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H. DE B. KNIGHT
ELECTRICAL DISCHARGE DEVICE

2,460,132

Filed Sept. 25, 1946

Fig. 1.

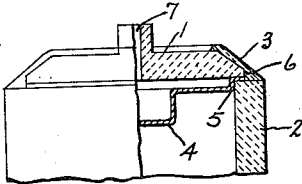


Fig. 2.

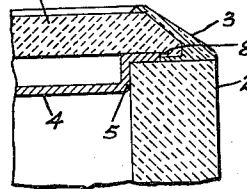


Fig. 3.

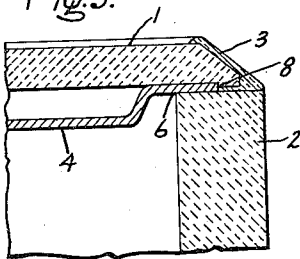


Fig. 4.

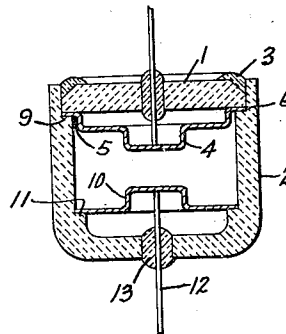


Fig. 6.

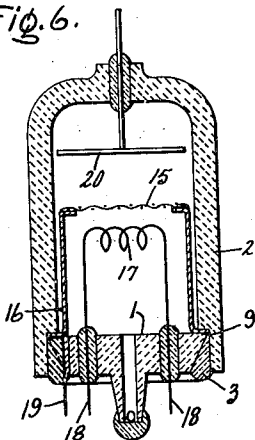


Fig. 5.

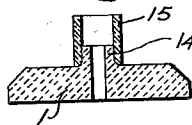


Fig. 8.

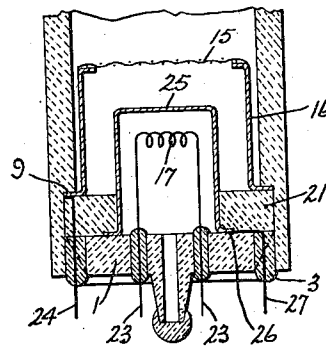
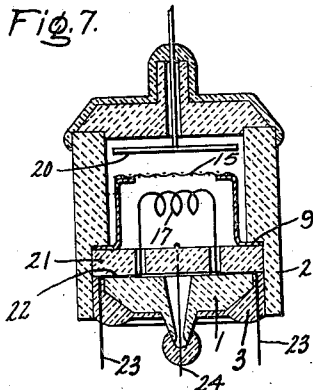


Fig. 7.



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UNITED STATES PATENT OFFICE

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ELECTRICAL DISCHARGE DEVICE

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14 Claims. (Cl. 250—27.5)

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The present invention relates to electric discharge devices and in particular to the manufacture of such devices in which the evacuated or gas-filled envelope is of simplified construction conveniently adaptable to economical quantity manufacture and which may consist wholly or mainly of ceramic or similar insulating material.

It is essential in manufacturing electric discharge devices to maintain a predetermined relationship between the electrodes of the device, and it is one of the main objects of the present invention to provide a construction for devices employing a ceramic envelope in which the required disposition of the electrodes and the securing of the electrodes in position in the envelope can readily be effected.

An electric discharge device according to one aspect of the invention comprises an envelope of ceramic material within which an electrode is secured by means of a closure plate or header which covers an opening in and is sealed to the envelope, the interior periphery of the envelope or the header being provided with an annular shoulder against which the electrode or a support therefor abuts, whereby the electrode is both positioned within the envelope and secured thereto by the sealing of the header to the envelope.

According to another aspect of the invention, an electric discharge device comprises an envelope of ceramic material within which an electrode is secured by means of a shoulder which covers an opening in and is sealed to the envelope, the electrode, or a support therefor, being provided with a peripheral shoulder which abuts against the inner periphery of the envelope and with an outwardly extending flange which is sealed between the header and the rim of the envelope.

