ENCAPSULATED ELECTRICAL COMPONENTS AND METHOD OF ASSEMBLY

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This invention relates to an electrical terminal and its method of assembly with electrical components and more particularly to a solid plug-in terminal and its method of assembly with encapsulated electrical units.

Encapsulated units are used quite widely in electrical equipment. Very often, especially in military equipment, such encapsulated units must be hermetically sealed to prevent moisture and other external influences from deleteriously affecting their operation. Several methods have been devised for bringing electrical connections out from the inside of encased components. These include (1) the use of hollow terminals mounted on the outside of the case, the electrical lead wires being brought through to the terminal from the inside of the case and soldered within the hollow portion of the terminal (2) the use of solid terminals, mounted on the outside of the case, the wire leads being brought through appropriate apertures in the case, wound around these solid terminals and soldered thereto.

Such terminals and methods of attachment of the leads thereto have several disadvantages. Where the wire leads are brought through the case, motion of these flexible leads often results in voids being produced in the encapsulated unit due to mechanical stresses pulling the wires loose from the encapsulating material. It has been found that this often results in the breaking of the hermetic seal with the resultant loss of moisture proofing and other advantages of such sealing. Hollow terminals are not as strong for a given diameter as a solid terminal. They have an additional disadvantage in that the soldered joint within the terminal may melt loose when a soldering connection is made to this terminal in normal assembly in the equipment in which the component is to be used. This may readily break the seal to the interior of the assembly.

This invention provides a novel, solid terminal, a method for assembling this terminal into an encapsulated unit which overcomes these problems, and a unique, reliable unit which can be assembled at reduced cost and time as compared with conventional assemblies. A solid terminal having a recessed section for receiving the wire leads, this recessed section being formed with a pair of parallel flat shoulders, is utilized. The terminals are suitably connected to an insulator board, the component lead wires being suitably brought through apertures, for example, in this board and attached to the terminals at the recessed sections. The insulator board which is attached to the component is then suitably mounted in a case having apertures through which the contact pins of the terminals may pass. One of the flat shoulders forming the recessed section abuts against the inside surface of the wall of the case having the apertures to receive the contact pins. The entire unit is then potted or otherwise encapsulated by conventional techniques and may be hermetically sealed if desired. The rigid contact pins are the only protrusions from the inside of the case, and these contact pins may be plugged into suitable receptacles provided in the equipment in which the unit is to be utilized.

It thus can be seen that by the device and method of this invention the disadvantages of conventional methods and devices may be avoided. No flexible leads are brought through the potting or other encapsulation mate-rial. Thus, the likelihood of breaking the seal on the unit is minimized. In addition there are no soldered sections forming any part of the seal and therefore, the danger of breaking this seal with the application of heat to the terminals is avoided. Solid terminals having a maximum strength for their dimensions may be utilized, thereby making for a more compact yet substantial terminal.

It is therefore an object of this invention to provide an improved electrical terminal.

It is another object of this invention to provide an improved method for assembling terminals with electrical components.

It is a still further object of this invention to facilitate the production of hermetically sealed encapsulated components.

It is still another object of this invention to provide a simpler and less costly method of assembling terminals with electrical components.

It is still a further object of this invention to provide a reliable terminal for electrical components which can be utilized to plug into a receptacle.

It is still a further object of this invention to provide a more reliable encapsulated electrical component that is easier and more economical to fabricate than heretofore possible.

Other objects of this invention will become apparent from the following description taken in connection with the accompanying drawings in which:

FIG. 1 is a greatly enlarged elevation view of a preferred embodiment of the terminal of this invention,

FIG. 2 is an elevation view of a preferred embodiment of the terminal of this invention attached to a terminal board,

FIG. 3 is an enlarged exploded view illustrating the method of assembly of the device of this invention and the completed, encapsulated unit, and

FIG. 4 is a perspective view with cutaway section of a finished encapsulated unit.

