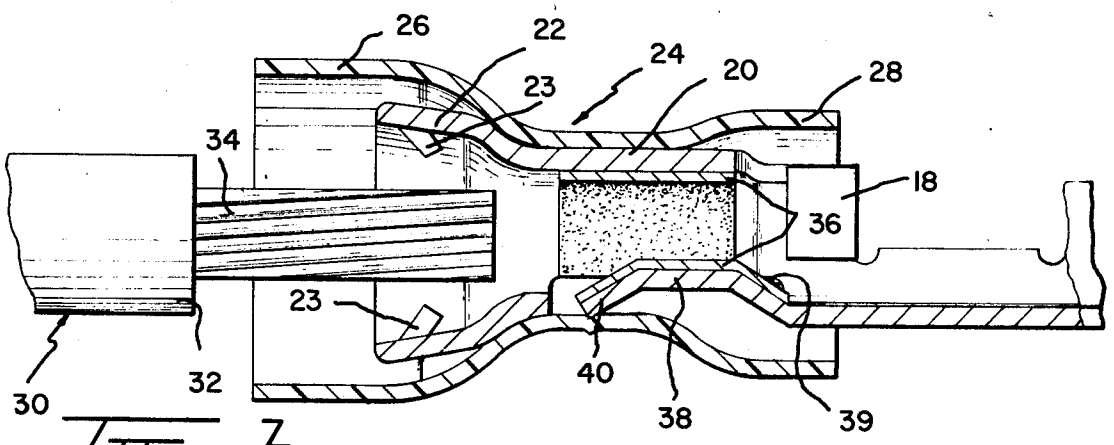

FIG 3

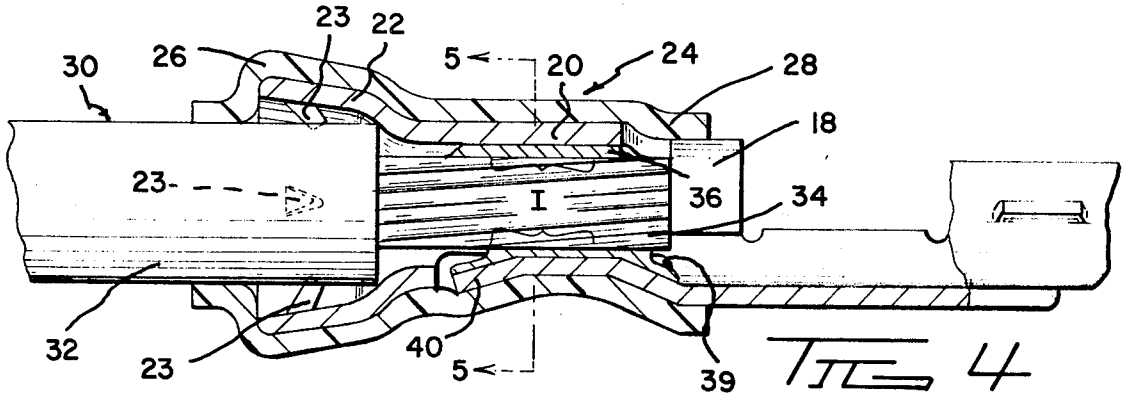

FIG 4

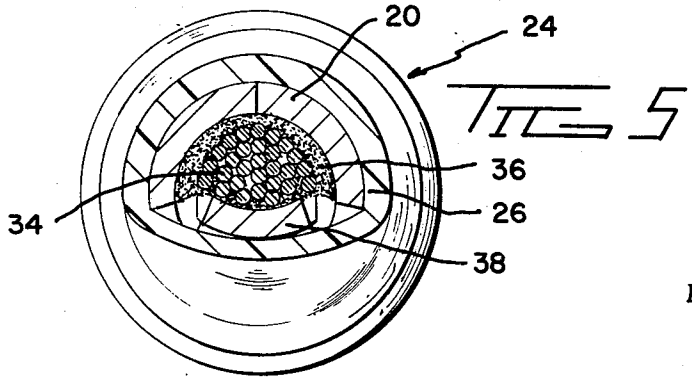

FIG 5

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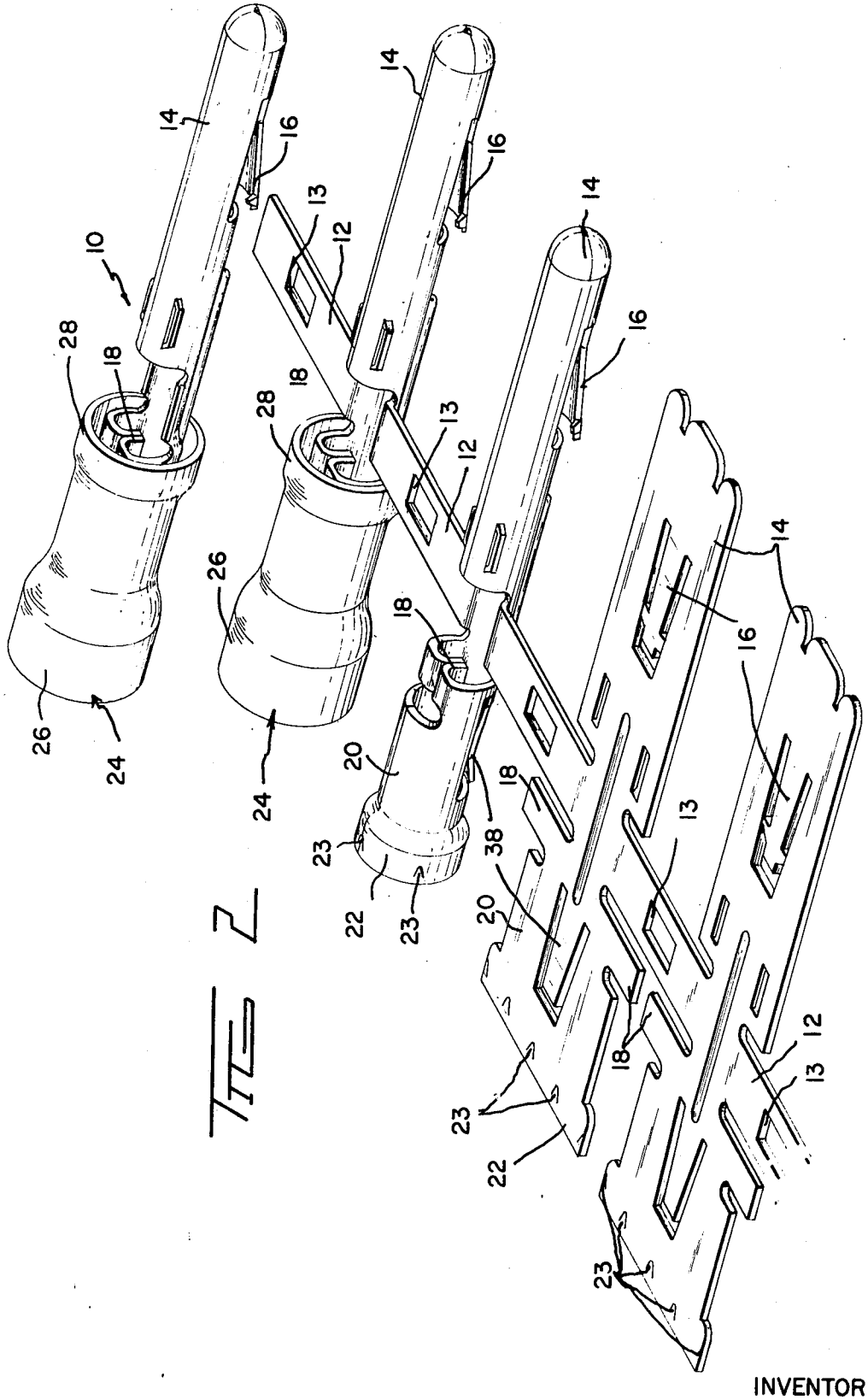

FIG. 2

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ELECTRICAL CONNECTOR WITH SPRING BIASED SOLDER INTERFACE

BACKGROUND OF THE INVENTION

Electrical connectors are known which feature a connector body carrying a heat shrinkable plastic insulating sleeve which serves to contain the movement of a strip of preplaced solder when heat is applied to effect a joint between a lead and the connector body. The plastic sleeve is utilized to press or force the lead wire into the molten solder while controlling and limiting the flow of solder to a region around the lead. Since sufficient heat must be used to reflow the solder, the plastic insulating material utilized must have characteristics in the appropriate temperature range to not only shrink down but to also properly force the lead wire and confine the solder while the sleeve shrinks. This places a design limitation upon the choice and type of plastic insulating material employed. As an additional point, when soldering two elements together it is preferable to have the two elements pressed firmly into engagement prior to the time the solder actually melts in order to better transfer heat to the surfaces of the elements to be soldered. It is also preferable to maintain the elements against moving as reflow occurs and while the solder cools to a hardened state. The amount of force which can be generated by shrink-type tubing in the process of shrinking, is generally quite limited.