In carrying out the invention in connection with a discharge device possessing two electrodes between which a discharge is adapted to occur when a predetermined potential between them is exceeded, the device thus being of the nature of a spark gap, while one electrode is secured to the envelope by means of the header, as above set forth, the other electrode may be accurately spaced with respect to the first electrode by mounting it at the end of the envelope remote from the header by means of a support rod sealed through an opening in the envelope. This second electrode may have its rim seated against an internal shoulder in the inner periphery of the wall of the envelope so as to space it accurately from the other electrode.

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A somewhat similar construction may be employed for the case in which two electrodes are again provided, one of them consisting of an electron-emitting cathode. The support for the cathode may then comprise a member sealed between the header and the envelope in the manner above described, this support constituting one terminal of the cathode while the other terminal is brought through an aperture in the header and sealed therethrough. The cathode may be in two or more sections, each section having one terminal connected to the support sealed to the envelope by the header, while a common terminal for each section is connected to the second lead which is independently brought through the header. The cathode may be of the indirectly heated type, if desired, in which case the indirectly heated portion may consist of a hollow cylinder mounted on or forming part of the support for the cathode which is sealed to the envelope and the header.

The header preferably consists also of ceramic material but it may consist of metal. In the case in which the header consists of metal, any leads required to be brought through it in insulating relation thereto may be brought through by glass to metal seals of well known character.

The sealing of the header to the envelope is preferably effected by glass. The glass may be provided in the neighborhood of the seal in the form of a collar constituted by a short length of glass tubing, the glass being softened and caused to flow to form the seal by heating the device, preferably in a reducing atmosphere, after assembly.

When glass is employed for sealing, it is necessary to ensure that the thermal expansion coefficient of the glass is suitably matched to that of the ceramic material and to any metal which may be present at the seal.

Alternatively, the sealing may be effected by soft solder, in which case those parts whereat sealing is to be effected and which consist of ceramic material are previously provided with an adherent metallic coating, for example, by coating with an oxide of tungsten or molybdenum, as by sputtering, and reducing the oxide to a metal.

In the case in which two or more electrodes are to be secured in the envelope in spaced relationship to one another by means of the header, each electrode or the support therefor may be provided with a peripheral flange which fits within a shouldered recess in the interior wall of the envelope adjacent the open end thereof, one of the flanges being seated against the shoulder, while

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another (or others) is seated against an insulating ring which separates electrically two otherwise adjacent flanges. The flanges are then secured in position within the recess by seating against the outermost flange (or an insulating ring placed thereon) a header which closes the open end of the envelope and is sealed thereto.

Conveniently, the envelope may consist of a cup-shaped hollow body of ceramic material, but a hollow cylinder may also be employed. In the latter case electrodes may be secured to both ends of the envelope by the means above set forth. When the envelope is cup-shaped, the closed end thereof may be provided with an aperture through which the lead to an electrode supported at the closed end of the envelope is brought. A shoulder may be provided adjacent the closed end of the envelope for seating the electrode thereagainst if desired.

In the case in which the envelope is completed by sealing a single header to an open end thereof, the remote closed end may be provided with an opening through which the evacuation and, if desired gas filling may take place.

The invention will now be described with the aid of the accompanying drawings, in which Figs. 1, 2 and 3 show in cross-section illustrative alternative methods of locating an electrode with respect to a ceramic envelope by means of a header which is sealed to the envelope; Fig. 4 illustrates in cross-section a hermetically sealed spark gap constructed in accordance with the invention; Fig. 5 a method of providing a sealing-off tubulation for the envelope; and Figs. 6, 7, and 8 alternative constructions for a multi-electrode discharge device in accordance with the invention. In the drawings, like numerals have been used to designate like parts throughout.

Referring first to Figs. 1, 2 and 3, there is shown therein methods of employing a ceramic header for locating and sealing an electrode into a ceramic envelope. The header 1 is fitted to a generally cylindrical ceramic envelope 2 and is sealed to it by the glass shown at 3, thereby forming a closure for the otherwise open end. The electrode 4, which may be made in the form of a pressed metal disk, is provided with a peripheral shoulder 5, which abuts against the internal periphery of the envelope 2, and an outwardly flanged portion 6 resting against the end of the envelope between the header 1 and the envelope rim. The sealing of the header to the envelope by glass thus secures the electrode in position in desired relationship to the envelope. The header may be provided with an aperture 7 through which a leading-in wire to the electrode may be passed and sealed therein in any suitable manner, e. g., by glass in a manner similar to that shown in Fig. 4. In the arrangements shown in Figs. 2 and 3 the header is provided with an internal shoulder 8 to receive the rim of the electrode flange.

