United States Patent

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[54] **RIVET-SHAPED ELECTRICAL LEAD-THROUGH CONTACT**
8 Claims, 3 Drawing Figs.

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313/283, 174/50.52, 174/50.61, 339/144
[51] **Int. Cl.** **H01j 5/46,**
H01j 19/66, H01j 29/00, H01r 33/20
[50] **Field of Search** 313/64,
283, 318; 174/50.52, 50.61; 339/144

[56] **References Cited**

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ABSTRACT: An electrical lead-through contact for a cathode ray tube is described which is in the shape of a hollow metal rivet having an enlarged head portion closing one end thereof and an open end portion which is bent outward over a washer to mechanically fasten the rivet within an aperture in a ceramic envelope. A hermetic seal is then formed by heat fusion of glass previously provided around such rivet either as a glaze coating or as a compressed glass frit washer. The contact may be provided with a conductive coating over an oxide surface on such head portion to electrically connect it to a wallband electrode formed by another portion of such coating on the inner surface of the envelope. In another embodiment, a projection extends from such head portion for attachment to a lead conductor connected to another electrode within the tube envelope.

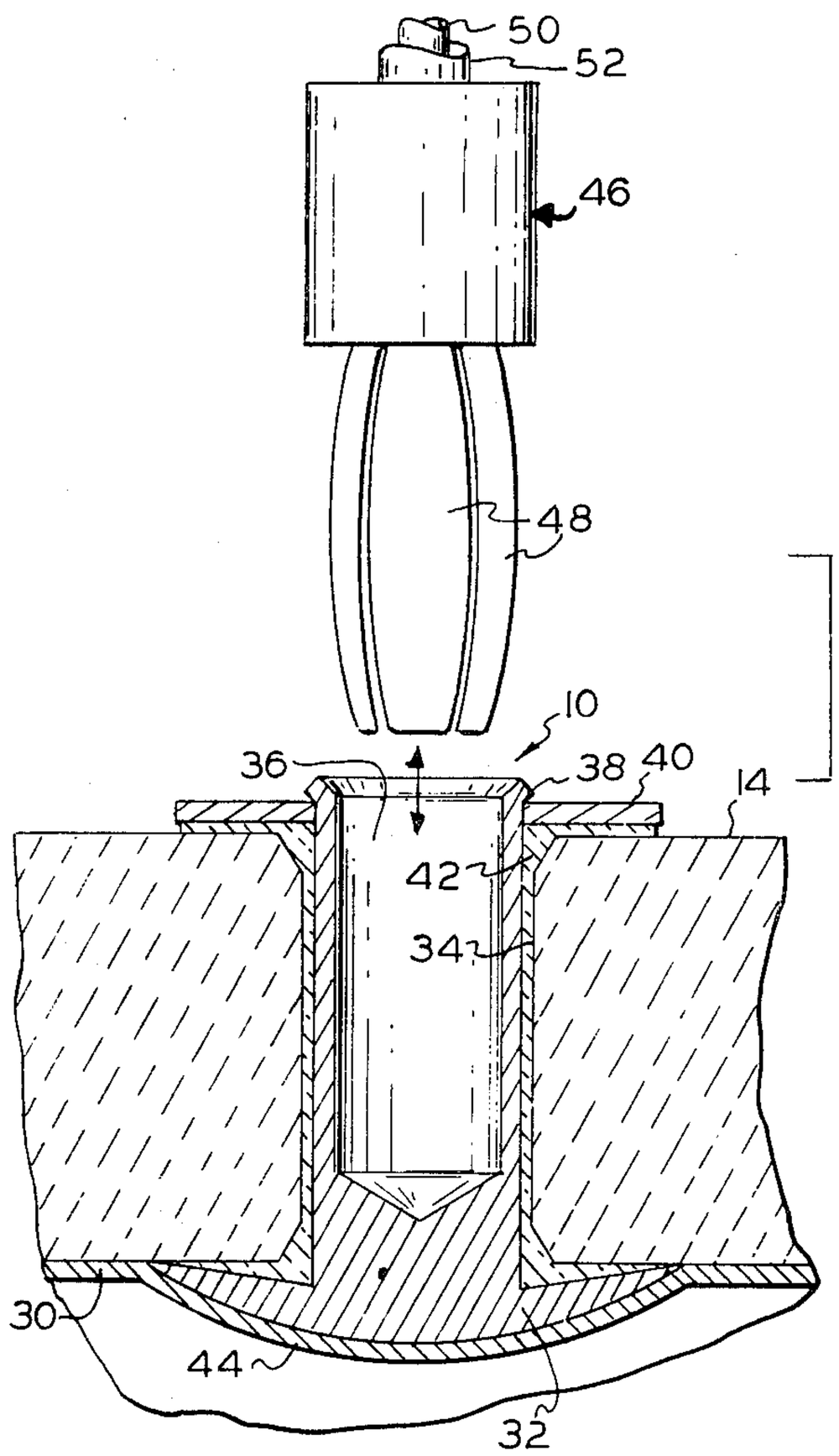


FIG. 1

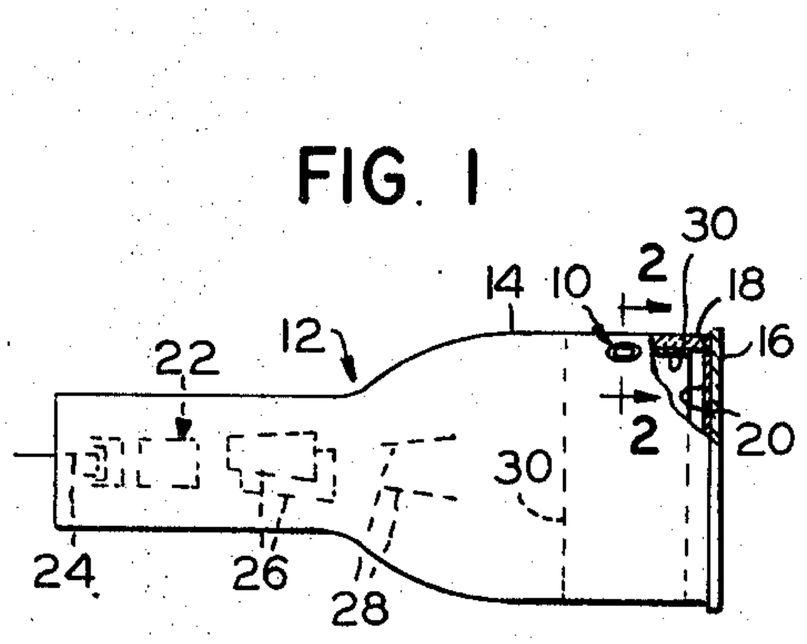


FIG. 2

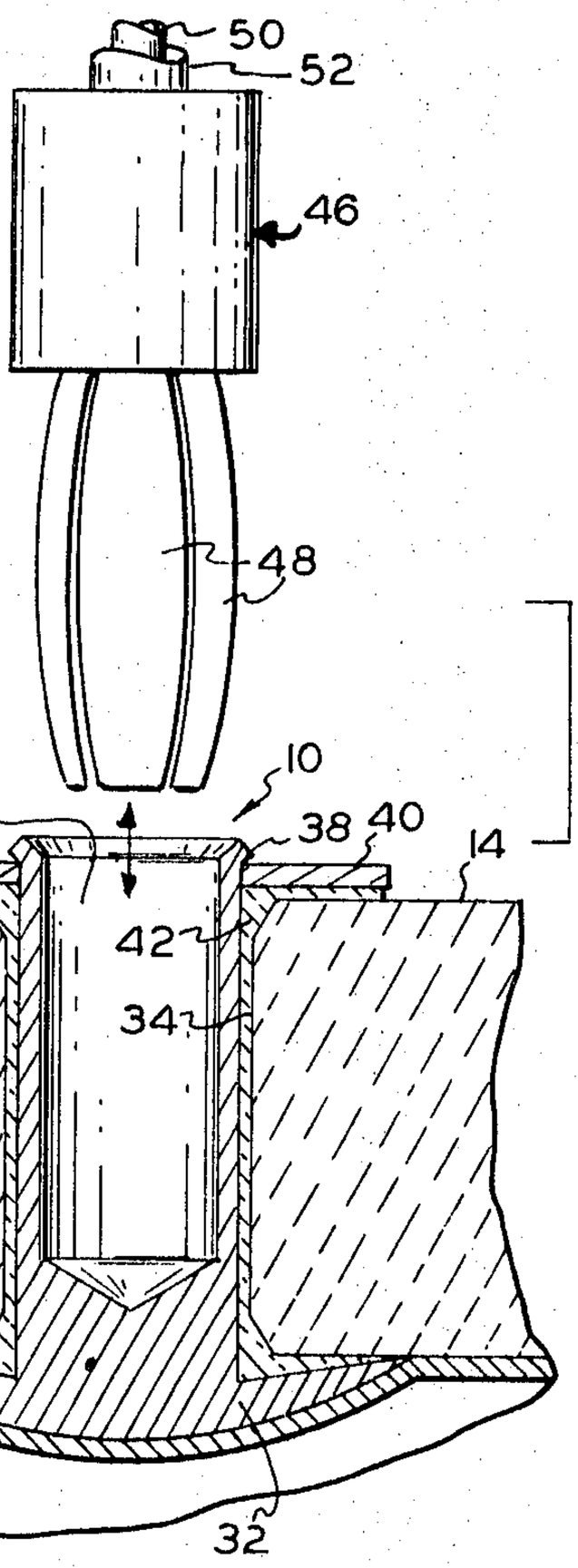
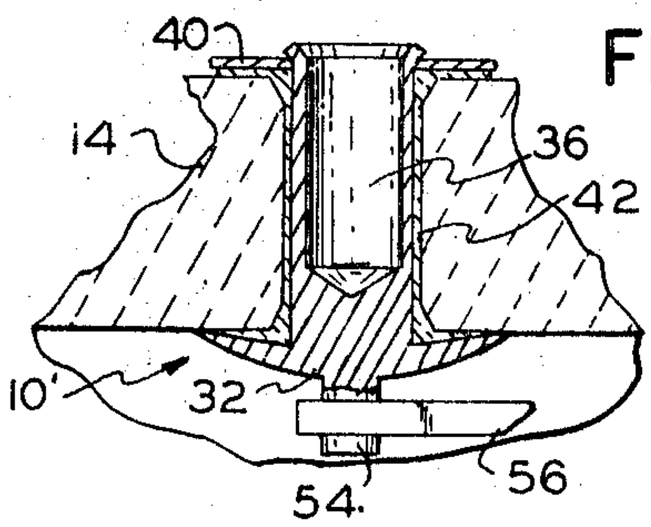


