Oct. 6, 1936. W. A. ROBERTS 2,056,621

GASEOUS OR VAPOR ELECTRIC DISCHARGE DEVICE AND ITS MANUFACTURE

Filed Aug. 11, 1934

Fig. 1.

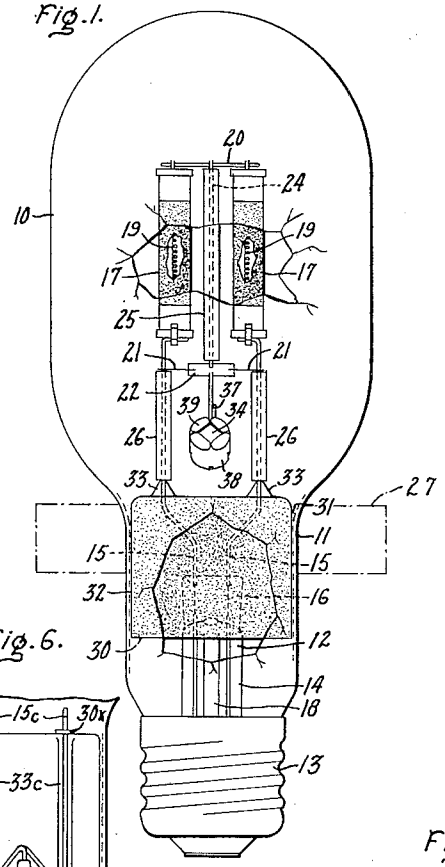


Fig. 5.

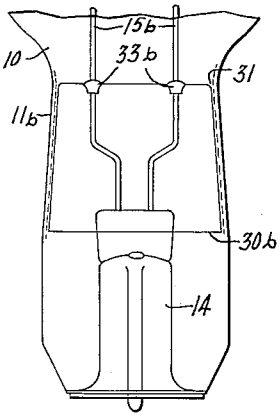


Fig. 2.

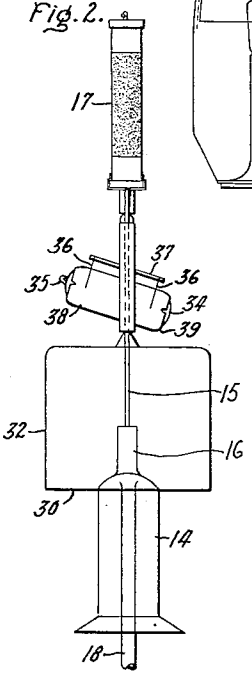


Fig. 6.

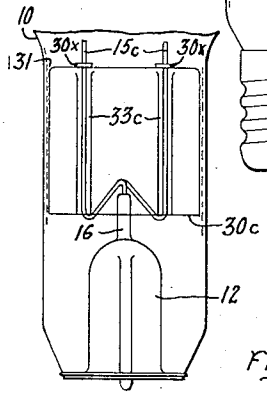


Fig. 3.

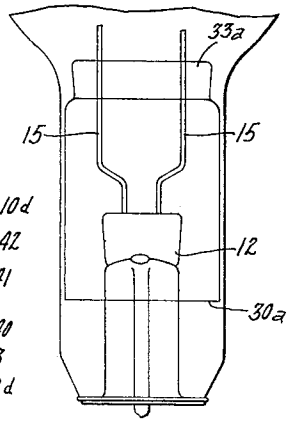


Fig. 4.

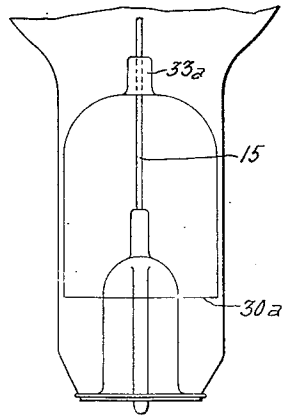
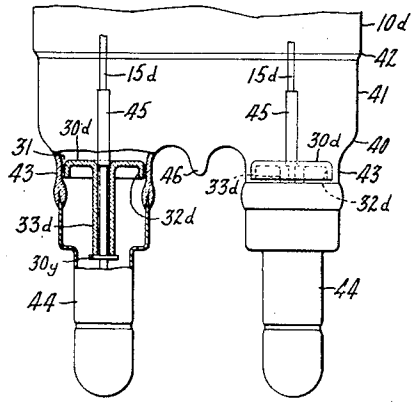


Fig. 7.