In Fig. 2 the shoulder 5 serves to center the electrode and the header with respect to the envelope, while in Fig. 3 the flange on the electrode abuts against the shoulder 8 so that the positioning of the header on the envelope effects the centering of the electrode therein.

Referring now to Fig. 4, which illustrates an exemplary construction of a spark gap, the envelope 2 is made cup-shaped and is provided adjacent its open end with an annular shoulder 9 against which the flanged portion 6 of the electrode 4 rests. The header 1 is made to fit into the recess in the open end of the envelope and

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is again sealed thereto by glass as at 3. If desired the glass may be arranged to extend over the whole external surface of the header, as indicated in interrupted lines. In this construction, the second electrode 10 of the spark gap is seated against an internal shoulder 11 adjacent the closed end of the envelope, and the leading-in conductor 12 to electrode 10 is brought through an aperture in the closed end of the envelope and is sealed therein by glass as at 13.

With such a construction the electrodes 4 and 10 may be accurately spaced, in so far as the electrodes are made from stampings and are thus of constant dimensions and since the spacing of the shoulders 9 and 11 of the envelope can be accurately controlled. If desired, the electrode 10 may be mounted in a similar manner to that adopted for the electrode 4 by making the envelope in the form of a hollow cylinder open at both ends and seating the electrode 10 against a shoulder similar to the shoulder 9 but adjacent the remote end of the tube. The closure of the remote end is then effected by a header similar to 1.

In Fig. 5 there is illustrated the manner in which evacuation of the envelope may be effected by providing a boss 14 on the header 1 and surrounding the boss by a glass tube 15 which is sealed around the boss. The glass tube 15 may then be connected to a vacuum pump and sealed off by a tip in the usual manner when the device has been evacuated and/or gas-filled.

In place of providing an internal shoulder within the envelope we may employ a series of internal projections which form a discontinuous shoulder and which are to be regarded as being equivalent to the shoulder.

Referring now to Fig. 6 there is shown a construction of a three-electrode discharge device embodying the invention. The cup-shaped envelope 2 is again provided with an internal shoulder 9 adjacent its open end against which the rim of a control electrode 15, or support therefor 16, is seated, the electrode 15 being held in position by sealing-in the header 1 in the manner above described. In this case the cathode 17 is in the form of a directly heated filament having leads or supporting rods 18 passed through apertures in the header 1 which are sealed by glass. A lead 19 may be connected to the support for the control electrode 15 and passed through a notch or groove in the periphery of the header 1 prior to the sealing of the header to the envelope by the glass shown at 3. The electrode 15 and its support 16 may be of suitable cylindrical construction. The anode 20 is supported from the closed end of the envelope by means similar to that already described in connection with Fig. 4.

Fig. 7 shows a further construction similar to Fig. 6 in which two or more electrodes may be supported from the end of the envelope closed by the header 1. In this case, the support for the control electrode 15 is seated against the shoulder 9, and against the flange portion of the support is placed an insulating ring or disk 21 having apertures for the passage of the leading-in wires to the cathode 17. As indicated at 22, these lead-in wires are then spread out around the edge of the header 1, which is sealed to the envelope by glass at 3, and holds the electrodes in position. The leads 23 to the cathode and 24 to the grid are peripherally spaced from one another to provide adequate insulation, the leads being taken through notches in the periphery of

the header as described in connection with Fig. 6.

In the arrangement shown in Fig. 7 the anode 26 is supported by means of a further header sealed to the envelope by glass. The anode 20 may be supported and centered within the envelope by any of the methods shown in Figs. 1, 2, 3, or 4 if desired.