It is to be noted that the device of the invention is particularly suited to miniaturized components to be utilized, for example, with printed circuit boards. Typical dimensions of a unit such as that illustrated in FIG. 3, might, for example, include a case 33 about 15/8" x 1" x 1" with the terminal contact pins 12 being about 3/8 inch in diameter.

Referring to FIG. 1, a preferred embodiment of the terminal is illustrated. The terminal has a solid contact pin 12 which is integrally attached to a support portion 14. The connector portion 12 may be cylindrical as illustrated but need not necessarily be so shaped. The support portion 14 is formed with a hollow portion 15 which may be utilized as a clamping section and has two parallel flattened ring shaped sections 16 and 17 integrally formed therewith or otherwise fixed thereto which act as shoulders to form a circular enclosure or recess running around a section 18 of support portion 14. The terminal may be fabricated of a highly electrically conductive material, and its horizontal cross-section may be circular throughout its entire length.

Referring to FIG. 2, the terminal illustrated in FIG. 1 is illustrated attached to an insulated terminal board 20. The top of support portion 14 may be inserted through the snugly mating aperture 19 in terminal board 20 and the walls 21 of hollow section 15 may be staked or cramped to the terminal board which fits snugly between wall section 21 and flattened ring 16. A wire lead 25 from the component with which the terminal is to be utilized, is fed over the edge of terminal board 20 and held in place by an appropriate slot or passage 28 in the edge of the board. This wire lead may be...
wrapped around recessed section 18 of the support portion of the terminal.

Referring now to FIG. 3, the method of assembling the terminal with an electrical component is illustrated. Apertures (not shown) are drilled in terminal board 20 which is fabricated of an electrically insulating material. These apertures should mate with the ends of the support portions of the terminals and the two tapped inserts 32 and 34. The terminals are attached to the terminal board as already described by flattening out the walls 21 of hollow portion 15 of the terminals (see FIGS. 1 and 2). Tapped inserts 32 and 34 may be a press fit or may be swaged into place in their respective apertures. Each insert should have a shoulder which abuts against the same surface of the terminal board as one of the shoulders of each terminal. These insert shoulders should protrude from the terminal board the same distance as do the furthest extended terminal shoulders. Electrical component 29 which may be, for example, a transformer is suitably attached to terminal board 20 by cementing, taping, or any other suitable means. Care should be taken to assure that the component's metal case is adequately insulated from the walls 21 of the terminals. This may be accomplished, for example, by inserting a barrier insulator (not shown) between terminal board 20 and the core of component 29. It is not essential that this component 29 be attached rigidly to the terminal board 20 as it will later be held in place by the encapsulating material. The electrical leads 25 of component 29 are brought through slots 28 along the edge of terminal board 20 and the ends of these leads wound around recessed sections 18 of the terminal. While the use of such passages are edge slots to hold the wires in place is desirable it is not essential, and the leads may be brought through any suitable apertures in the terminal board or over the edge of the board without using slots. The wire leads may now be soldered to the recessed sections of the electrical terminals.

The unit may now be tested prior to the subsequent encapsulation conveniently and simply by plugging it into a fixture which provides the necessary test connections.

A case 33 which, for example, may be fabricated of plastic is used to encase the assembled unit. Terminal board 20 should have slightly smaller dimensions than case 33 so that it fits loosely therein so as to permit the encapsulating material to flow around the terminal board edges over to the soldered portions of the terminals. Appropriate apertures 37 and 39 should be drilled in wall 40 of the case to mate with the terminals and with tapped inserts 32 and 34 respectively. The terminal apertures 37 should be drilled so they readily receive the contact pins 12 of the terminals. The assembled unit should then be inserted into case 33 so that flattened rings 47 and the shoulders of inserts 32 and 34 abut against the inside surface of wall 40 of the case. Suitable screws 41 and 42 which mate with tapped inserts 32 and 34 should be tightened down into these inserts from the outside of the case to form a single, self-supporting assembly.

