United States Patent

Morinaud

[15] **3,665,239**

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[54] **ELECTRICAL LEAD-IN TUBULAR SOCKET MEMBER FOR ELECTRONIC TUBES**

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[73] Assignee: **Tektronix, Inc.**, Beaverton, Oreg.

[22] Filed: **Nov. 12, 1970**

[21] Appl. No.: **88,739**

Related U.S. Application Data

[63] Continuation of Ser. No. 766,912, Oct. 11, 1968, abandoned.

[52] **U.S. Cl.** .... **313/318,** 174/50.52, 174/50.61, 339/218 R

[51] **Int. Cl.** **H01j 5/50,** H05k 5/06, H01r 9/12

[58] **Field of Search** .... 313/64, 317, 318; 174/50.52, 174/50.61, 152.4; 359/176, 218 R

[56] **References Cited**

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3,356,466 12/1967 Wildeboer et al. .... 174/50.61 X

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[57] **ABSTRACT**

An electrical lead-in connector of low capacitance and high strength is described including a tubular socket member. The connector socket member is sealed within an aperture extending through an envelope wall and is provided with a pin receiving chamber open to the exterior of the envelope which has a length greater than its width. A lead attachment projection of solid metal is provided on the interior end of the socket member for welding an electrical lead thereto which may be connected to an electrode within the envelope of a cathode ray tube or other electrical device. The lead-in connector is provided with spring contacts within the pin receiving chamber for engagement with a connector pin inserted into the chamber, or the connector pin itself may be formed with leaf spring contacts or of a resilient member of twisted wire.