Where an indirectly heated type of cathode is required, a cathode cylinder surrounding a heater element similar to cathode 17 may be provided with a flanged support on its lower end which is held between the header 1 and an insulating ring 21, the heater leads being taken through the header as in Fig. 6. Where a lead to another electrode is to pass a conducting flange, the flange may be provided with a cut away portion to avoid electrical connection between the electrodes. Such an arrangement is shown in Fig. 8 wherein the support 16 for the grid 15 is positioned by the disk 21 as in Fig. 7, while a cathode cylinder 25 (which may be provided with a thermionically emissive coating) is arranged to fit concentrically within a circular hole in the center of disk 21. A flange 26 on the lower end of the cathode cylinder 25 is arranged to engage a recess in the lower wall of disk 21. As in Fig. 7 the header 1 is sealed to the envelope and holds both the disk 21 and the electrodes in position. The cathode heater 17 may be provided with leads 23 extending through the header 1 as in Fig. 6. Lead 24 to the grid 15 may be provided as before and a lead 27 to the cathode 25 may be arranged to pass through the glass seal and in between the disk 21 and header 1 to contact the flange 26. It will be understood of course that an anode structure such as in Fig. 7 may be provided.

While I have shown and described a particular embodiment of my invention, it will be obvious to those skilled in the art that various 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 is:

1. An electric discharge device comprising a plurality of electrodes, an hermetically sealed envelope for said electrodes including a portion defining a part of a closed discharge chamber and having an opening therein, a closure member hermetically sealed to said portion and covering said opening, and a shoulder adjacent the juncture of said portion and said closure member, one of said electrodes having a portion secured between said portion of said envelope and said closure member in engagement with said shoulder whereby said electrode is supported from and positioned within said envelope.

2. An electric discharge device comprising a plurality of electrodes, an hermetically sealed envelope for said electrodes including a substantially cylindrical portion defining a part of a closed discharge chamber and having an open end therein, a closure member hermetically sealed to said portion and covering said opening, and a shoulder adjacent the juncture of said portion and said closure member, one of said electrodes having a flanged portion secured between said portion of said envelope and said closure member in engagement with said shoulder whereby said electrode is supported from and positioned within said envelope.

3. An electric discharge device comprising a plurality of electrodes, an hermetically sealed envelope for said electrodes including a portion

defining a part of a closed discharge chamber and having an opening therein, and a closure member hermetically sealed to said portion and covering said opening, said portion having a shoulder thereon adjacent the juncture of said portion and said closure member, one of said electrodes having a portion secured between said portion of said envelope and said closure member in engagement in said shoulder whereby said electrode is supported from and positioned within said envelope.

4. An electric discharge device comprising a plurality of electrodes, an hermetically sealed envelope for said electrodes including a substantially cylindrical portion defining a part of a closed discharge chamber and having an opening therein, and a closure member hermetically sealed to said portion and covering said opening, said portion having a shoulder thereon adjacent the juncture of said portion and said closure member, one of said electrodes having a flanged portion secured between said portion of said envelope and said closure member in engagement in said shoulder whereby said electrode is supported from and positioned within said envelope.

5. An electric discharge device comprising a plurality of electrodes, an hermetically sealed envelope for said electrodes including a portion defining a part of a closed discharge chamber and having an opening therein, a first closure member in engagement with said portion and covering said opening, and a second closure member hermetically sealed to said portion over said first closure member and forming an hermetic seal over said opening, one of said electrodes having a portion secured between said portion of said envelope and said first closure member whereby said electrode is supported from and positioned within said envelope, another of said electrodes having a portion secured between said first and second closure members and extending through said first closure member into said discharge chamber whereby said other electrode is supported and positioned within said envelope.

6. An electric discharge device comprising a plurality of electrodes, an hermetically sealed envelope for said electrodes including a substantially cylindrical portion defining a part of a closed discharge chamber and having an open end therein, a disk shaped member in engagement with said portion and covering said opening, and a closure member hermetically sealed to said portion over said disk shaped member and forming an hermetic seal over said opening, one of said electrodes having a flanged portion secured between said portion of said envelope and said disk shaped member whereby said electrode is supported from and positioned within said envelope, another of said electrodes having a flanged portion secured between said disk shaped and closure members and extending through said disk shaped member into said discharge chamber whereby said other electrode is supported and positioned within said envelope.

7. An electric discharge device comprising a plurality of electrodes, an hermetically sealed envelope for said electrodes including a portion defining a part of a closed discharge chamber and having an opening therein, a first closure member in engagement with said portion and covering said opening, a second closure member hermetically sealed to said portion over said first closure member and forming an hermetic seal over said opening, and a shoulder adjacent the juncture of said portion and said closure members, one of

said electrodes having a portion secured between said portion of said envelope and said first closure member in engagement with said shoulder whereby said electrode is supported from and positioned within said envelope, another of said electrodes having a portion secured between said first and second closure members and extending through said first closure member into said discharge chamber whereby said other electrode is supported and positioned within said envelope.

