Jan. 26, 1965 H. F. MASON 3,167,608

HERMETICALLY SEALED TERMINAL STRUCTURE

Filed April 10, 1961

FIG. 1.

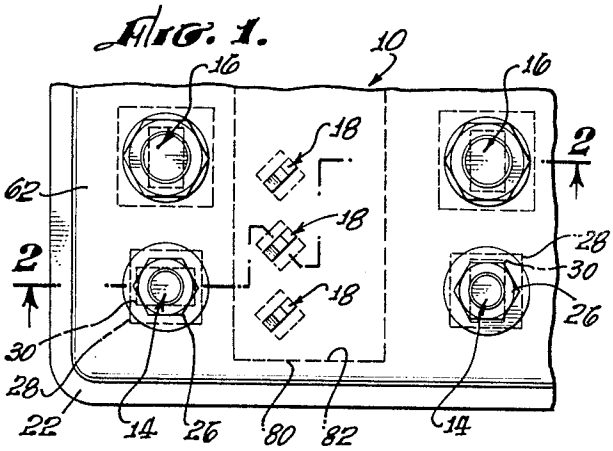


FIG. 3.

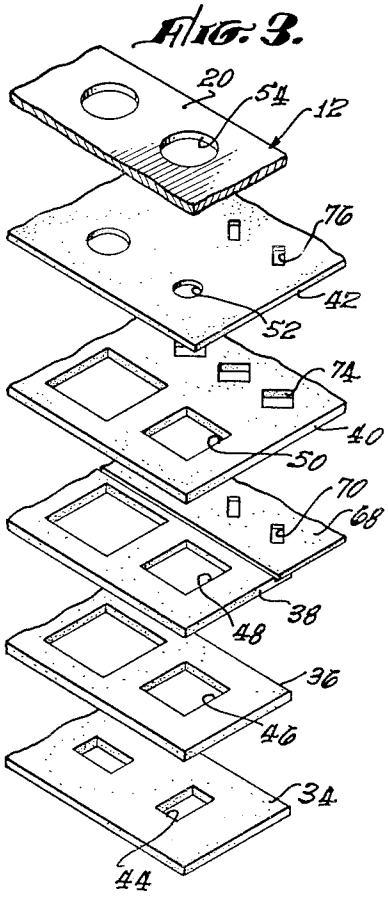


FIG. 2.

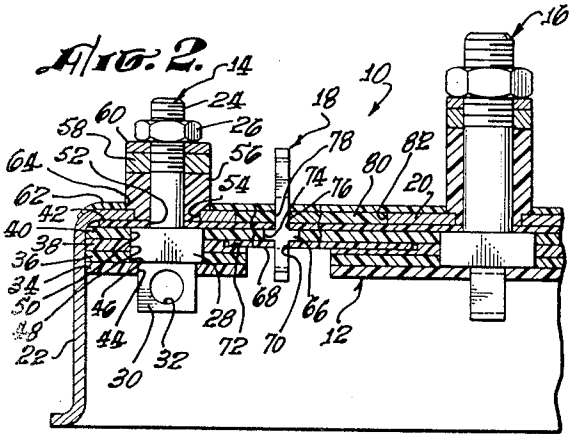


FIG. 6.

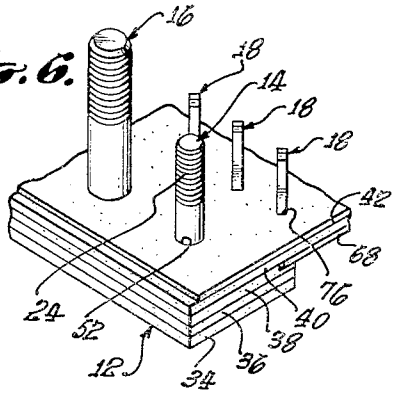


FIG. 4.

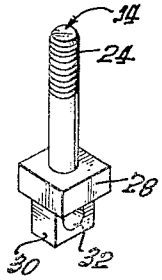
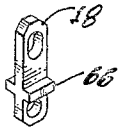


FIG. 5.



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HERMETICALLY SEALED TERMINAL STRUCTURE

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The present invention relates in general to a terminal structure, such as an electrical terminal structure, and, more particularly, to a terminal structure which is hermetically sealed.

General objects of the invention are to provide a hermetically sealed terminal structure which permits the use of low resistance terminal materials, which is not adversely affected by thermal expansion and contraction of the terminals even with terminal materials having high coefficients of thermal expansion, and which will remain hermetically sealed despite severe thermal shock, mechanical shock, torque applications, and the like.

The foregoing objects are attainable by providing, and an important object of the invention is to provide, a hermetically sealed terminal structure which includes a laminated wall comprising preformed, rigid laminae having communicating holes with nonaligned edges, and a terminal having portions respectively complementary to and disposed in such holes, the laminae being bonded together with the terminal in place.