17 Claims, 6 Drawing Figures

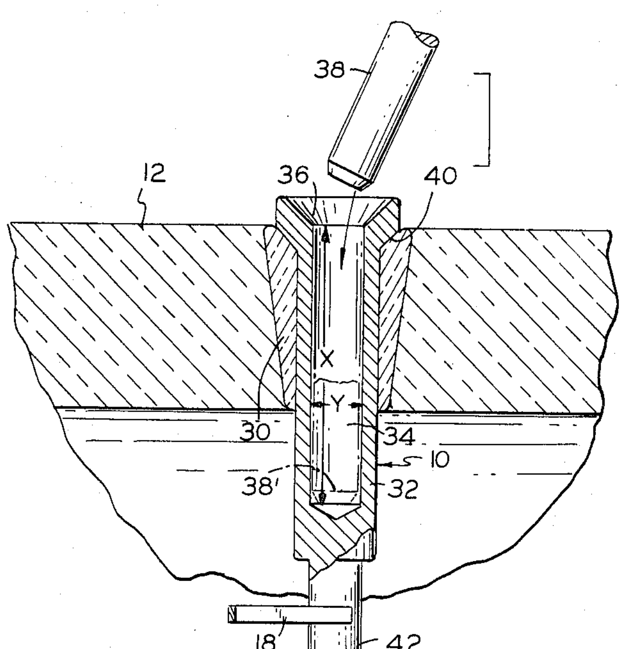

FIG. 1

PRIOR ART

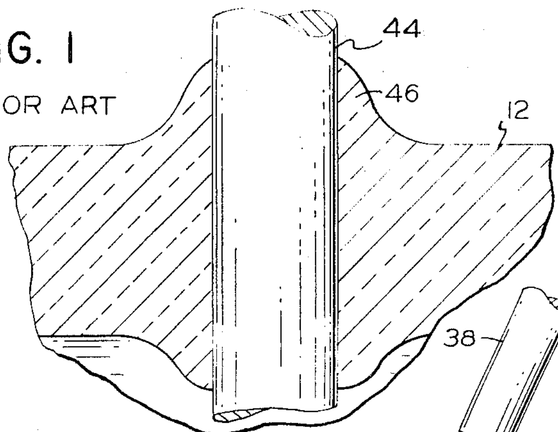

FIG. 3

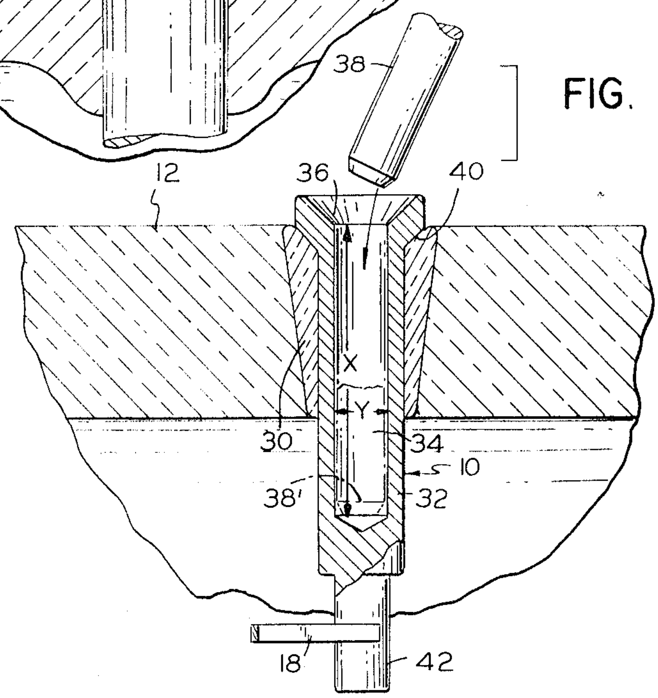

FIG. 2

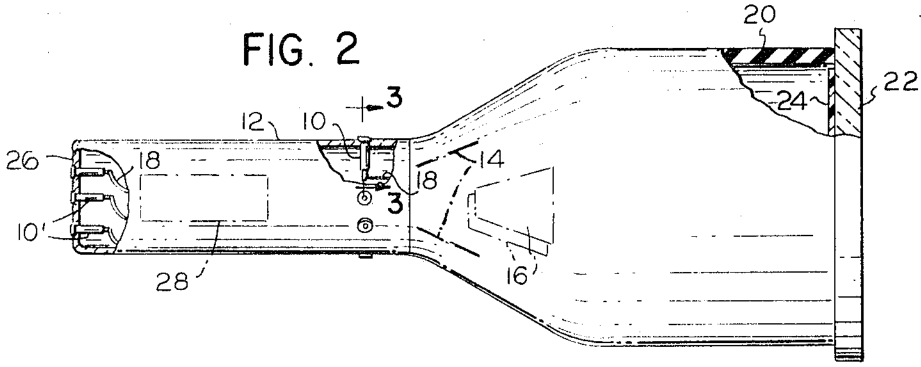

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FIG. 4

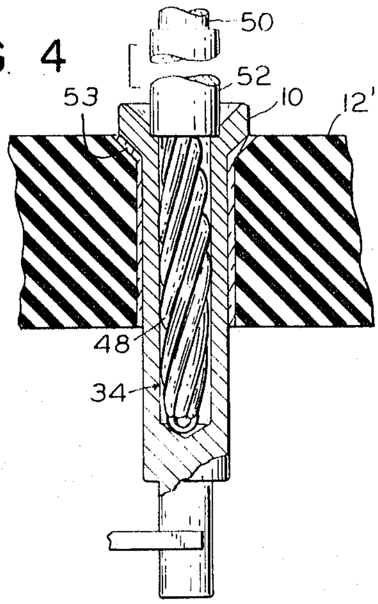


FIG. 5

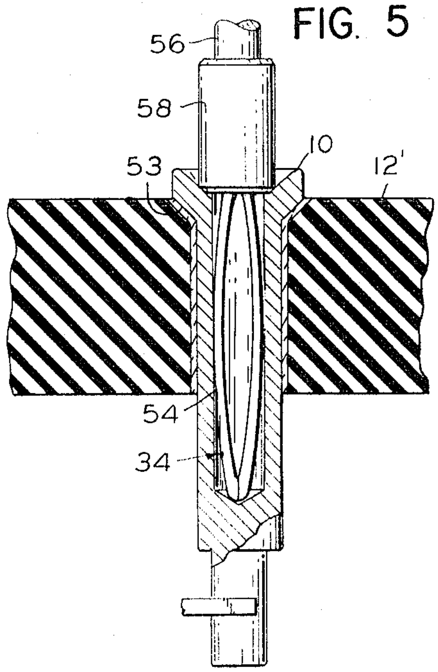
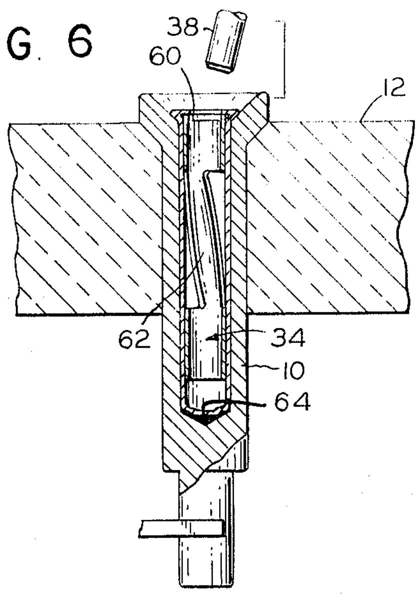