SUMMARY OF THE INVENTION

The present invention relates to a solder-type electrical connector-terminal device utilized to interconnect electrical leads.

It is an object of the invention to provide a connector-terminal device of a construction which facilitates making solder joints at high production rates. It is another object to provide a solder-type connector-terminal which minimizes soldering skills. It is a further object to provide a solder-type connector-terminal device of a construction which stabilizes the surfaces being soldered automatically and facilitates the transfer of heat to effect solder reflow better than devices heretofore available.

The present invention achieves the foregoing objectives through a connector-terminal construction blanked out of flat sheet metal stock containing a strip of solder suitably affixed to a portion of the surface area thereof, with the sheet metal blank being subsequently formed into a barrel containing one or more spring elements. The barrel is dimensioned to receive a conductive lead wire inserted therewithin with the spring element or elements being loaded by such insertion. Tangs struck into the barrel cooperate with a wire stop to hold and stabilize the wire while heat is applied to reflow the solder and join the wire to the barrel. The spring element serves to force the surface of the wire and the surface of the barrel into a firm engagement to better conduct heat to the surfaces to be soldered. When sufficient heat has been generated to effect solder reflow, the spring acts to force the solder against the lead wire and into and between the strands thereof. A heat shrinkable sleeve applied in an expanded form over the barrel of the device is caused to shrink down to effect a seal around the insulation of the lead wire and prevent solder from escaping and creating a shorting path. The shrinkable sleeve plays no part in either pressing the wire into engagement with the barrel or effecting flow of the solder. It does insulate the joint at the rear of the termination.

In the drawings:

FIG. 1 represents a perspective view of a connector-terminal device terminated to a lead wire;

FIG. 2 represents a progression from blank to the assembled device shown in FIG. 1;

FIG. 3 depicts in cross section the barrel portion of the device, enlarged from the view shown in FIG. 1, with the stripped end of a lead wire positioned for insertion into such barrel portion;

FIG. 4 depicts the device and lead wire shown in FIG. 3, but fully inserted and terminated thereto; and

FIG. 5 is a cross section taken along lines 5—5 of FIG. 4.

Turning now to FIG. 1, a connector device 10 is shown terminated to a cable 30. FIG. 2 shows the device as blanked (to the lower left) from flat sheet metal stock, as formed (to the center), with an insulating sleeve applied and then as severed from a carrier (to the upper right). The carrier 12 includes indexing holes 13 which are utilized to index a series of devices during the manufacture thereof and thereafter in automatic terminating equipment, providing wire insertion and movement of a series of devices to a heat applying station. Either before or after termination to a wire, depending upon the type of automatic equipment employed, carrier 12 is severed at the juncture thereof as indicated in FIG. 2. Device 10 includes a forward contact portion 14 containing a latching element 16, adapted to cooperate with an offset in an insulating block to hold the device in operative position. Device 10 represents a male pin part of a connector and there would be a female portion similar to 10, but adapted to receive the end portion of 10 inserted therein. Viewing FIGS. 1 and 2, just to the left of junction of carrier 12 are a pair of folded-down portions, which serve as a wire stop 18 to accurately position the lead wire inserted within a barrel 20 formed at the rear of the device. Such barrel is flared at the outboard end as at 22, to facilitate a lead wire insertion. A series of tangs 23 are provided in 22 to bite into the lead wire insulation and hold an inserted lead wire in against stop 18. Overlying the barrel 20 is a sleeve of insulating material 24 which is preferably of a heat shrinkable material having an expanded configuration as shown in FIGS. 1 and 3 and a configuration following the application of adequate heat, as shown in FIG. 4. Within the base of the wire barrel 20 is a spring 38 which is positioned to extend into the interior of the barrel 20 to be loaded by wire insertion to press the lead wire against interior barrel surfaces.

