July 7, 1970 G. R. BANGE 3,519,799

HERMETICALLY SEALED ELECTRICAL PLUG-IN TERMINAL WITH MATING ELECTRICAL SOCKET

Filed Sept. 24, 1968

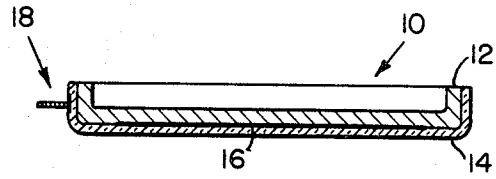

FIG. 1

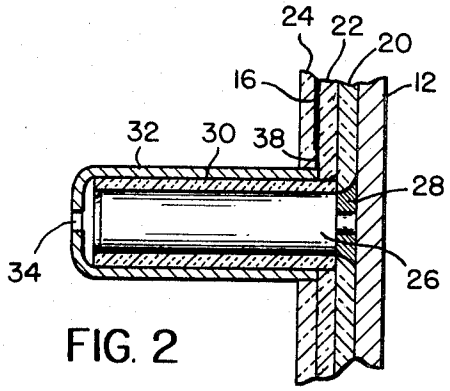

FIG. 2

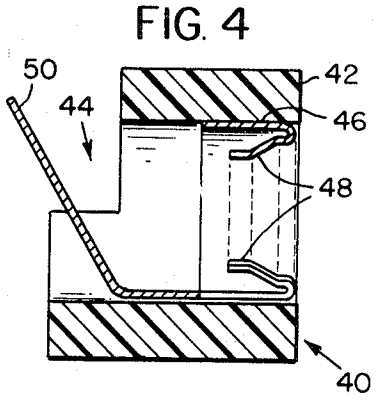

FIG. 4

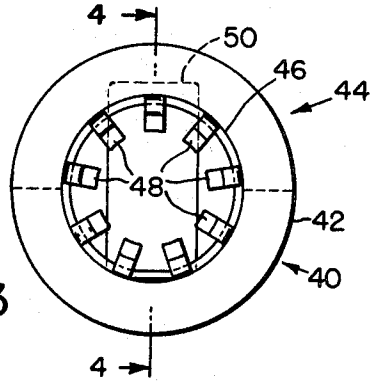

FIG. 3

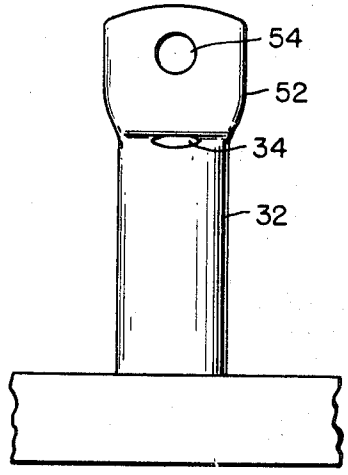

FIG. 5

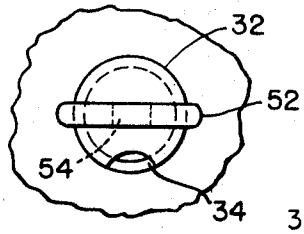

FIG. 6

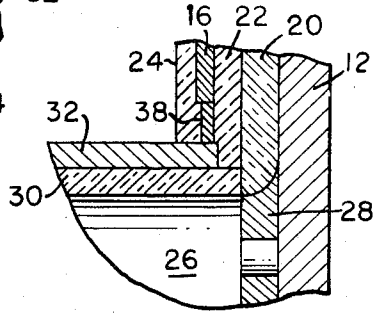

FIG. 7

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United States Patent Office 3,519,799 Patented July 7, 1970

3,519,799

HERMETICALLY SEALED ELECTRICAL PLUG-IN TERMINAL WITH MATING ELECTRICAL SOCKET

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Filed Sept. 24, 1968, Ser. No. 762,039
Int. Cl. H05b 3/08, 3/16; H01r 13/50
U.S. Cl. 219—541 7 Claims

ABSTRACT OF THE DISCLOSURE

A plug-in terminal for a sealed heater unit is disclosed. The terminal unit is hermetically sealed by the method of manufacture that is also disclosed which allows the terminal to be completely immersed in water for washing. The terminal comprises a stud welded to the heater substrate with a ceramic tube and a metal sleeve bonded to the welded stud and to each other.