FIG. 3



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RIVET-SHAPED ELECTRICAL LEAD-THROUGH CONTACT

BACKGROUND OF THE INVENTION

The subject matter of the present invention relates generally to electrical lead-through contacts for transmitting DC supply voltages or other signals through an envelope wall such as in a cathode ray tube. In particular, the present contacts are of a rivet shape so that they may be mechanically attached to the envelope prior to hermetic sealing, thereby enabling automated production, accurate positioning and lower production cost. In addition, the present contact is provided with an extremely low resistance, on the order of 1 ohm, and provides a highly reliable electrical contact to an anode wall coating or other electrode within a cathode ray tube.

Conventional cathode ray tubes have lead-through contacts in the form of "buttons" which are hermetically sealed in apertures provided in glass envelopes as shown in U.s. pat. No. 2,820,166 of A. D. Pinotti, issued Jan. 14, 1958. However, these contacts are not of a rivet shape and are not mechanically attached to the envelopes prior to sealing. As a result, the contacts must be manually inserted into the envelope aperture and held in that position during sealing which is extremely expensive and inaccurate. These prior art tubes have glass envelopes and the contacts are attached by local heating of the glass envelope wall and then punching a hole in the center of the heated area by inserting the contact through the softened glass. This produces distortions in the glass envelope surrounding the button which makes electrical connections to wall coating electrodes difficult and also produces distortion in the electrical field within the envelope.

The above-mentioned problems are overcome by the rivet-shaped contact of the present invention. In addition, a layer of conducting material may be provided over the oxide surface of the enlarged head portion of the rivet to provide a low contact resistance, on the order of about 1 ohm, and to prevent any electrical charge accumulation on the insulating material adjacent such contact which might distort the field within the envelope. Furthermore, because of its reduced seal surface area, the present contact has less capacitance and lower leakage current characteristics than convention lead-through contacts which typically have a region of increased envelope wall thickness at the seal due to spreading of the melted portion of the glass envelope during the heat sealing.

It is therefore one object of the present invention to provide an improved electrical lead-through contact and method of attachment which is less expensive and more accurate.

Another object of the present invention is to provide an improved electrical lead-through contact in the shape of a rivet which may be mechanically attached within an aperture to the envelope by automatic machines prior to sealing.

A further object of the present invention is to provide such a lead-through contact in a cathode ray tube having an envelope of ceramic material with a glass seal portion fusing the metal contact to the ceramic envelope to form a contact of low capacitance and low leakage.