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UNITED STATES PATENT OFFICE

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GASEOUS OR VAPOR ELECTRIC DISCHARGE DEVICE AND ITS MANUFACTURE

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Application August 11, 1934, Serial No. 739,480

17 Claims. (Cl. 176—122)

This invention relates to gaseous or vapor electric discharge devices of a general type exemplified by metal vapor lamps, whose working substance or filling when in operation consists essentially (or in part) of vaporous sodium, cadmium, or the like. The invention is particularly concerned with devices whose filling, while gaseous or vaporous during operation of the device, is readily condensible (in part, at least), and does usually condense when any part of the bulb or envelope that contains the filling is allowed to become comparatively cool during operation,—as well as when the device is thrown out of operation and allowed to cool off. In such devices as commonly constructed, it is highly desirable to exclude the filling from certain regions of the bulb or envelope; either because such regions would entrap the filling, being cool enough for the filling to remain or to condense and collect in them, without vaporizing there as the proper operation of the device would require, or because such regions contain parts constructed of material that is liable to attack by the filling,—or for both of these reasons. Often, such regions have the character of recesses opening off from the main open space or bulb proper of the device. Such recesses are exemplified by the neck of the usual bulb, and by the projecting nipples and attached hollow terminals of the so-called "bipost flare" that answers the purposes of a base on some large lamps. In present practice, the bulb neck (or the nipple with its hollow terminal) is shut off from the rest of the bulb by means of a disc (of metal, mica, glass, or other ceramic material) which is permanently sealed by fusion or cemented into the neck (or nipple) about where it joins the larger part of the bulb or envelope,—which may conveniently be distinguished as the "bulb proper",—thus becoming part of the bulb.

While fairly effective for its purpose, this type of "shut-off" has certain practical disadvantages. First, there is considerable loss or failure of lamps due to cracking of the bulb where the edge of the disc is sealed to it, or to chipping or other defects when the joint around the disc edge is cemented, or to unequal expansion or contraction of bulb and disc with temperature changes. Sometimes, also, the heat used to seal a disc to the bulb overheats and injures an electrode of the device; or it may vaporize protective enamel or glaze used on the inner bulb surface to prevent sodium or other metal vapor from attacking it, and this vaporized material may coat the electrode and interfere with the proper operation of the device. Secondly, if the disc edge is cemented to the bulb, the cement gives off a great deal of gas when the device is being exhausted, so that the time required for the exhaust is excessive,—amounting sometimes to five, six, or seven hours, as against less than one hour to exhaust an ordinary incandescent lamp bulb of similar volume. Thirdly, it becomes necessary to provide a very fine special tubular connection between the two sides of the disc, to allow the recess shut off by it to be exhausted, as well as the bulb proper. Owing to the fineness of this connection, it is customary to exhaust the bulb through an exhaust tube on its bowl, which is afterwards sealed off to form a "tip"; because if all the gas drawn out of the bulb proper in the exhaustion had to pass through the fine tubular connection in order to reach an exhaust tube in the "stem" of the device (as usual in exhausting tipless bulbs), the time required for the process would become quite inordinate. Fourthly, the sealing-in of the stem cannot be done by machine with the proper pull-down to produce the best seal.

My invention affords means of overcoming these and other drawbacks of present practice, and of providing a simple, effective "shut-off" that simplifies the manufacture of vapor electric discharge devices. For this purpose, I occlude the desired region from the rest of the envelope or bulb with a shield or septum that need not be sealed, cemented, or otherwise united to the bulb as part of it, but may remain structurally separate from the bulb, and is preferably, indeed virtually, a part of the "mount" of the device. This shield is not even required to fit the circumjacent surfaces tightly, because I arrange to close or seal up the crack or clearance around the shield with some of the filling condensed or remaining unvaporized in the device. For this purpose, I preferably use an excess of sodium or other such filling in the device, as compared with the amount commonly used, to afford a surplus for sealing around the shield. The invention also facilitates the charging of vapor electric discharge devices with their working substance or filling. Various other features and advantages of the invention will appear from the following description of species thereof, and from the drawing.