With the foregoing construction, the terminal and the laminated wall are securely locked together mechanically even when the terminal structure is subjected to severe thermal shock, mechanical shock, torque applications, or the like, and there is an irregular, stepped interface between the laminated wall and the terminal to virtually eliminate any possibility of leakage along such interface.

Other objects are to provide a terminal structure of the foregoing nature wherein the irregular, stepped interface between the laminated wall and the terminal is formed by varying the lateral configuration of the terminal longitudinally thereof and using complementary holes in the laminae having different shapes and/or sizes and/or angular orientations and/or the like.

The foregoing objects, advantages, features and results of the present invention, together with various other objects, advantages, features and results thereof which will be evident to those skilled in the hermetically sealed terminal structure art in the light of this disclosure, may be achieved with the exemplary embodiments of the invention described in detail hereinafter and illustrated in the accompanying drawing, in which:

FIG. 1 is a fragmentary plan view illustrative of a terminal structure which embodies the invention;

FIG. 2 is a sectional view taken along the irregular arrowed line 2—2 of FIG. 1;

FIG. 3 is an exploded perspective view of a laminated wall of the terminal structure of the invention;

FIGS. 4 and 5 are perspective views of terminals of the terminal structure of the invention; and

FIG. 6 is a perspective view showing the terminals of FIGS. 4 and 5, and other similar terminals, assembled with certain of the laminae of the laminated wall of FIG. 3 of the drawing.

In the drawing, the hermetically sealed terminal structure of the invention is designated generally by the numeral 10 and includes a laminated wall 12 through which extend terminals 14, terminals 16 and terminals 18. As will be explained, these terminals are anchored in the laminated wall 12, the laminae of such wall being bonded together to secure the terminals in place.

As hereinbefore outlined, and as will be discussed in more detail hereinafter, there are irregular, stepped interfaces between the laminated wall 12 and the terminals 14, 16 and 18 so as to virtually eliminate any possibility of leakage along such interfaces. The irregular, stepped interface between the laminated wall 12 and each of the terminals 14, 16 and 18 is formed by providing holes in the laminae of the laminated wall which have different shapes and/or sizes and/or angular orientations and/or the like, and by complementarily varying the cross sectional configuration of the terminal longitudinally thereof so that each longitudinal increment of the terminal fits snugly in a corresponding hole.

The laminated wall 12 includes, as a main supporting lamina 20 thereof, one wall of a housing 22. The latter is preferably formed of sheet metal.

Considering one of the terminals 14 and its relationship to the laminated wall 12, each terminal 14, as best shown in FIG. 4 of the drawing, comprises a stud having an externally threaded outer end 24 adapted to accommodate a nut 26. The terminal 14 is provided intermediate its ends with a square head 28 and is provided at its inner end with a rectangular projection 30 having a hole 32 therethrough in which an electrical conductor, not shown, may be soldered.

The portion of the laminated wall 12 associated with each terminal 14 comprises stacked laminae 34, 36, 38, 40 and 42, of electrical insulating material, which are all bonded together and the lamina 42 of which is preferably bonded to the main supporting lamina 20. The lamina 34 is provided therein with a rectangular hole 44 complementary to and receiving the rectangular projection 30 on the terminal 14 under consideration. The laminae 36, 38 and 40 are respectively provided with holes 46, 48 and 50 complementary to and receiving therein the square head 28 of the terminal 14. Similarly, the lamina 42 is provided therethrough with a round hole complementary to and receiving therein the cylindrical portion of the terminal 14 which is located outwardly of the square head 28.

It will be noted that the hole 44 differs in size and shape from the holes 46, 48 and 50, and that the latter differ in size and shape from the hole 52. This provides an irregular, stepped interface between the terminal 14 and the laminae 34, 36, 38, 40 and 42 to avoid any direct leakage path between the terminal and such laminae even if there is not a perfect bond between the terminal and the laminae in question. It will be understood that while the terminal 14 has been shown as provided with rectangular, square and circular portions in the corresponding rectangular, square and circular holes, other shapes and other relationships may be used to obtain the desired irregular, stepped interface between the terminal and the laminae 34, 36, 38, 40 and 42.

The cylindrical portion of the terminal 14 projects outwardly through a hole 54 in the main supporting lamina 20 and is surrounded by an insulating bushing 56 having a reduced-diameter portion fitting tightly in the hole 54. Outwardly of the bushing 56 are washers 58 and 60 and the nut 26, the washers being adapted to receive a terminal clip therebetween and at least the washer 58 preferably being formed of an electrically conductive material. As will be apparent, the laminae 20 and 42, the bushing 56 and the washers 58 and 60 are all clamped between the nut 26 and the square head 28 of the terminal 14.

Outwardly of the main supporting lamina 20 is an outer lamina 62 having therein a hole 64 which accommodates the bushing 56. This outer lamina may be provided with terminal-identifying indicia thereon.