Still another object of the present invention is to provide such a contact in which a conductive coating is applied over the enlarged head portion of the contact, as well as the surrounding portion of the envelope wall, to provide a reliable low resistance electrical connection between such contact and an electrode coated on such envelope wall, and to prevent charge accumulation around such contact.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and advantages of the present invention will be apparent from the following detailed description of preferred embodiments thereof and from the attached drawings of which:

fig. 1 is an elevation view of a cathode ray tube employing the electrical lead-through contact of the present invention with parts broken away for clarity;

FIG. 2 is a section view taken along the line 2–2 of FIG. 1 showing one embodiment of the lead-through contact of the present invention; and

FIG. 3 is a section view of a second embodiment of the lead-through contact of the present invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

As shown in FIG. 1, the electrical lead-through connector **10** of the present invention may be employed as a high voltage connection on the envelope of a cathode ray tube **12**. While the envelope of the cathode ray tube may be made of glass, its funnel portion **14** is preferably made of a crystalline ceramic material such as a Fosterite porcelain ceramic, as shown in U.S. Pat. No. 3,207,936, issued Sept. 21, 1965 to W. H. Wilbanks et al. The ceramic funnel portion **14** is sealed to a glass faceplate **16** by a seal **18** of fused glass frit. The fluorescent screen may be in the form of a layer **20** of phosphor material provided on the inner surface of the glass faceplate **16**. Such phosphor screen is bombarded by an electron beam emitted from an electron gun **22** including a cathode **24** provided in the neck portion of the envelope. A pair of horizontal deflection plates **26** and a pair of vertical deflection plates **28** are provided within the envelope between the electron gun and the phosphor screen for deflecting the electron beam in accordance with signals applied to such deflection plates. Of course when the cathode ray tube **12** is part of an oscilloscope, the input signal conventionally is applied to the vertical plates while the ramp voltage is applied to the horizontal plates.

An anode electrode **30** is provided as a metal coating on the inner surface of the funnel portion **14** of the envelope. The anode **30** may be the spiral shaped post deflection acceleration anode of a conventional cathode ray tube or it may be in the form of a wallband electrode in a direct viewing bistable storage tube of the type using a phosphor storage dielectric, as shown in U.S. PAT. No. 3,293,473 of R. H. Anderson. The electrical lead-through connector **10** connects the wallband electrode **30** to a source of DC supply voltage located exterior of the envelope. It should be noted that the lead-through connector **10** may also be employed to transmit electrical signals to or from other electrodes within the envelope as hereafter described with reference to FIG. 3.

As shown in FIG. 2, the lead-through connector **10** is a socket member of a hollow rivet shape including an enlarged head portion **32** closing one end which extends beyond the edges of a mounting aperture **34** through the envelope wall of the ceramic funnel **14**. The connector **10** has a chamber or socket **36** which opens at the other end of such connector on the other side of the envelope wall from head **32**, and terminates in an outer flange **38** formed by staking or outward bending of the open end of the rivet. A metal washer **40** is provided around the shank of the rivet at its open end so that the flange portion **38** extends over the edge of the central opening in such washer in order to mechanically attach the rivet **10** to the envelope wall portion by clamping it between the head portion **32** and the washer **40**. After such riveting, a hermetic seal of metal to glass to ceramic is formed by a sealing glass **42** between the outer surface of the rivet **10** and the inner surface of the hole **34** formed in the ceramic envelope wall **14**. The rivet connector **10** and washer **40** may be formed of a metal alloy of 42 percent nickel, 6 percent chromium and 52 percent iron. In order to form this seal, the metal rivet is oxidized by heating in an atmosphere of "wet" hydrogen containing water vapor to a temperature of about 1900° to 2100° F. before the sealing step. The sealing glass **42** is made of any suitable soft sealing glass, such as a lead borosilicate glass, having a low temperature softening point and a coefficient of expansion which matches that of the metal alloy and Fosterite ceramic. One such suitable sealing glass is "Harshaw" Q–12. This sealing glass may be provided as a glaze on the surface of the rivet connector **10** or it may be formed as a self-supporting washer of compressed glass frit and organic binder. The glass frit washer is provided beneath metal washer **40** and upon

heating flows down the sides of the shank portion of the rivet connector **10** and underneath the enlarged head portion **32** by capillary action and gravity. After heating at about 600° C. for approximately 1 hour, the sealing glass **42** fuses to the metal and the ceramic to form a hermetic seal which extends between the envelope wall and the washer **40** and the enlarged head portion **32**, as well as between the shank of the rivet connector **10** and the surface of aperture **24**. When it is desired to make an electrical connection to the wallband electrode **30**, a conductive layer of gold **44** is coated on the surface of the head portion **32** of the rivet and on the ceramic area of the ceramic envelope wall. This conductive layer **44** is formed by applying a layer of gold resinate mixture including a gold salt, such as gold chloride, an organic resin binder and a suitable volatile carrier. When the gold resinate layer is heated, the binder and carrier are removed and the gold salt is converted into elemental gold which penetrates through the oxide layer on the surface of the head portion **32** so that it is fused to the rivet to make a low resistance contact of about 1 ohm resistance. At the same time, the gold is also bonded to the surface of the ceramic envelope wall to form the anode wallband **30**. This electrical connection of the rivet to the wallband electrode through the conductive coating is achieved simultaneously by the same heating step of 600° C. which forms the seal **42**. It should be noted that the heating temperature is above the softening point of the sealing glass, but below the melting point of the metal alloy used in the rivet and washer, and is sufficiently high to cause the gold coating **44** to fuse to the rivet and ceramic metal wall.