Also disclosed is a mating female socket having a plurality of flexible fingers spaced around the periphery of the electrical socket. The fingers serve as the receiving means for the mating hermetically sealed terminal plug, with the flexibility allowing the plug to be inserted into the socket with some degree of misalignment.

BACKGROUND OF THE INVENTION

This invention relates generally to an electrical male and female quick-disconnect connections and more particularly to a hermetically sealed male plug-in terminal designed for insertion into a mating female electrical socket having features which allow some degree of misalignment between the male terminal and the female socket.

In the production of encapsulated heating units for consumer products wherein the heating unit is encapsulated with a glass or ceramic material, a reliable electrical terminal has long been needed. When the heating unit is designed for fixed locations as shown in FIG. 1, prior art terminals comprise a disc attached to a plurality of twisted wires, with the disc placed in the encapsulating media prior to firing of the structure.

Problems are encountered with this construction in that the terminal unit is very fragile and will often break away from the glass coating thereby preventing the heater unit from operating properly.

When the heater unit is designed for a remote or removable operation, as in the case where it may be removed to a different location to be cleaned, provisions must be made for a quick disconnect connection between the unit and the stand containing the unit. Prior art terminals and sockets of this type are generally not strong enough to long time usage and will tend to break whenever the heater unit is plugged into the female socket with some misalignment. This occurs as a result of the lack of provisions for misalignment when the male terminal is inserted into the female socket.

SUMMARY OF THE INVENTION

The present invention overcomes the difficulties and limitations found in prior art terminals and sockets by providing a hermetically sealed electrical male terminal which has structural strength greater than previous male electrical terminals of the same type. The electrical male terminal of the invention may be used in either fixed heater locations or with heaters used for remote heating as before mentioned.

The present invention also provides a mating female socket for the electrical terminal whenever the electrical terminal is used as a plug-in unit. The mating female socket contains means which allow the male terminal to be inserted therein with some degree of misalignment thereby minimizing breakage of the male terminal or the female socket.

Accordingly, it is an object of the invention to provide a new and novel electrical male terminal unit which is hermetically sealed and has structural strength necessary for plug-in terminal operation.

Another object of the invention is to provide a new and novel male terminal designed for fixed terminal locations which is structurally strong and which is also hermetically sealed.

Still another object of the invention is to provide a female electrical socket designed for a mating male terminal plug with means provided for misalignment between the plug and the socket whenever one is inserted into the other.

These and other objects and advantages of the invention will become more apparent from a study of the attached drawings and from a reading of the description of the preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side sectional view showning a prior art fixed terminal attached to an encapsulated heating unit;

FIG. 2 is a sectional view of the present invention showing the hermetically sealed plug-in terminal unit;

FIG. 3 is an end view of the mating female electrical socket;

FIG. 4 is a sectional view through the female electrical socket taken along line 4—4 of FIG. 3;

FIG. 5 is a side view of a hermetically sealed fixed terminal unit for use with a permanent electrical connection;

FIG. 6 is a top view of the hermetically sealed electrical terminal of FIG. 5; and

FIG. 7 is a view greatly enlarged of a portion of the hermetically sealed plug-in terminal unit of FIG. 2 showing the electrical connection of the heating element to the terminal.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1, there is shown an encapsulated heating unit **10** of a conducting type used with the invention. The heating unit **10** comprises a substrate **12** having a glass or ceramic coating **14** bonded thereto by well known bonding means. The coating **14** may be a multi-layer coating but is shown as a single layer in FIG. 1 for illustrative purposes only. A heating element **16** is encapsulated by the coating **14** and serves as the means for heating the ingredients contained within the substrate **12**.

A prior art terminal is shown generally at **18** in FIG. 1 and is positioned in the coating **14** prior to the firing of the coating on the substrate **12**. The prior art terminal **18** is electrically connected to the heating element **16** by means not shown in the drawing and serves as the terminal unit for electrically connecting a source of power to the heating element **16**.