Prior to assembly, the various laminae 34, 36, 38, 40 and 42 are coated on both sides with a curable bonding agent, such as a synthetic resin, and are assembled with

the terminal 14. The structure just described is then assembled with the housing 22, the bushing 26 and the washers 58 and 60. The entire assembly is then clamped together with the nut 26. Preferably, the portions of the bushing 56 in contact with the housing 22 and the lamina 42 are also coated with a curable bonding agent. The bonding agent is then caused to cure, with the result that the coated components are permanently hermetically sealed together. The outer lamina 62 may be applied during assembly of the components just discussed, or subsequently.

With thin laminae as shown, the laminae 34, 36, 38 and 40 are secured during clamp up by friction with the terminal 14 and/or by the bonding agent. Consequently, the terminal 14 and its nut 26 provide the only clamping means needed. With heavier laminae, however, it may be necessary to clamp up the laminae 34, 36, 38 and 40 separately.

The resulting terminal structure is tightly sealed and sturdy and positively locks the terminal 14 under consideration in place within the laminated wall. The hermetic seal and the mechanical interlock between the laminated wall 12 and the terminal 14 retain their integrity despite severe thermal shock, mechanical shock, torque applications, and the like, even when terminal materials having high coefficients of thermal expansion are used. Also, as previously pointed out, the irregular, stepped interface between the laminated wall 12 and the terminal 14 virtually eliminates any possibility of leakage since there is no direct leakage path through the terminal structure.

The remaining terminals 14 and 16 have the same relationship to the laminated wall 12, and are assembled therewith in the same manner, as the terminal 14 just described. The terminals 16 differ only in being somewhat larger and longer, the structural differences required in the laminated wall 12 to accommodate same being apparent so that any further description is not necessary.

The terminals 18, which are designed to have soldered connections at both ends, have substantially the same relationship to the laminated wall 12 as the terminals 14 and 16, and are assembled therewith in a similar manner. Consequently, only a brief description of one of the terminals 18 and its relationship to the laminated wall 12 is necessary.

As best shown in FIG. 5 of the drawing, each terminal 18 is of rectangular cross section and includes a substantially square head 66 intermediate its ends. Inwardly of the head 66 is a lamina 68, of insulating material, having a rectangular hole 70 therethrough for the terminal 18. The lamina 68 is disposed between the laminae 38 and 40, the lamina 38 having a recess 72 in one edge thereof to receive a corresponding edge of the lamina 68.

The square head 66 of each terminal 18 fits into a complementary hole 74 in the lamina 40. Outwardly of the head 66, each terminal 18 extends through a rectangular hole 76 in the lamina 42. The terminals 18 project outwardly through, and fit tightly in, holes 78 in a lamina 80 of insulating material which is disposed in an opening 82 in the main supporting lamina 20 and which underlies, and is covered by, the outer lamina 62. As previously pointed out, the terminals 18 are assembled and sealed with respect to the corresponding laminae in the same manner as the terminals 14 and 16.

Although exemplary embodiments of the invention have been disclosed herein for purposes of illustration, it

will be understood that various changes, modifications and substitutions may be incorporated in such embodiments without departing from the spirit of the invention as defined by the claims which follow.

I claim:

1. In a hermetically sealed terminal structure, the combination of:

(*a*) a laminated wall comprising preformed rigid laminae of electrical insulating material having communicating holes therethrough;

(*b*) certain of said holes having edges which are nonaligned relative to each other;

(*c*) at least one of said holes being noncircular;

(*d*) a terminal extending through said wall and having portions respectively complementary to and disposed in certain of said holes with nonaligned edges and said noncircular hole;

(*e*) an outer lamina of said wall having a hole therethrough which is larged than said terminal;

(*f*) a bushing of electrical insulating material encompassing said terminal and disposed in and complementary to said hole in said outer lamina;

(*g*) said laminae and said bushing being bonded together; and

(*h*) whereby to hermetically seal said terminal in said laminated wall and said bushing with a stepped, sealed interface between said terminal and said laminated wall to positively prevent leake through said laminated wall along the exterior of said terminal.

2. In a hermetically sealed terminal structure, the combination of:

(*a*) a laminated wall comprising preformed rigid laminate having communicating holes therethrough;

(*b*) certain of said holes having edges which are nonaligned relative to each other;

(*c*) at least one of said holes being noncircular;

(*d*) a terminal extending through said wall and having portions respectively complementary to and disposed in certain of said holes with nonaligned edges and said noncircular hole;

(*e*) at least one lamina of said wall having a hole therethrough which is larger than said terminal;

(*f*) a bushing encompassing said terminal and disposed in and complementary to said hole in said one lamina;

(*g*) said laminae and said bushing being bonded together;

(*h*) whereby to hermetically seal said terminal in said laminated wall and said bushing with a stepped, sealed interface between said terminal and said laminated wall to positively prevent leakage through said laminated wall along the exterior of said terminal; and

(*i*) said one lamina being formed of sheet metal and the remainder of said laminae and said bushing being formed of electrical insulating material.

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