FIG. 6



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ELECTRICAL LEAD-IN TUBULAR SOCKET MEMBER FOR ELECTRONIC TUBES

This is a continuation of pending U.S. Pat. application Ser. No. 766,912 entitled ELECTRICAL LEAD-IN TUBULAR SOCKET MEMBER FOR ELECTRONIC TUBES, Filed Oct. 11, 1968

BACKGROUND OF THE INVENTION

The present invention relates generally to lead-in connector apparatus for transmitting electrical signals through the wall of a hermetically sealed envelope, and in particular relates to a lead-in connector in the form of a tubular socket member having a pin receiving chamber therein which opens to the exterior of the envelope for receiving a connector pin inserted into such chamber. The term "pin" as used herein refers to a connector of greater length than width and includes not only a rigid metal rod but also a resilient spring contact member formed of leaf spring contacts or of twisted wire strands.

The lead-in connector of the present invention can be employed in any electrical apparatus having a hermetically sealed envelope including electron tubes, vacuum evaporation apparatus, electron microscopes and the like, to transmit electrical signals through the envelope wall. Thus the lead-in connectors of the present invention may be employed in place of the base pins ordinarily provided in the base portions of diodes, triodes and other electron tubes including cathode ray tubes for applying supply voltages or input signals to the cathode, anode and grid electrodes of such tubes. However, because of its lower capacitance, the present lead-in connector is especially useful when substituted for the neck pins ordinarily provided in the neck portion of a cathode ray tube for applying high frequency signals to the deflection plates within such tube when it is employed in a cathode ray oscilloscope.

The pins conventionally used as lead-in connectors for cathode ray tubes are in the form of rigid rods of solid metal which were sealed through the glass wall of the base or neck portion of the envelope. The glass-to-metal seals of the neck pins have a thickness of approximately twice the width of the envelope wall, and as a result provide the lead-in connectors with a high capacitance due to the large seal area. In addition, the prior art neck pins also suffer from the disadvantage that any non-axial force exerted on such pins tends to crack the glass around the seal because such glass is placed under tension and the tensile strength of glass is much less than its compression strength.

The above disadvantages are overcome by the tubular lead-in connector of the present invention since such connector has a lower capacitance due to the smaller seal area caused by the reduced width of the seal between such connector and the envelope wall. In addition, the present lead-in connector does not extend outwardly from the envelope wall and is stronger because no appreciable tensile stresses are produced in the glass seal region when external forces are applied thereto, such as during the insertion of a pin. It should be noted that for most glasses the compression strength is approximately three times the tensile strength. As a result of the reduced stresses placed on the seal of the present connector, the envelope wall may be made thinner than would otherwise be possible, and still resist breakage in the seal area surrounding such connector. In addition, the socket lead-in connector of the present invention has the advantage that it requires much less mounting space than the pin lead-in connectors of the prior art.

Previously lead-in connectors in the form of shallow receptacle cups for snap-on button connectors, have been employed to apply a source of high D.C. supply voltage to the anode coating on the inner surface of the envelope of the cathode ray tube, as shown in U.S. Pat. No. 2,499,834. However, these prior art lead-in connectors do not have pin receiving chambers of greater length than width extending through the wall of the envelope into the interior of such envelope in the manner of the present invention. In addition, these prior art connectors are of much greater diameter to prevent high voltage corona which provides them with a high capacitance, rendering them unsuitable for high frequency signal transmission. Unlike the high voltage anode connector buttons, the tubular lead-in connectors of the present invention are also provided with a lead attachment projection of solid metal at their inner end to enable an electrode lead to be welded to such attachment projection without producing a hole in the side wall of the pin receiving chamber.

The present lead-in connector also has a tapered inlet end including a tapered inner surface which acts as a guide funnel to enable easier insertion of a connector pin, and tapered outer surface which prevents sealing glass from inadvertently flowing into the pin receiving chamber and insulating the pin from such connector.

It is therefore one object of the present invention to provide an improved electrical lead-in connector for a hermetically sealed envelope in the form of a tubular connector member having a pin receiving chamber.

Another object of the invention is to provide an improved lead-in connector apparatus for an electron tube which is stronger and more compact and which enables the use of thinner envelope walls.