In the drawing, Fig. 1 is a side view of an electric discharge device or lamp embodying my invention in one preferred form, one of the parts being partially broken away; Fig. 2 is a side view of the mount of the device shown in Fig. 1 prior

to sealing into the bulb, taken at right angles to Fig. 1; Fig. 3 is a fragmentary side view of the neck, stem, and associated parts of a bulb, illustrating a modified construction embodying my invention; Fig. 4 is a similar view at right angles to Fig. 3; Fig. 5 is a view similar to Fig. 3 showing another modification; Fig. 6 is a view similar to Figs. 3 and 5 showing still another modification; Fig. 7 is a fragmentary side view, partly in vertical section, illustrating the application of my invention to a device having a bipost flare instead of the usual stem and base construction illustrated in Fig. 1.

The device shown in Fig. 1 is adapted for use as a glow discharge lamp, and comprises an envelope or bulb 10 of elongated cylindrical form spherically rounded at its ends, with a reduced neck 11, and a mount 12 sealed into the neck 11 at its lower end, within an Edison base 13. The bulb 10 contains a charge of alkali metal such as sodium, or of cadmium, or of other suitable metal,—introduced or liberated in it after it has been thoroughly exhausted,—and also, preferably a suitable gas at low pressure, (e. g., about 1 or 2 up to 7 mm), such as one of the easily ionized gases like neon, argon, etc.,—introduced after exhaustion but before "sealing off". The mount 12 is shown separate in Fig. 2, just as it would appear before sealing into the bulb neck 11: It includes a tubular stem 14, current leads 15, 15 sealed into the upper end of the stem at the press 16 and extending inward (and upward) into the interior of the bulb proper, and electrodes 17, 17 connected to the leads 15, 15, and also supported by them. Through the stem 14, the leads 15, 15 extend out to the shell and center contacts of the base 13, to which they are connected. In the stem 14 is also shown an exhaust tube 18 that opens into the bulb neck 11 through the stem press 16, and is in practice sealed off at its lower end, where it is hidden by the base 13.

The electrodes 17, 17 may be of an indirectly heated type, with an electron-emissive surface as of barium oxide, and are shown as located in the midst of the bulb proper, a little above its center. Heating resistances 19 of tungsten inside the electrodes 17, 17 have their lower ends electrically connected to the current leads 15, 15, and their upper ends electrically interconnected by a nickel wire member 20. The electrodes 17, 17 may be held parallel and spaced exactly the right distance apart by the connection 20 and by an insulative mechanical connection comprising refractory (molybdenum) wires 21, 21 welded to the current leads 15, 15 a little below the electrodes, and including an insulative refractory (zirconia) part 22. In operation, the serially connected resistances 19, 19 are in parallel with the electrical discharge between the electrodes, when it starts. The electrodes are held upright, as against any tendency to sag, by a refractory (molybdenum) wire support 24 paralleling the electrodes 17, 17 in their common plane (mechanically), attached at its upper end to the middle of the member 20, and at its lower end attached to the insulative part 22 of the member 21. The upright support 24 may be protected by a refractory (alumina or magnesia) sleeve 25 around it. To prevent electrical discharge between the electrodes 17, 17 from extending down the leads 15, 15 the latter may have insulative coverings 26, 26 below the electrodes, such as refractory (alumina or magnesia) sleeves or tubes. However, experience has shown that the sleeves 25 and 26, 26 may be omitted.

As thus far described, the device and its details of construction are illustrative, and may be widely varied, since such a device is merely the background (as it were) of my invention to be presently set forth. It will also be understood that the lamp may in practice be operated with such usual accessories of sodium vapor lamps as an enclosing vacuum jacket (not shown) and a refractory thermo-insulative (asbestos) jacket gasket 27, indicated in dot and dash lines in Fig. 1, to prevent loss of heat; a ballast (not shown) to control the current rise as the device heats up after starting; a compensating resistance, reactor, or transformer (not shown) to allow the device to be used on ordinary A. C. lighting circuits of 110 volts or the like, etc.

When the device is in operation, it heats up sufficiently to vaporize some of the sodium, which ionizes and is the main cause of the luminosity of the glow discharge between the electrodes 17, 17—the neon being specially useful as a carrier at starting. The walls of the bulb proper exclusive of the neck 11 are so configured and arranged that they generally heat up to a fairly uniform temperature ranging from around 220° C. to 275° C. more or less, in different areas. In the depth of the recess formed by the neck 11, however, the bulb walls are somewhat cooler; so that if the neck 11 were not shut off from the bulb proper, the sodium would be entrapped there. For shutting off the bulb neck 11 from the bulb proper in accordance with my invention, there is shown in Figs. 1 and 2, a loose-fitting (glass) shield 30 that substantially occludes the neck 11 about where it joins or merges with the bulb proper, with only a small clearance or crack 31 around the shield, to be closed by the sodium or other filling. I prefer to assure a seal of metal at 31 by condensation of metal vapor arranged to occur even in normal operation, after the device has heated up fully, and in any position in which it may properly be operated,—as by a cool area or zone of the bulb wall. This may be right around the shield 30, in the clearance 31 itself; or somewhere in the bulb proper to the inside of the shield, when the metal filling is such and is so used as to run to the crack 31 by gravity after condensation, like mercury, for example.