Referring now more particularly to FIG. 2, there is shown a cross sectional view of the improved terminal of the invention. The substrate **12** contains a ground coat **20**, an electrical coat **22** and a cover coat **24**, all bonded to the substrate **12** by the method hereinafter described. The terms ground coat, electrical coat and cover coat are well known in the enameling art and for purposes of the present invention, it is sufficient merely to say that as used herein the term "ground coat" means that layer of enamel or glass which is applied directly to the base metal; the term "electrical coat" refers to that layer of glass or enamel which is applied over the ground

coat and which is in intimate contact with the electrical heating element; and the term "cover coat" refers to that layer of glass or enamel which is applied over the heating element and electrical coat. It should be understood that while the same glass or enamel composition may be used for all of these coatings, it is also possible and within the skill of the art to select glass or enamel compositions most suited to the particular purpose of the ground coat, electrical coat and cover coat. For example, a ground coat would be a glass composition which adheres to the base metal. The electrical coat being in direct contact with the heating element would be a glass or enamel composition which has a high order of resistivity at high temperature and the cover coat being in direct contact with the atmosphere would have the characteristics of impact and thermal shock resistance to prevent damage to the article, for example, when accidently dropped or when plunged into cold water for cleaning.

A metallic stud **26** is rigidly fastened to the substrate **12** by means of weld **28**. An insulating sleeve **30**, of ceramic material, completely surrounds the metallic stud **26**. A metallic cap **32** completely surrounds the insulating sleeve **30** in the manner shown in FIG. 2. The metallic cap **32** contains a hole **34** formed in the base thereof and functioning in a manner which will be hereinafter described.

The heating element **16** is encapsulated by the cover coating **24** and the electrical coating **22**. The electrical connection between the heating element **16** and the metallic cap **32** is completed by means of a conducting electrical paint **38** which is applied as hereinafter described in the operation of the method of assembling the terminal connection.

The insulating sleeve **30** is bonded to the metallic stud **26** by fused glass and the metallic cap **32** is also bonded to the insulating sleeve **30** by fused glass as will be hereinafter more fully described.

By use of the metallic stud configuration as shown in FIG. 2, it can be seen that a terminal plug-in connection is provided having substantial structural strength and also one that may be installed at any angle to the substrate **12** simply by positioning the metallic stud **26** at the desired angle and then welding it to the substrate **12**.

Referring now to FIG. 3, there is shown an end view of the mating female socket **40** which comprises an insulating sleeve **42** having an arcuate segment **44** removed from one thereof. The insulating sleeve **42** may be constructed of plastic or some other suitable material, and contains within the insulating sleeve **42**, a metallic sleeve **46** having a plurality of flexible fingers **48** spaced around the periphery thereof.

The fingers **48** of the metallic sleeve **46** serve as the receiving means for the mating external male electrical plug inserted therein. The metallic sleeve **46** may be constructed of copper or some other suitable material having resilient properties which allow the fingers **48** to grasp the mating electrical plug. This flexibility allows some degree of misalignment between the mating male plug and the female socket without damaging the socket **40** or the male plug. As a result should the heater unit be inserted in the electrical socket **40** in a misaligned manner, the flexibility of the fingers will allow the terminal to be inserted without damage to the female socket **40** or the male plug.

Contained on the rear portion of the metallic sleeve **46** is a tail-like terminal **50** for connection to the electrical conduit of the circuit for the heater unit. FIG. 4 shows the tail-like terminal **50** extending upwardly and positioned within the arcuate segment **44** removed from the insulating sleeve **42**.

Referring now to FIGS. 5 and 6, there is shown a hermetically sealed terminal unit for use with a permanently located encapsulated heater unit **10**. Since the heater unit **10** is mounted in a permanent position in this embodiment, the mating male terminal shown in FIG. 2, with the female terminal shown in FIG. 4, would not be required. However, the electrical terminal shown in FIG. 5 is constructed in a manner similar to the plug-in terminal shown in FIG. 2 and in addition contains an outwardly extending wing-like protuberance **52** formed on the base of the metallic cap **32** for connection to an electrical conduit of the electrical circuit. The electrical terminal shown in FIG. 5 would also contain the hole **34** which will be described more fully hereinafter. In addition, it may contain a second hole **54** serving as a means of allowing the electrical conduit of the electrical circuit to be attached to the wing-like protuberance **52**.

In the manufacturing, the hermetically sealed plug-in terminal shown in FIG. 2, or the hermetically sealed fixed terminal shown in FIG. 5, the hereinafter described sequence of operation is followed.

The metallic stud **26** is attached to the substrate **12** by well known welding operations and provides the mechanical strength and rigidity for the terminal to withstand the forces normally encountered during usage of the heater unit **10**.