An electrical plug **46** including a plurality of resilient spring finger contacts **48** may be employed as a male connector for insertion into the socket **36** of the lead-through connector **10**. The spring fingers **48** are electrically connected within the plug **46** to a lead conductor **50** having an insulating coating **52** thereon, such conductor being connected to a suitable source of DC supply voltage or a source of electrical signals as the case may be. Of course it is also possible to provide the lead conductor **50** as a coating on the exterior surface of the envelope **14** which extends over the washer **40** in a similar manner to the way conductive coating **44** extends over head portion **32**.

Another embodiment of the lead-through connector of the present invention is shown as connector **10'** in FIG. **3**. Connector **10'** is similar to that of FIG. **2** but also includes a cylindrical projection **54** of solid metal extending from the enlarged head portion **32**. Projection **54** is attached to a metal lead strip **56** by welding or other suitable means, and such lead is connected to an electrode other than a wallband coating. Since the rivet connector of FIG. **3** is in other respects similar to that of FIG. **2**, the same reference numerals have been applied to designate like parts which will not be described in detail. In both embodiments of the rivet connector **10** and **10'**, the connector is mechanically attached to the ceramic envelope wall before sealing, thereby enabling automatic assembly operation by a rivet machine which reduces expense and enables accurate positioning of the connector. It should be noted that the metal washer **40** is not absolutely essential since the flange **38** may instead be bent over the edge of the ceramic envelope surrounding aperture **34**. However, this tends to cause chipping or cracking of the ceramic during the bending operation which is prevented by the washer **40**.

It will be obvious to those having ordinary skill in the art that many changes may be made in the details of the description of preferred embodiments of the present invention. For example, while the enlarged head portion **32** has been shown on the interior of the envelope, it is possible to reverse the rivet connector so that such head portion is on the exterior of the envelope. In addition, other combinations of female and male connectors can be employed such as those shown in copending U.S. Pat. application Ser. No. 766,912 filed on Oct. 11, 1966 by T. C. Morinaud. Therefore the scope of the invention should only be determined by the following claims.

We claim:

1. An electrical lead-through contact apparatus comprising:

an envelope of insulating material having an aperture through the envelope wall; an electrical contact member of metal having an enlarged head portion at one end and a side portion extending from said head portion, said contact member being supported with said side portion in said aperture and with said head portion extending over the edge of the aperture and engaging the inner side of the envelope wall to accurately position the contact member; and

seal means for sealing at least the side portion of said contact member to the envelope to form a metal to insulator seal hermetically sealing said aperture and providing an electrical lead-through envelope wall.

2. A contact apparatus in accordance with claim **1** in which the contact member is a socket member in the form of a hollow rivet with the enlarged head portion closing one end and having an open end portion with a tubular side portion therebetween said open end being bent outward on the outer side of the envelope wall to mechanically hold the contact in position within the aperture when the seal is formed.

3. A contact apparatus in accordance with claim **1** in which the seal is formed of an insulating material different than that of the envelope.

4. A contact apparatus in accordance with claim **3** in which the envelope includes a wall portion of crystalline ceramic material having the aperture provided therethrough and in which the seal is formed of glass.

5. A contact apparatus in accordance with claim **4** in which the envelope is the evacuated envelope of a cathode ray tube and the ceramic wall portion is sealed to a glass faceplate portion supporting the phosphor screen of said tube.

6. A contact apparatus in accordance with claim **1** in which the metal contact member has an oxide surface layer and a coating of noble metal is provided over the oxided surface on the enlarged end of said contact member and over a portion of the inner surface of the envelope to make contact with an electrode provided within said envelope.

7. A contact apparatus in accordance with claim **6** in which the electrode is an anode of a cathode ray tube, said anode being provided as a conductive coating on the inner surface of the envelope.

8. A contact apparatus in accordance with claim **2** provided in a cathode ray tube in which the rivet has a projection extending inside the envelope from the head portion and such projection is connected by a lead conductor to an electrode in said envelope.