In the present instance, both of these provisions for condensation are employed; i. e., the shield 30 impedes circulation of vapor and transmission of heat to the inner (shield) wall of the crack or clearance 31 sufficiently to assure condensation of vapor at 31 by the atmospheric cooling of the surrounding outer (neck) wall; and the bulb proper is so configured and arranged as to have a cool, metal-condensing zone around and just above the neck 11 and the shield 30. It will of course be understood that there are an infinity of bulb configurations that would obviously accomplish this, many of them very different in appearance from that here shown. The desirable coolness at the top or inner end of the shield 30 is greatly promoted and enhanced by the thermo-insulative vacuum jacket gasket 27 (above referred to) when in its usual and proper position as far up as possible on or against the "bead" or shoulder where the bulb neck 11 expands and merges into the bulb proper,—around the upper, inner end of the shield 30. When the gasket 27 is properly installed,

fitting snugly into the vacuum jacket and around the bulb neck 11, and including an ample thickness of asbestos felt sheets, it may even obviate the need of designing the bulb 10 with any special consideration for coolness around and above the shield 30. If, on the other hand the gasket 27 were lower down on the bulb neck 11,—around or below the lower end of the shield 30,—or were loose-fitting or otherwise ineffective, then not only would the ordinary heat-conserving purpose of the gasket be pro tanto defeated by heat conduction and convection in the body of air around the device inside the vacuum jacket, but the zone around the upper end of the shield 30 might not be cool enough to condense an effective metal seal in the clearance 31 before an undesirable amount of condensed metal had accumulated in the bulb neck 11 below the shield 30.

As shown in Figs. 1 and 2, the shield 30 has an extended perimetric wall 32 in close proximity to the surrounding neck wall, 11 affording an ample (capillary) space for holding the liquid metal, and formed by a skirt extending axially back into the neck around the stem 14: i. e., the shield 30 has the form of an inverted cup, whose axial height approximates its diameter. The current leads 15, 15, pass through the shield 30, and are sealed thereinto by fusion at 33, 33. These seals 33, 33 may be formed by providing the glass shield 30 with small tubular nipples extending upward from holes through which the leads 15, 15 are inserted, and fusing down these nipples as shown after insertion of the leads through the holes and nipples. This is easily done before inserting the mount 12 in the bulb 10, and makes the shield 30 virtually part of the mount. However, the shield 30 remains practically separate from the bulb 10, in the sense of having no direct attachment thereto after the mount is sealed into the bulb. Even after the seal of condensed filling at 31 is formed, there is no actual permanent union of the shield 30 with the bulb 10, but only a filling of the crack.

Without attempting to state concrete theoretical limits for the width of the clearance 31, a fair practical rule is that it should be great enough to assure that no probable temperature conditions or changes can take it up completely, so as to grip the shield 30 tightly in the neck 11, and perhaps burst the latter; and it should be small enough to be in a practical way "capillary": i. e., to assure that a film of liquid metal cannot exist indefinitely on one or both walls of the clearance (the adjacent shield and neck surfaces) without eventually touching the opposite wall all the way around. Subject to this last limitation, the crack need not, of course, be uniform all around the shield; and the shield may even touch the surrounding wall at one side. In general, a clearance 31 of about 0.01 inch radial width, more or less, will be found satisfactory.

The glass envelope or bulb 10 and shield 30 should preferably be resistant to attack by sodium or other such metal vapors, either by virtue of a suitable composition of the glass, or by having their exposed surfaces protected with a coating of suitably resistant enamel or glaze. The stem 14, on the other hand, may preferably be of ordinary glass such as used for ordinary incandescent lamps, since it is shut off and protected from access of metal vapor by the shield 30 and its metallic "seal" at 31. This is of particular advantage because the use of metal-vapor-resistant glasses and enamels for the stem 14 would make it difficult to seal the leads 15, 15 into the stem properly. As already mentioned, the bulb 10 should be charged with an excess of sodium or other corresponding filling in comparison with ordinary practice, so that after the formation of the seal at 31, there may still be plenty of the filling left for the normal operation of the device.