After the metallic stud **26** is welded to the substrate **12**, the ground coat **20** is applied to the substrate **12** in such thicknesses as desired. In order to prevent the ground coating **20** from being inadvertently applied to the metallic stud **26**, short lengths of plastic tubing may be placed over the metallic stud **26** prior to the application of the ground coating **20** to the substrate **12**. The plastic tubing may be removed from the metallic stud **26** while the glass coating is still wet.

After the ground coating **20** has been applied to the substrate **12**, a small predetermined amount of glass slip is applied to the metallic stud **26** by means of an eyedropper or some other suitable instrument. The glass slip serves as the bonding means to bond the ceramic insulating sleeve **30** to the metallic stud **26** when the unit is fired.

After coating the metallic stud **26** with the glass slip, the ceramic insulating sleeve **30** is positioned over the metallic stud **26** and rotated into the ground coating **20**. The terminal unit is then allowed to dry and is fired thereby fusing the insulating sleeve **30** to the metallic stud **26** and the ground coat **20** to the substrate **12**.

After firing, the electrical coat **22** is applied over the ground coat **20** after placing short lengths of plastic tubing over the ceramic insulating sleeve **30** to prevent the electrical coat from coming in contact with the ceramic insulating sleeve **30**. The heating element **16** is then positioned on the electrical coating **22** and a small predetermined amount of glass slip is applied to the ceramic insulating sleeve **30** by means of an eyedropper. This small predetermined amount of glass slip serves as the bonding means to bond the metallic cap **32** to the insulating sleeve **30**.

After applying the predetermined amount of glass slip to the ceramic sleeve **30**, the metallic cap **32** is positioned over the ceramic insulating sleeve **30** until it touches the surface of the previously fired ground coat **20**. The assembly terminal unit is then allowed to dry and is fired a second time to fuse the electrical coat **22**, containing the heating element **16**, and to bond the metallic cap **32** to the ceramic insulating sleeve **30**. After the second firing to fuse the electrical coat **22**, the electrical paint **38** is applied to electrically connect the heating element **16** to the metallic cap **32** and the assembly fired again to dry and fuse the electrical paint.

Since the glass slip used as a bonding agent contains water, which upon heating releases air in the form of bubbles, the air must be allowed to escape from the terminal unit during the heating to prevent bubbles from erupting through the electrical coating **22**. For this reason, the hole **34** is provided in the metallic cap **32** and serves as a means of venting the air bubbles to atmosphere formed during the firing. Without the hole **34**, the bub-

bles would build-up at the base of the terminal unit and may break the electrical connection **38** between the terminal and the heater **16**. The presence of bubbles in the electrical coating **22** also reduces the dielectric strength of the terminal unit which causes failure during high potential testing of the terminal piece, prior to shipment to the customer.

After the metallic cap **32** is bonded to the insulating sleeve **30**, the cover coating **24** is applied to the electrical coat **22**. Short lengths of plastic tubing again may be fitted over the metallic cap **32** to prevent the cover coating **24** from being applied to the metallic cap **32**. When the cover coating **24** is applied to the desired thickness, the short length of plastic tubing are removed and the cover coating **24** is allowed to dry and is then fired to fuse the cover coating **24** to the electrical coat **22** thereby providing the hermetically sealed electrical terminal unit. This unit may now be immersed in liquid for cleaning purposes without damaging the electrical parts. In addition, the bonding of the various parts of the unit to each other as before mentioned also greatly improves the strength of the terminal unit.

From the above, it can be seen that there has been provided a new and novel electrical terminal plug-in unit having improved strength characteristics due to the novel design configuration and method of construction. There is also shown a mating female electrical socket which may be used with the male terminal plug unit, said socket having the characteristic of allowing the male terminal plug unit to be inserted therein with some degree of misalignment without damaging the socket structure or the male terminal plug-in.

While only certain forms of the present invention are shown and described herein in detail, other forms and configurations are possible and changes may be made in the arrangements and combination of the parts and in the detailed structures and methods of construction without departing from the spirit and scope of the invention as defined in the claims herein appended.

I claim:

1. A hermetically sealed electrical male plug-in terminal for a ceramic encapsulated electrical heater element, comprising:

(a) a metallic base;

(b) a metallic stud rigidly attached to said base;

(c) a ground coating fused to said base and the lower portion of said metallic stud;

(d) an insulating sleeve surrounding said metallic stud and bonded thereto;

(e) an electrical coating fused to said ground coating and the lower portion of said insulating sleeve;

(f) a metallic cap, having a hole formed in the base thereof, surrounding said insulating sleeve and bonded thereto, said hole serving as a means of permitting gases formed during the bonding to escape;

(g) means for electrically connecting the heater element to said metallic cap; and

(h) a cover coating encapsulating the heater element and fused to said electrical coating and to the lower portion of said metallic cap thereby providing a hermetically sealed electrical terminal for the heater element.