8. An electric discharge device comprising a plurality of electrodes, an hermetically sealed envelope for said electrodes including a generally cylindrical portion defining a part of a closed discharge chamber and having an opening therein, a disk shaped member in engagement with said portion and covering said opening, a closure member hermetically sealed to said portion over said disk shaped member and forming an hermetic seal over said opening, and a shoulder adjacent the juncture of said portion and said disk shaped member, one of said electrodes having a flanged portion secured between said portion of said envelope and said disk shaped member in engagement with said shoulder whereby said electrode is supported from and positioned within said envelope, another of said electrodes having a portion secured between said disk shaped and closure members and extending through said disk shaped member into said discharge chamber whereby said other electrode is supported and positioned within said envelope.

9. An electric discharge device comprising a plurality of electrodes, an hermetically sealed envelope for said electrodes including a portion defining a part of a closed discharge chamber and having an opening therein, a first closure member in engagement with said portion and covering said opening, and a second closure member hermetically sealed to said portion over said first closure member and forming an hermetic seal over said opening, said portion having adjacent said opening a shoulder thereon upon which said first and second closure members rest, one of said electrodes having a portion secured on said shoulder between said portion of said envelope and said first closure member whereby said electrode is supported from and positioned within said envelope, another of said electrodes having a portion secured between said first and second closure members and extending through said first closure member into said discharge chamber whereby said other electrode is supported and positioned within said envelope.

10. An electric discharge device comprising a plurality of electrodes, an hermetically sealed envelope for said electrodes including a substantially cylindrical portion defining a part of a closed discharge chamber and having an opening therein, a disk shaped member in engagement with said portion and covering said opening, and a closure member hermetically sealed to said portion over said first closure member and forming an hermetic seal over said opening, said portion having adjacent said opening a peripheral shoulder thereon upon which said disk shaped and closure members rest, one of said electrodes having a flanged portion secured on said shoulder between said portion of said envelope and said disk shaped member whereby said electrode is supported from and positioned within said envelope, another of said electrodes having a

flanged portion secured between said disk shaped and closure members and extending through said first closure member into said discharge chamber whereby said other electrode is supported and positioned within said envelope.

11. An electric discharge device comprising a plurality of electrodes, an hermetically sealed envelope for said electrodes including a substantially cylindrical portion defining a part of a closed discharge chamber and having an opening at one end thereof, a closure member hermetically sealed to said portion and covering said opening, and a peripheral shoulder at the other end thereof, one of said electrodes having a portion secured between said portion of said envelope and said closure member whereby said electrode is supported from and positioned within said envelope, another of said electrodes being supported on said peripheral shoulder.

12. An electric discharge device comprising a plurality of electrodes, an hermetically sealed envelope for said electrodes including a substantially cylindrical portion defining a part of a closed discharge chamber and having an opening at one end thereof, a first peripheral shoulder adjacent said opening, a closure member engaging said shoulder hermetically sealed to said portion and covering said opening, and a second peripheral shoulder at the other end thereof, one of said electrodes having a flanged portion secured between said portion of said envelope and said closure member whereby said electrode is supported from and positioned within said envelope, another of said electrodes being supported on said second peripheral shoulder.

13. An electric discharge device comprising a plurality of electrodes, an hermetically sealed envelope for said electrodes including an envelope member defining a part of a closed discharge chamber having an opening therein, and a closure member hermetically sealed to said envelope member and covering said opening, a peripheral shoulder on one of said members adjacent the juncture of said members, one of said electrodes having a portion secured between said members and engaging said shoulder to position said electrode within said envelope.

14. In an electric discharge device, the combination comprising a hermetically sealed envelope including a cylindrical member having an opening and a closure member sealed to the open end of said cylindrical member, an electrode supported within said envelope and including a flanged portion received between said cylindrical member and said closure member, said electrode and said envelope having axially extending interengaging surfaces in the region of the juncture of said members cooperating to position said electrode within said envelope.

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