My shut-off above described offers a number of advantages over the use of discs sealed or cemented into the bulb neck. The special sealing-in or cementing-in of the disc is dispensed with, and the consequent losses and failures of the devices are avoided. The shield 30 is easily inserted in the neck 11 when the mount 12 is inserted in the bulb, because of its loose fit due to the clearance 31; and the surrounding seal of condensed metal which makes it fully effective is self-forming as soon as needed: i. e., when the device is first operated. Moreover, sodium, potassium, or other filling of like properties is soft and yielding when solidified in the crack 31, so that when such filling is used the shut-off cannot cause bulb failure through unequal expansion and contraction, as the old sealed-in or cemented-in disc sometimes does. As the shield 30 remains loose and unattached to the bulb 10 until after the device has been completed, it can be shifted up or down in the neck 11 as desired, and hence does not interfere with sealing-in the stem 14 on the usual machines, and giving this stem seal the proper "pull-down", as usual in incandescent lamp manufacture. Not only is there no cement to give off gas and prolong the exhaustion process excessively, but there is ample communication between the two sides of the shield 30 via the clearance 31, permitting rapid exhaust through the tube 18 in the stem 14 without provision of any special means of communication through the shield, and allowing the finished device to be tipless.

As sodium and potassium are highly oxidizable even in the atmosphere at ordinary temperatures, special precaution is necessary in introducing such metals into the bulb 10 of an electric discharge device. One method used has been to seal up the desired charge of sodium in a hermetic protective (glass) capsule and introduce this in the bulb before sealing in the mount 12. After exhaustion and sealing off, the capsule is tumbled about in the bulb until it happens to break and liberate the sodium. I prefer, however, to employ the following procedure:

As shown in Figs. 1 and 2, a glass capsule 34, containing the charge of sodium or other oxidizable metal and sealed at 35, may be attached to the mount 12 in a convenient position, as by attaching it by fine wires 36, 36 to the cross bar of a T member 37 that is itself secured to the insulative part 22 and thus insulated from the other metal parts 21, 21, 24. The capsule 34 may preferably be provided with a conductive case 38, such as a piece of thin-walled nickel tubing with its ends crimped inward at 39 to keep the capsule from dropping out. The capsule 34 is thus installed on the mount 12 before the latter is inserted in the bulb 10 and sealed in. After the bulb 10 has been exhausted, and preferably after its exhaust tube 18 has been sealed off, the metal-cased capsule 34 is brought into the field of a high frequency coil externally

surrounding the bulb 10; and in this way the casing 38 and capsule 34 are heated up until the pressure of the sodium due to the heat generated in the casing explodes or ruptures the capsule,—which softens under the heat,—and thus liberates the charge of sodium in the bulb. As shown in Fig. 2, the capsule 34 slopes downward with its weaker end (away from the seal 35) directed toward or just above the upper corner of the shield 30, so as to direct its discharging contents into the annular channel around the shield at the junction of the neck 11 with the outward flaring wall of the bulb proper. If the high frequency energy used is powerful enough, the metal casing 38 may be dispensed with, although it is always useful to retain the pieces of the ruptured capsule and to direct the discharge of the sodium.

Figs. 3 and 4 show a shield cup 30*a* somewhat longer in proportion to its diameter than the cup 30 in Figs. 1 and 2, and rounded nearly cylindrically in one direction on top. The current leads 15, 15 are sealed through this shield 30*a* with a pressed seal 33*a* similar to the stem press 16 in Figs. 1 and 2.

Fig. 5 shows the bulb neck 11*b* conically flared downward from the bulb proper around the shield cup 30*b*, which is correspondingly flared. This enables the desired clearance 31 to be gauged and secured very easily as an incident of sealing in the stem 14 into the neck 11*b*. For this purpose, it is merely necessary to insert the stem 14 and the rest of the mount into the bulb 10 until the conical shield cup 30*b* fits firmly in the conical neck 11*b*, and to maintain the parts in this relation until the stem seal is ready to be pulled down. By then pulling down an amount previously determined from the known taper at 11*b*, 30*b* and the desired magnitude of the clearance 31, the exact clearance 31 desired can be accurately obtained.

