Oct. 4, 1949. W. J. SCOTT 2,483,940

METHOD OF MAKING LEAD-IN SEALS

Filed Dec. 3, 1946

Fig. 1

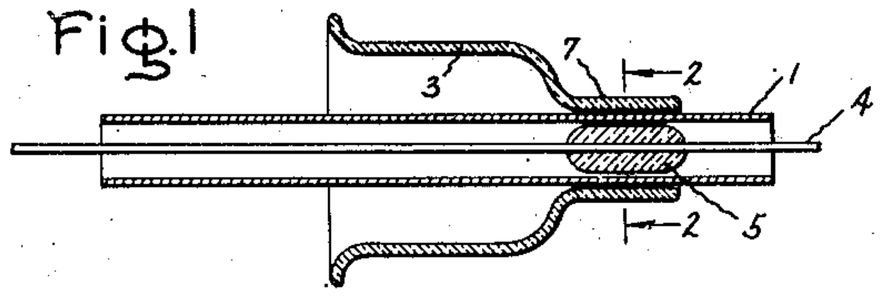


Fig. 2

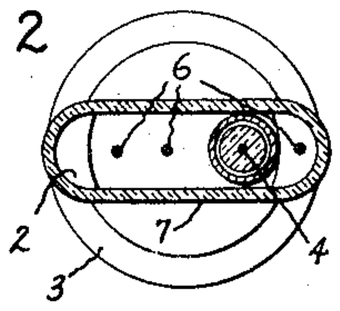


Fig. 3

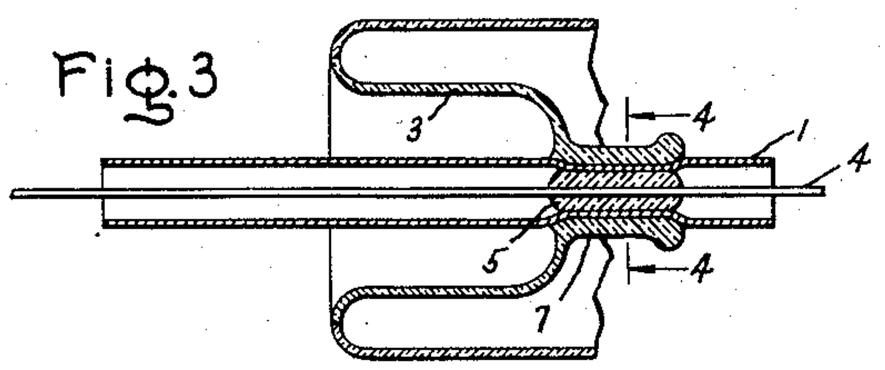


Fig. 4

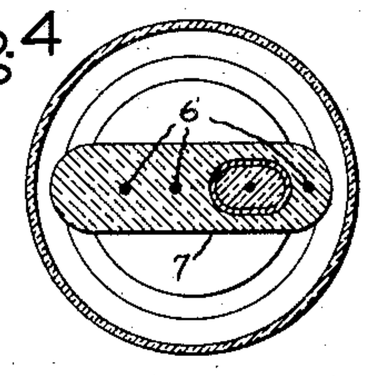


Fig. 5

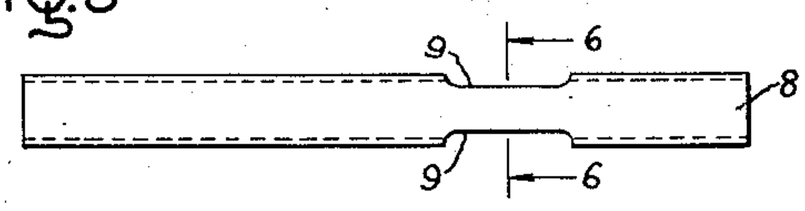


Fig. 6

Fig. 7

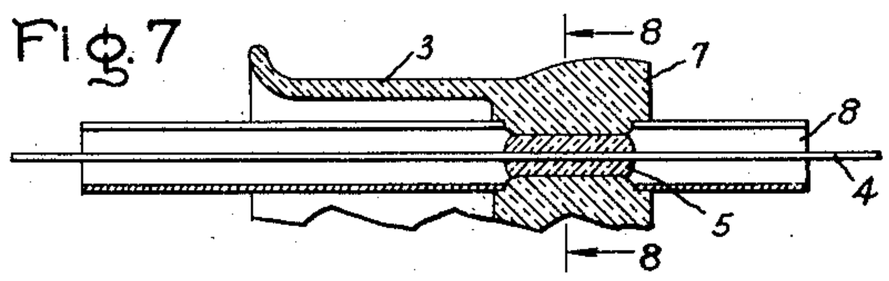


Fig. 8