A further object of the invention is to provide an improved lead-in connector of lower capacitance for a cathode ray tube or other electron tube, which is capable of transmitting signals of higher frequency.

An additional object of the present invention is to provide an improved lead-in connector for an electron tube including a tubular pin receiving member having a lead attachment projection on its inner end to enable welding of an electrode lead thereto without producing a hole in the wall of the tubular member.

Still another object of the present invention is to provide a lead-in connector apparatus including a tubular connector member having a pin receiving chamber with tapered end surfaces to enable easier insertion of a connector pin and to prevent sealing glass from flowing into such chamber.

BRIEF DESCRIPTION OF DRAWINGS

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

FIG. 1 is a section view of the prior art lead-in connector used to apply signals to the deflection plates in a conventional cathode ray tube;

FIG. 2 is a schematic view of a cathode ray tube employing lead-in connectors made in accordance with one embodiment of the present invention;

FIG. 3 is an enlarged vertical section view taken along the line 3—3 of FIG. 2 showing a connector pin being inserted into the lead-in connector;

FIG. 4 is a section view of another embodiment of the present lead-in connector apparatus;

FIG. 5 is a section view of a third embodiment of the lead-in connector apparatus of the present invention; and

FIG. 6 is a section view of a fourth embodiment of a lead-in connector apparatus.

DESCRIPTION OF PREFERRED EMBODIMENTS

As shown in FIG. 2, a cathode ray tube may be provided with a plurality of metal lead-in connectors **10** in accordance with the present invention which are sealed in the glass wall of a neck portion **12** of the evacuated tube envelope. The lead-in connector is a tubular pin receiving socket member extending from the exterior to the interior of the envelope. The interior end of the lead-in connectors are electrically connected to vertical deflection plates **14** or horizontal deflection plates **16** contained within such envelope by means of conductor leads **18** welded thereto.

The envelope of the cathode ray tube may have a ceramic funnel portion **20** sealed to the glass neck portion **12** by means of a devitrified glass seal, as shown in U. S. Pat. No. 3,207,936 of W. H. Wilbanks, or the neck portion may also be made of the same crystalline ceramic material integral with the funnel portion. A glass face plate **22** supporting a phosphor screen **24** is attached to the other end of the ceramic funnel portion **20** by another seal of devitrified glass. The base **26** of the envelope is provided on the closed end of the glass neck portion **12** and such base may also be provided with similar lead-in connectors **10'**. The base lead-in connectors **10'** are electrically connected to the cathode and other electrodes of an electron gun **28** within the envelope by means of conductor leads **18** welded thereto.

As shown in FIG. **3**, the lead-in connector **10** is coated with a sealing glass **30** which forms a hermetic glass-to-metal seal between the glass envelope wall **12** and the metal connector. The lead-in connector **10** has a tubular wall portion **32** surrounding a cylindrical pin receiving chamber **34**. The sealing glass **30** may be of the same glass employed in the envelope wall **12** and is shown as a different glass for purposes of clarity. The sealing glass is applied to the exterior surface of the wall portion **32** of the lead-in connector **10** to wet the connector and spreads to the approximate shape shown by region **30** during sealing.

The outer end of the pin receiving chamber **34** has an inlet opening surrounded by a tapered conical inner surface **36** which acts as a guide funnel to facilitate the insertion of a connector pin **38** into such chamber. The exterior of the outer end of connector **10** is also provided with a tapered conical outer surface **40** which deflects the sealing glass **30** outward and prevents it from flowing into the inlet opening of chamber **34**, which would otherwise insulate the pin **38** from the lead-in connector **10**. The pin receiving chamber **34** has a length X much greater than its maximum width or diameter Y, so that X may be three or four times Y to enable the pin **38** to be firmly held within the lead-in connector **10** in its inserted position **38'**.

A lead attachment projection **42** of solid metal is provided on the interior end of the lead-in conductor and may extend inward from the bottom of the pin receiving chamber **34**. The attachment projection **42** enables the electrical lead **18** to be spot welded thereto without forming a hole through the tubular wall portion **32** of the lead-in connector, which would prevent the envelope from being hermetically sealed since such connector forms part of the envelope wall. In order to avoid any possibility of the lead **18** being welded to the thin wall portion **32**, such attachment projection is made of a smaller diameter to visually indicate the upper end of the projection. The upper end of the projection **42** is spaced from the bottom of the receiving chamber a distance several times the thickness of the wall portion **32**. Of course, if desired, the attachment projection **42** could extend from the side, rather than the bottom, of the lead-in connector to provide more mounting space for the electrodes within the envelope.