FIG. 2 depicts a blank formed from flat sheet metal stock having a strip of solder material 36 applied to the upper surface thereof prior to blanking and forming of the stock. The solder strip may be laminated to the stock by heated rollers. The configurations shown in FIG. 2 may be achieved by passing the laminated stock through appropriate progressive dies to blank material and define the various portions of each element as identified by numerals common with the other views in the drawings. Following the blanking operation the stock may be rolled and formed and the insulating sleeve added as shown in FIG. 2.

Referring now to FIG. 3, the barrel or rear portion 20 is shown just preparatory to the insertion of a lead 30 comprised of an insulating sheath 32 and conductive strands 34. The lead is stripped so as to expose a sufficient portion of strands 34 to fit within the wire barrel when the ends of the strands abut wire stop 18. As can be seen from FIGS. 2 and 3, the solder lamination 36 is extended around the interior portion of the wire barrel 20, including the surface of spring 38. The free end of spring 38 is turned downwardly as at 40 to avoid catching on the end of the strands 34, as the lead is inserted.

The spring 38 is joined to the base of the stock from which connector device 10 is formed at a point 39 near or under the inner surface of wire stop 18 and is deformed upwardly to present a relatively flat surface extending well into the interior of the barrel for engagement with the lead wire. The configuration given to spring 38 makes the spring relatively stiff and its position as shown in FIG. 3 constricts the wire barrel relative to the diameter of the lead wire so that as the lead wire is inserted to be stopped by the wire stop 18 the spring is loaded to tightly and firmly grip the lead wire within the barrel 20. The tangs 23 are oriented to hold the lead wire axially in against wire stop 18. Since the spring itself contains a solder surface there are at least two regions shown as 1 in FIG. 4 wherein an interface between the lead wire and the terminal is maintained in a tight, firm grip. As will be appreciated by those familiar with soldering skills, the maintenance of the two surfaces to be soldered under force is highly desirable prior to

actual solder reflow. This is so because such a condition better assures heat conduction to the surfaces to be soldered. As the solder **36** is caused to go from a solid to a liquid state it is necessary to maintain the interfaces to be soldered in a relatively fixed position until the level of heat applied is dropped to allow the solder to cool and harden. In accordance with the invention concept, as evidenced in FIG. **4**, spring **38** is given a dimension and position to maintain a force against the lead wire while heat is being conducted to the surfaces to thus improve heat conduction. Once solder **36** has started to flow the spring **38** serves to force the solder in the top and bottom regions of the barrel against the wire pushing the solder into the interstices of the lead wire stands. Spring **38** is made so as to maintain a spring force, although reduced, once solder has been displaced by reflow and to hold the wire against movement until the solder has hardened. Spring **38**, stop **18** and tangs **23** thus work together to stabilize the surface of the wire relative to the surface of the barrel during reflow.

FIGS. **4** and **5** show the interface resulting from solder reflow utilizing the invention device. As depicted in FIG. **4**, the heat shrinkable sleeve **24** is caused to shrink down tightly around the wire barrel and into engagement in the region shown as **26** in FIG. **4**, with the insulating sleeve **32** of the lead wire. The sleeve in the forward end **28** also shrinks down to conform to the exterior configuration of the barrel and lock the sleeve to the barrel. End **28** is made sufficiently long so as to assure that no solder droplets will extend exteriorly of the sleeve to form a site for a possible short circuit. In accordance with the invention concept, devices like **10** may be utilized with the source of heat being applied to the carrier **12** proximate its junction with the body of the device and to the wire stop structure **18**, the heat being conducted to the interior of the wire barrel and causing solder reflow. This source of heat, and if desired an additional source of heat, such as a blower directed onto the sleeve, may be employed to cause shrinkage of the sleeve **24** into position. Following reflow the carrier may be severed from the device with the lead then being utilized in an appropriate connector. It is also contemplated that devices may be utilized in loose-piece form with heat being applied by a suitable means to the floor of the terminal ahead of the wire stop and to the wire stop for conduction to the interior of the barrel to effect solder reflow.