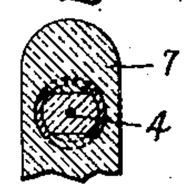


Fig. 9

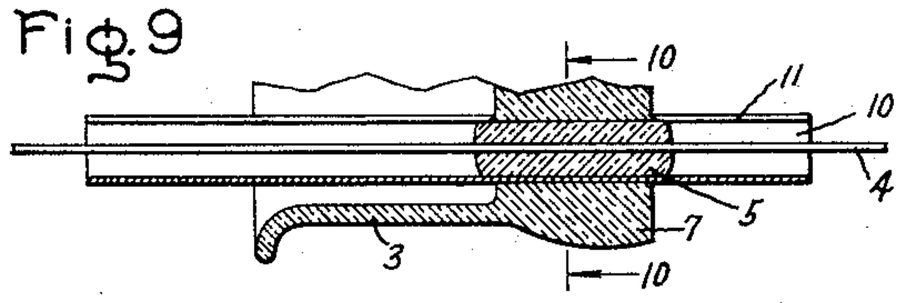


Fig. 10

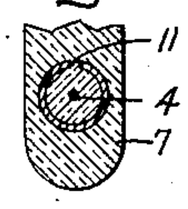


Fig. 11

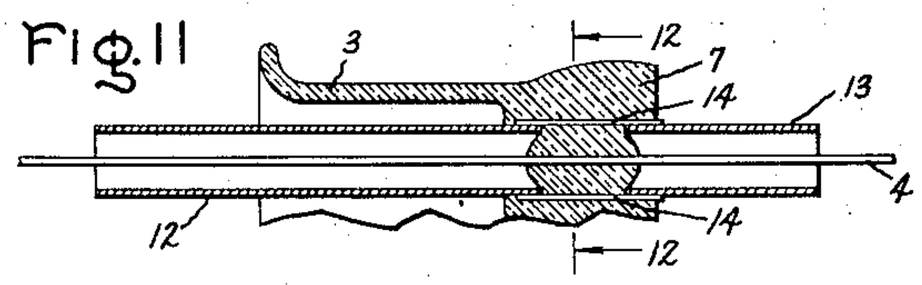


Fig. 12

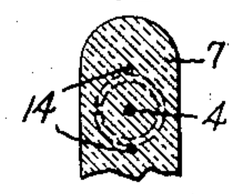


Fig. 13

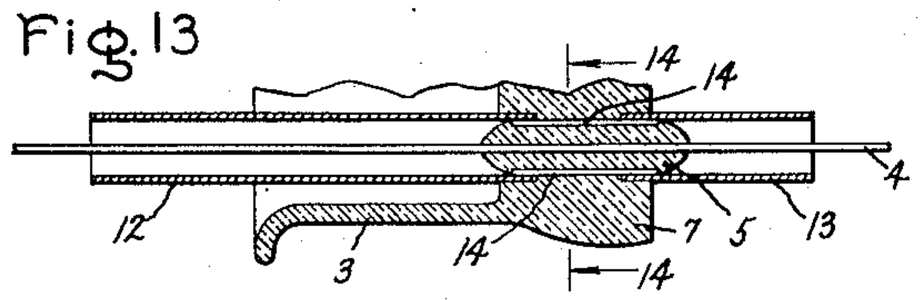
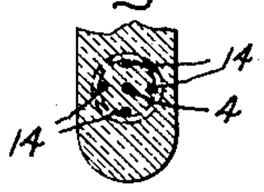


Fig. 14



Inventor:
William J. Scott,
by Merton D Morse
His Attorney.