The lead-in conductor **10** is of a metal having a thermal coefficient of expansion approximately the same as that of the glass of the envelope wall **12**. Thus the lead-in connector **10** may be made of a metal alloy having the following composition by weight: 41.5 to 42.5 percent nickel, 5.4 to 5.9 percent chromium, 0.15 percent aluminum, 0.07 percent carbon, 0.15 to 0.25 percent manganese, 0.025 percent phosphorous, 0.15 to 0.30 percent silicon, and the balance iron. The glass of the envelope wall portion **12** in which a lead-in conductor of the above alloy is secured, may be a Code 0120 glass sold by Corning Glass Works having a typical composition of approximately 68 percent silicon dioxide (SiO_2), 15 percent lead oxide (P_bO), 10 percent sodium dioxide (Na_2O), 6 percent potash (K_2O), 1 percent lime (CaO).

In one example the outer diameter of the tubular wall portion **32** is 0.06 inch, and the chamber **34** is drilled with a 0.04 inch diameter and a length of 0.16 inch so that the thickness of the wall portion is approximately 0.01 inch and the length X is four times the width Y of the chamber. The projection **42** may be 0.04 inch diameter and 0.08 inch in length. The outer surface of the inlet end of the lead-in connector has a maximum diameter of 0.09 inch and the conical surfaces **36** and **40** are at an angle of approximately 45° with respect to the axis of the chamber **34**. The connector pin **38** may be coated with tin or other soft metal to provide a diameter slightly larger than that of the chamber **34** to insure a tighter friction fit.

As shown in FIG. **1**, the prior art lead-in connectors conventionally used in the neck portion and base of a cathode ray tube are each formed by metal rod or pin **44**, which extends through the envelope wall **12** and is flame sealed thereto by a glass seal portion **46**. The seal **46** is of much greater thickness than the thickness of the envelope wall **12**. Thus the contact area between the glass seal **46** and the connector pin **44** is much greater in the prior art connector of FIG. **1** than in the lead-in connector **10** of the present invention. This increased thickness is necessary to provide the seal for the prior art connector with greater strength due to the higher stresses produced in the seal when a force is applied to the outer end of the connector pin **44** in a direction other than an axial direction. A component of such nonaxial force will be in a direction such as to place a portion of the glass seal **44** under tension, while another portion of the seal on the opposite side of the pin is placed under compression. However, with the present tubular lead-in connector **10** any force applied by pin **38** thereto produces only stresses of compression on its seal due to the construction of such connector. Since all glasses are much stronger in compression than under tension, the seal of the prior art connector of FIG. **1** has more of a tendency to break for a given force than the seal in the connector apparatus of the present invention. For this reason the prior art seal must be made of greater thickness. As a result of the smaller area of contact between the glass seal and the lead-in connector of the present invention, such connector has a lower capacitance than that of the prior art. This, of course, means that signals of higher frequency may be transmitted through the lead-in conductors **10** to the vertical deflection plates of the cathode ray tube.

As shown in FIG. **4**, a resilient connector pin **48** may be employed to provide better electrical contact between such pin and the lead-in connector **10**. The resilient pin **48** is formed by a plurality of twisted wires which function in the manner of a helical spring to provide many contact points around the periphery of the twisted wire. The connector pin **48** is fastened to a lead wire **50** by a sleeve which may be crimped or soldered thereto. Other than the use of the twisted wire pin **48**, the embodiment of the lead-in connector apparatus of FIG. **4** may be similar to FIG. **3**. However the envelope wall **12'** can be made of a crystalline ceramic material, such as "-FOSTERITE," and sealed by a metal braze **53** to the lead-in connector **10**. One suitable twisted wire pin which can be employed in the embodiment of FIG. **4** is shown in U.S. Pat. No. 3,319,217 of D. L. Phillips.

A third embodiment of the lead-in connector apparatus of the present invention similar to that of FIG. **4**, is shown in FIG. **5**, in which the spring contact connector pin is in the form of a pair of leaf spring members **54** which are slightly bowed, and in a relaxed position have a maximum width greater than the diameter of the pin receiving chamber **34**. The leaf spring pin member **54** may also be attached to a lead wire **56** by means of crimping or soldering within a fastener sleeve **58**.