It is contemplated that numerous standard types of solder may be employed, although true eutectics are preferred which have a quick transition rate from solid to liquid to solid form. In a preferred embodiment the solder should be capable of being applied to the flat stock and withstanding subsequent operations of blanking, rolling and forming to the configuration shown without parting from the base material. In an actual embodiment using a base material of brass about 0.014 of an inch thick a solder lamination about 0.007 of an inch was employed. The solder was SN63-37P6.

While the invention has been illustrated with a single spring element **38**, the invention contemplates the use of two or three or more spring elements made to extend into the area of the wire barrel portion and effect a tight gripping of the lead wire inserted therein to better assure heat conduction and to press reflowed solder into the interstices of the strands of wire employed with the device. The invention also contemplates a use in connectors and/or terminals of different configurations adaptable to mounting in connector blocks or on insulating or printed circuit boards. In such uses the invention device would have a contacting element appropriate thereto. In other words, the invention device would have a front end different from **14** in accordance with the given application. The front end then might be in the form of an eyelet mounted in the aperture of a printed circuit board or in the form of some post staked into a connector block or board. It is also contemplated that splices may be effected utilizing a modification of the invention to contain essentially two of the wire barrels. In other words, the device would be comprised of wire barrels like **20** in lieu of the pin portion **14**. For busing applications, the invention could be utilized by providing a series of wire barrels like **20** without any forward portion such as **14** but left joined by the carrier strip which serves as the medium of electrical and mechanical connection between multiple barrels.

Having now disclosed my concept for a connector-terminal device of the solder-type, I define what is believed as inventive through the appended claims.

1. A device for connecting and/or terminating electrical lead wires including a body formed of metal to define a forward connection portion and a wire receiving barrel portion, the said barrel portion including on an interior surface thereof a layer of solder, at least one spring element extending into said barrel portion, the interior cross-sectional diameter of said barrel portion between the interior surface of said spring element and the opposing wall surfaces of said barrel portion being appreciably less than the outer diameter of a lead wire to be inserted therein, whereby to engage and firmly grip the conductive strands of a lead wire inserted within said barrel portion and to maintain a force better assuring the conduction of heat to effect solder reflow, thereby joining the lead wire to the device, said barrel portion further including stop means extended over the end thereof opposite to the end of insertion of the lead wire, said stop means serving to accurately position the lead wire relative to the interior of the barrel portion and the surface of the spring element, and said barrel portion including means positioned to grip the insulating sheath of said lead wire and hold said lead wire in against said stop means.

2. The device of claim **1** wherein there is provided a sleeve of heat shrinkable insulating material fitted over said barrel portion with one end thereof extending outboard of said barrel portion so as to engage the insulating sheath of a lead wire and effect partial seal of the interior of said wire barrel.

3. The device of claim **2** wherein said sleeve is made to extend over the entire exterior surface of said wire barrel and to overlie the said spring element whereby to prevent solder displaced by the force generated from said spring element during reflow from escaping from said wire barrel.

4. In a device for terminating electrical lead wires a connector-terminal formed of flat sheet stock metal having a lamination of solder extending over portions thereof, said connector terminal being blanked and formed to define a contact portion and a wire barrel portion comprised of the stock and the lamination of solder, said connector-terminal including in said wire barrel portion at least one spring element struck up from the stock to extend into the wire barrel portion, such spring element containing on the interior surface thereof a portion of the solder lamination, said spring element being displaced interiorly of said wire barrel portion so as to be loaded by the insertion of the lead wire into said barrel portion to firmly grip the surface of said lead wire and press such between the surfaces of said solder on the interior of said barrel portion and on said spring element whereby to better assure conduction of heat to effect solder reflow and to force reflowed solder into the interstices of the strands of the lead wire to provide a termination thereof.

5. For use in terminating electrical lead wires of a type having a core of conductive material and a sheath of insulating material thereon, a series of terminal bodies each formed from a common piece of thin sheet metal having a layer of solder laminated thereto with each said body including a wire receiving barrel portion formed to have an area of said solder layer disposed on the inner surface thereof and with said bodies joined together by a web of said sheet metal as a carrier for said bodies, and with each of said wire barrel portions further having in combination, a stop means for limiting lead wire insertion to align the stripped surface of said care with said layer of solder, means included in said wire barrel portion for gripping the insulating sheath of said lead wire to hold said core in place in said barrel portion, and spring means included in said barrel portion for pressing said core against said layer of solder during solder reflow to terminate a lead wire thereto.