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METHOD OF MAKING LEAD-IN SEALS

William J. Scott, Rugby, England, assignor to General Electric Company, a corporation of New York

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4 Claims. (Cl. 49—81)

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My invention relates to a method of making improved lead-in seal constructions which is particularly adapted for use in electric discharge devices designed for ultra-high frequency operation.

In high frequency electric discharge devices it is desirable to provide a section of concentric transmission line, sealed through the envelope of the device to provide accessible high frequency terminals for the device. In accordance with an important aspect of my invention, I provide a method of making an improved structure having a stem press or pinch of the type commonly used in electric discharge devices having glass envelopes.

It is an object of my invention to provide a method of making a new and improved lead-in seal construction for high frequency electric discharge devices.

It is a further object of my invention to provide a method of making an improved lead-in construction for electric discharge devices employing a concentric transmission line section as the high frequency terminals of the device.

It is a still further object of my invention to provide an improved method of manufacturing an electric discharge device having a concentric transmission line sealed through the envelope.

My invention will be better understood by reference to the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claims. In the drawing, Fig. 1 is an elevational view in section showing the components of a lead-in seal embodying my invention as they appear before the sealing operation; Fig. 2 is a sectional view taken along the line 2—2 of Fig. 1; Fig. 3 is an elevational view corresponding to Fig. 1 and showing the parts after the sealing operation is complete; Fig. 4 is a sectional view taken along the line 4—4 of Fig. 3; Fig. 5 is an elevation view of a hollow cylindrical conductor employed in a modification of my invention; Fig. 6 is a sectional view taken along the line 6—6 of Fig. 5; Figs. 7 and 8 are sectional views illustrating modifications of my invention employing the conductor shown in Fig. 5; and Figs. 9 to 14 inclusive are sectional views illustrating three further modifications of my invention.

Referring now to the drawing, I have shown in Fig. 1, an embodiment of my invention in which a concentric transmission line including an outer hollow conductor 1 is received within the opening 2 of a glass body 3 which is of the type commonly employed for providing the stem press of

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an electric discharge device. A central solid conductor 4 of the transmission line is received within the outer conductor 1 and sealed to it by a body of glass 5 which may to advantage be a glass bead which is sealed to the conductor 4 prior to assembly with the conductor 1. As shown in Figs. 2 and 4 conventional lead-in conductors 6 may also be positioned in the opening 2. The various parts described and illustrated in Figs. 1 and 2 are assembled in a suitable jig and the parts heated by any suitable means (not shown) in the region at which the pinch or press is to be formed. It will be noted that the flattened portion 7 of the glass body 3 and the glass bead 5 have the same longitudinal location so that the seal between the hollow conductor 1 and the press, as well as the seal between the glass body 5 and the outer conductor 1 may be made simultaneously. After the glass parts have been heated sufficiently to render them plastic or semi-plastic, pressure is applied to form the seal as illustrated in Figs. 3 and 4. The pressure is sufficient to flatten the outer conductor 1 of the transmission line at the region of the press and to contract it into sealing engagement with the bead 5. It is readily appreciated that the change in shape of the conductor from circular to non-circular effects a reduction in the cross-sectional area sufficient to bring the outer conductor into engagement with the glass bead.

I have found that it is desirable in many cases to provide for the flow of glass from the press to the area between the inner and the outer conductors of the transmission line in order to avoid the necessity of reducing of the cross-sectional area of the outer conductor when making the seal. In Figs. 5 to 6 is illustrated an outer conductor 8 of suitable construction for this purpose. The conductor 8 may be formed of suitable material such as copper-coated steel, and shaped on a mandrel of generally cylindrical cross section. As shown in Fig. 6, the edges of the sheet material need not be joined. At the region where the conductor is to be received in the press, a pair of openings 9 are provided on opposite sides of the conductor. It is apparent from Figs. 7 and 8 that, as the glass is heated and pressure applied, sufficient glass of the press flows through the openings 9 and joins with the glass bead 5. In Figs. 7 to 14 parts corresponding with the parts illustrated in Figs. 1 to 4 inclusive are designated by the same reference numerals. In Figs. 9 to 10 is illustrated a modification of my invention which is very similar to that shown in Figs. 7 and 8. In Figs. 9 and 10 the outer con-

ductor is not provided with additional openings 9 and the gap 11 between the adjacent edges of the sheet material forming the conductor is relied upon to permit the glass from the press 3 to join with the bead 5.