2. The hermetically sealed terminal as described in claim **1** and further characterized by:

(a) the insulating sleeve being formed of a ceramic material; and

(b) the bonding of said metallic cap to said insulating sleeve and said insulating sleeve to said metallic stud being accomplished with fused glass.

3. A female electrical socket comprising:

(a) an insulating sleeve having an arcuate segment removed from one end thereof;

(b) a metallic sleeve positioned within said insulating sleeve;

(1) one end of said metallic sleeve having a tail-like terminal portion for connection to an electrical conduit, said tail-like portion being positioned within said arcuate segment;

(2) the other end of said metallic sleeve having a plurality of flexible fingers, spaced around the periphery thereof, said fingers serving as a female receiving electrical socket for a mating external male electrical plug inserted therein and also serving to allow misalignment between said plug and said socket when said plug is inserted and removed from said socket.

4. An electrical quick-disconnect assembly for a ceramic encapsulated electrical heat element, comprising:

(a) a hermetically sealed electrical male plug-in terminal having;

(1) a metallic base;

(2) a metallic stud rigidly attached to said base;

(3) a ground coating fused to said base and the lower portion of said metallic stud;

(4) an insulating sleeve, surrounding said metallic stud and bonded thereto;

(5) an electrical coating fused to said ground coating and the lower portion of said insulating sleeve;

(6) a metallic cap, having a hole formed in the base thereof, surrounding said insulating sleeve and bonded thereto, said hole serving as a means of allowing gases formed during the bonding to escape;

(7) means for electrically connecting the heater element to said metallic cap;

(8) a cover coating encapsulating the heater element and fused to said electrical coating and to the lower portion of said metallic cap thereby providing a hermetically sealed terminal for the heater element;

(b) a female electrical socket having;

(1) a second base having a hole formed therein;

(2) an insulating sleeve contained within said hole and having an arcuate segment removed from one end thereof;

(3) a metallic sleeve, positioned within said insulating sleeve;

(a) one end of said metallic sleeve having a tail-like terminal portion for connection to an electrical conduit, said tail-like portion being positioned within said arcuate segment; and

(b) the other end of said metallic sleeve having a plurality of flexible fingers spaced around the periphery thereof, said fingers serving as a female receiving electrical socket for the mating male terminal plug inserted therein and also serving to allow misalignment between said plug and socket when said plug is inserted into and removed from said socket.

5. Electrical quick disconnect assembly unit as defined in claim **4** and further characterized by:

(a) said insulating sleeve bonded to stud of said male terminal plug being formed of a ceramic material; and

(b) the bonding of said metallic cap to said insulating sleeve and said insulating sleeve to said metallic stud being accomplished with fused glass.

6. A hermetically sealed electrical terminal for a ceramic encapsulated electrical heater element, comprising:

(a) a metallic base;

(b) a metallic stud rigidly attached to said base;

(c) a ground coating fused to said base and the lower portion of said metallic stud;

(d) an insulating sleeve surrounding said metallic stud and bonded thereto;

(e) an electrical coating fused to said ground coating and the lower portion of said insulating sleeve;

(f) a metallic cap, having a hole formed in the base thereof surrounding said insulating sleeve and bonded thereto, said hole serving as a means of allowing gases formed during the bonding to escape;

(1) said metallic cap containing an outwardly extending wing-like protuberance formed on the base thereof for connetcion to an electrical conduit;

(g) means for electrically connecting the heater element to said metallic cap; and

(h) a cover coating encapsulating the heater element and fused to said electrical coating and to the lower portion of said metallic cap thereby providing a hermetically sealed electrical terminal for the heater element.

7. The hermetically sealed electric terminal as defined in claim 6 and further characterized by:

(a) said insulating sleeve being formed of a ceramic material; and

(b) the bonding of said metallic cap to said insulating sleeve and said insulating sleeve to said metallic stud being accomplished with fused glass.

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VOLODYMYR Y. MAYEWSKY, Primary Examiner

U.S. Cl. X.R.

219—543; 339—149, 176, 258