Another approach to providing spring contact between the lead-in connector **10** and the connector pin **38** is shown in FIG. **6**. This embodiment differs from that of FIG. **3** in that a tubular insert sleeve **60** containing a slotted tubular liner **62** is provided within the connector **10**. The slotted liner **62** is secured within sleeve **60** by clamping the inlet end of the sleeve over the edge of the liner. The slotted liner has a plurality of spring contacts formed by the land areas between the slots which are bowed inwardly to engage the solid connector pin **38**, when it is inserted therein. The insert sleeve **60** is secured within the pin receiving chamber **34** of the connector **10** by a conductive epoxy resin cement **64**, or by a low temperature solder.

It will be obvious to those having ordinary skill in the art that many changes may be made in the details of the above described preferred embodiment of the present invention without departing from the spirit of the invention. Therefore the scope of the present invention should only be determined by the following claims.

I claim:

1. An electrical lead-in apparatus for a cathode ray tube comprising:

an envelope adapted to be hermetically sealed and having a wall portion of insulating material provided with an aperture therethrough;

an electrical lead-in connector mounted within said aperture, having a closed end portion within said envelope spaced inwardly from said wall portion, an open end portion which opens to the exterior of the envelope, and a tubular side portion extending between said closed end portion and said open end portion to provide a pin receiving chamber within said connector whose length is greater than its maximum cross sectional width and which extends completely through the envelope wall and into the interior of the envelope; and

seal means for attaching said connector to the envelope wall portion by a hermetic seal between said side portion of said chamber and said wall portion of said envelope.

2. An apparatus in accordance with claim 1 in which the connector has a lead attachment projection of solid metal extending from said closed end portion of a distance greater than the thickness of said side portion and positioned within said envelope so as to enable an electrical lead to be fused thereto without forming a hole through the conductor wall.

3. An apparatus in accordance with claim 1 in which the pin receiving chamber is of a uniform cross section throughout the length of said chamber, said chamber having a length greater than the thickness of said envelope wall and many times greater than the maximum cross sectional width of said chamber.

4. An apparatus in accordance with claim 1 in which an electrical conductor pin of greater length than diameter is inserted into the chamber of said connector for electrical connection thereto, said pin extending from the exterior into the interior of the envelope.

5. An apparatus in accordance with claim 4 in which the conductor pin is a resilient member.

6. An apparatus in accordance with claim 5 in which the resilient pin member includes spring contacts.

7. An apparatus in accordance with claim 1 in which the envelope wall portion is made of glass, the connector is made of metal, and the seal means forms a glass-to-metal seal.

8. An apparatus in accordance with claim 1 in which the envelope wall portion is made of crystalline ceramic material, the connector is made of metal, and the seal means forms a ceramic-to-metal seal.

9. A device in accordance with claim 1 in which the open end portion of said connector is provided with an inwardly tapering inlet opening communicating with said chamber.

10. A device in accordance with claim 9 in which the connector side wall portion in the region of the seal is provided with a tapered outer flange at said open end portion.

11. A device in accordance with claim 10 in which the connector is a cylindrical tube and the inlet opening and flange are conical.

12. A device in accordance with claim 2 in which the lead attachment portion projects from the bottom of the closed end portion and is of reduced cross-sectional area.

13. A device in accordance with claim 1 in which the pin receiving chamber is cylindrical with a substantially uniform diameter throughout its length.

14. A device in accordance with claim 1 in which a tubular insert having spring contacts therein is attached within the connector.

15. A device in accordance with claim 2 in which the envelope is part of an electron tube which has a plurality of said connectors attached thereto with the closed end portions connected to electrodes within said tube.

16. A device in accordance with claim 15 in which the electron tube is a cathode ray tube and at least some of the connectors are connected to electron beam deflection plates within said tube.

17. An electrical lead in apparatus for a cathode ray tube, comprising:

an envelope adapted to be hermetically sealed and having a wall portion provided with an aperture therethrough;

an electrical lead-in connector disposed within said aperture and having a closed-end portion and an open-end portion, said closed-end portion being within said envelope and a tubular portion extending between said closed-end portion and said open-end portion to provide a pin receiving chamber within said connector whose length is greater than its maximum cross-sectional width and which is adapted to electrically receive a connector pin therein; and

seal means surrounding said tubular portion from adjacent said open end portion to a position on said tubular portion substantially intermediate said open end portion and said closed-end portion for hermetically securing said connector in said aperture in electrically-insulated relationship with an inner surface of said envelope and with said open end portion in communication with the exterior of said envelope.

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