The unit should now be encapsulated. This may include baking, evacuating and impregnating and/or potting with a suitable resin or other material per conventional encapsulating techniques. Conventional hermetic sealing may be utilized if it is so desired. The impregnating and/or potting compound will run around the edge of terminal board 20 and encompass all of the soldered portions of the terminal which are on the inner side of the case. A tight seal will be formed between the contact pins 12 and the case. The unit may be finished off per conventional encapsulating techniques. A completed unit is illustrated in FIG. 4. As can be seen, the component 29 is encapsulated within case 33 by means of a potting compound 27.

The finished unit may either be plugged into appropriate receptacles in the electronic circuitry in which it is utilized or soldered connections may be made to contact pins 12. Experience has indicated that the finished unit so produced exhibits considerable improvement in reliability over long periods of operation. Very few problems have been encountered in this unit with the encapsulation seal or with the shorting of wire leads. In addition, the method of assembly results in savings in cost and time, especially significant in mass production operations.

While the device of this invention has been described and illustrated in detail, it is to be clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the spirit and scope of this invention being limited only by the terms of the appended claims.

I claim:

1. A method for assembling electrical contact terminals with an electrical component, said terminals having solid contact pins and support portions having a pair of parallel flat shoulders forming recesses therein and a hollow section adjacent one of said shoulders, comprising the steps of forming holes in a terminal board to receive the support portions of said terminals and threaded inserts, fixedly attaching the support portions of said terminals to said terminal board with the hollow section of each of said terminals being inserted through a respective aperture in the terminal board and a portion of the walls of the hollow section flattened against one surface of the terminal board, said one of said shoulders abutting against the surface of said terminal board opposite said one surface, attaching threaded inserts to said terminal board by pressing them through their respective terminal board holes, mounting the electrical component to said one surface of the terminal board with an insulating member between said component and said board, bringing each of the wiring leads of said component through respective apertures in said board to the side of said board opposite said one surface, soldering the ends of each of the wiring leads of the component to a separate one of said terminals within the recesses thereof, forming apertures in one side of a case to mate with the terminals and the threaded inserts, said case being adapted to receive the mounted component, mounting the component within the case with the threaded portions of the terminals protruding through their mating apertures and the threaded inserts opposite their mating apertures by tightening screws mating with the threaded inserts into said inserts the heads of said screws abutting against the outside wall of the drilled side of the case, the other of said shoulders of said support portions abutting against the inner wall of the apertured side of the case, and encapsulating the encased unit.

2. In combination, electrical terminals, each of said terminals comprising an electrically conductive solid contact pin portion, and a support portion fixedly attached thereto, said support portion having an electrically conductive recessed section intermediate the pin and support portions, said recessed section being flat with the pair of mutually spaced parallel shoulders, one of said shoulders being adjacent said contact pin portion, said support portion having a clamping section spaced from the other of said shoulders; a rigid non-conductive terminal board having apertures therein, each aperture receiving a portion of a different one of said support portions, a portion of each of said support portions being flattened against one surface of said terminal board to provide said clamping section, the other of said shoulders of each terminal abutting against a surface of said terminal board opposite and parallel to said one surface; an electrical component mounted on said one surface of said terminal board, said component having a plurality of electrical wire leads, said terminal board having a separate passage
3,009,985

5 therein for each of said leads, each of said leads passing through a respective one of said passages, each of said leads further being wound within said recessed section of a respective one of said terminals to electrically connect the leads and terminals; a case, said case having a wall with apertures therein, said terminal board and said component being mounted within said case, each of said apertures mating with a respective one of said contact pin portions, each contact pin portion passing through its respective associated aperture with said one shoulder adjacent each said pin portion abutting against a surface of said wall; and encapsulating material filling the spaces between said component and said case.

3. The device as recited in claim 2 wherein said shoulders are ring shaped and said contact pin portions are substantially cylindrical in shape.

4. The device as recited in claim 2 wherein said passages in said terminal board comprise notches in the edge of said board.

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