On Figs. 11 to 14, I have illustrated still further modifications of my invention in which the passages for allowing the flow of glass into the interior of the outer conductor are provided by making the outer conductor in two sections arranged in aligned and longitudinal spaced relation. As illustrated in Fig. 11, the outer conductor is made up of two parts 12 and 13 joined together at adjacent ends by small solid conductors 14 which are welded at opposite ends to the hollow conductors 12 and 13. When only two conductors 14 are employed, as illustrated in Figs. 11 and 12, it is possible to rely entirely on the flow of glass from the press body 3 and no bead on the inner conductor is required.

The modification shown in Figs. 13 and 14 is very similar to that shown in Figs. 11 and 12 except that four conductors 14 are employed to join the hollow conductors 12 and 13 together. These conductors 14 are arranged within the conductors 12 and 13 and as illustrated a glass bead 5 is provided on the inner conductor 4. It will be appreciated that in the modifications in Figs. 7 to 14 inclusive, the parts are assembled in the desired relationship and held in position by a suitable jig while the parts are heated at the region where the press is to be formed until the glass is sufficiently plastic to flow through the outer conductor upon the applications of pressure.

My invention as illustrated by the embodiments described above is well adopted for use in electric discharge devices utilizing a stem press which is in general of conventional design and which may be manufactured without any additional press operations over that required for the seal-in of the conventional lead-in conductors.

While I have described and illustrated a particular embodiment of my invention, it will be obvious to those skilled in the art that changes and modifications may be made without departing from my invention in its broader aspects, and I, therefore, aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. The method of sealing a concentric transmission line including inner and outer conductors through the press of an envelope for an electrical discharge device comprising the steps of locating a glass bead on the inner conductor of the line, assembling the inner and outer line conductors and the glass stem on which the press is to be formed in a required relation such that the bead is located at the position of the press, applying heat to render plastic the bead and the portion of the stem at which the press is to be formed, and then applying sufficient pressure to the heated portion of the stem to collapse that portion onto the outer conductor and to distort the outer conductor so as to cause the bead completely to fill the outer conductor at the press.

2. The method of sealing a concentric transmission line including inner and outer conductors through an insulating body of an envelope for an electrical discharge device comprising the steps of locating a glass bead on the inner conductor of

the line, assembling the inner and outer line conductors and the body of insulating material in a required relation such that the bead is located at the position at which the seal between the outer conductor and the body is to be formed, the outer conductor having an opening therethrough at the region where it passes through said body, applying heat to render plastic the bead and the required portion of the body, and then applying sufficient pressure to the heated portion of the body to cause the glass to flow through the opening to coalesce with the glass bead and embed the outer and inner conductors completely in the glass and form a vacuum-tight seal between the conductors and between the outer conductor and said body.

3. The method of sealing a concentric transmission line including inner and outer conductors through a glass body forming a part of an envelope for an electrical discharge device, said outer conductor having an opening therethrough comprising the steps of assembling the inner and outer line conductors and the glass body in a required relation such that the opening in the outer conductor is located at the point where the seal to said body is to be formed, applying heat to render plastic the required portion of the body and then applying sufficient pressure to the heated portion of the body to collapse that portion onto the outer conductor and to cause a part of the glass to flow through the opening into the interior of the outer conductor to form a vacuum-tight seal between said outer conductor and said body.

4. The method of sealing a concentric transmission line including inner and outer conductors through the press of an envelope for an electrical discharge device comprising the steps of locating a glass bead on the inner conductor of the line, assembling the inner and outer line conductors and the glass stem on which the press is to be formed in a required relation such that the bead is located at the position of the press, applying heat to render plastic the bead and the portion of the stem at which the press is to be formed and then applying sufficient pressure to the heated portion of the stem to collapse that portion onto the outer conductor and to affect a seal including said bead between said inner and outer conductors.

WILLIAM J. SCOTT.

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