While the current leads 15, 15 of such a flared neck and shield construction can pass through the shield 30*b*, in any way desired, Fig. 5 shows the leads extending through (conical) holes 33*b* in the (flat) top of shield cup 30*b* and cemented tight in these holes with any suitable cement. The amount of cement required is so small as not to increase the time for exhaustion very materially.

Fig. 6 shows a shield cup 30*c* resembling that of Figs. 1 and 2 in shape, but deeper axially, like that of Figs. 3 and 4, and traversed by the current leads 15*c*, 15*c* without fused or cemented joints, or other fixed attachments. For this purpose, the shield cup 30*c* has extended bores with clearance for the leads 15*c*, 15*c*, formed in tubular nipples or sleeves 33*c*, 33*c* extending downward into the cup substantially the full axial height of the cup. These sleeves 33*c*, 33*c* fit the current leads 15*c*, 15*c* rather loosely, with about the same clearance as at 31, or a little less. The shield cup 30*c* is turned 90° from the position of Figs. 1–5, and the current leads 15*c*, 15*c* are bent outward and downward (180°) to opposite sides of the seal press 16, to extend down below the shield tubes 33*c*, 33*c*, and are then bent upward (180°) again to extend up through the shield tubes. Above the shield 30*c*, the current leads 15*c*, 15*c* have wire cross pieces 30*x*, 30*x* welded to them, to prevent the shield from shifting axially more than a few hundredths of an inch or so. Thus the shield 30*c*, while part of the mount 12, has no fixed attachment either to the rest of the mount or to the bulb 10, but "floats" with a certain freedom of self-adjustment, up and down as far as permitted by the bends in the leads 15*c*, 15*c* and the stops 30*x*, 30*x*, and transversely in all directions as far as permitted by the clearance in tubes 33*c*, 33*c* and at 31. The bends in the leads 15*c*, 15*c* also take care of expansion and contraction, and serve as heat radiators.

Fig. 7 illustrates the adaptation of the invention to a device with a "bipost flare" 40 in lieu of the more common stem and base type of construction shown in Figs. 1–6. As here shown, the glass cup 41 of this "flare" 40 is fused at 42 to the wall of the contracted opening of the glass bulb 10*d* of the device, so as to form in effect part of this bulb. The flare 40 has glass nipples or flanges 43, 43 projecting downward around holes in its bottom wall, and into their lower ends are fused the knife-edges of hollow metal thimbles or terminal posts 44, 44. The current leads 15*d*, 15*d* of the mount (the rest whereof is not shown) extend upward and inward from their attachment to the posts 44, 44 through the enlarged upper ends of the latter and the flare 40 into the interior of the bulb 10*d*. My shut-off is shown applied to close off the recesses in the nipples 43, 43 and posts 44, 44 from the rest of the bulb, including the flare 40. As here shown, the shields 30*d*, 30*d* are of flat disc form, with rather short skirts 32*d*, 32*d*, and with fine clearance or cracks 31 around their perimeters, inside the circumjacent nipple portions 43, 43 of the bulb. Each shield 30*d* also has a tubular nipple or sleeve 33*d* (analogous to one of the nipples 33*c*, 33*c* of Fig. 6) through which the corresponding current lead 15*d* extends, with looseness or clearance as described in connection with Fig. 6. Upward and downward shifting or play of each shield 30*d* is limited as in Fig. 6; by a stop cross piece of wire 30*y* on the lead 15*d* below the nipple 33*d*, in position to keep the shield edge above the terminal seal in the nipple 33*d*, and by a stop enlargement or sleeve 45 fixed on the leads above the shield. The usual exhaust seal 46 is shown on the bottom of the flare 40, between the nipples 43, 43. In Fig. 7, the configuration of the spaces in the flared upper ends of the nipples 43, 43 creates a cool metal-condensing region; and the cracks 31 around the shields 30*d*, 30*d* are effectively sealed with metal, and objectionable entrapment of metal in the very cool recesses formed by the nipples 43, 43 and hollow terminals 44, 44 is prevented.

In Figs. 3–7, various parts and features are marked with the same reference characters as in Figs. 1 and 2, as a means of dispensing with repetitive description. It is also to be understood, of course, that the modifications indicated in Figs. 3–7 are applicable to devices like that of Figs. 1 and 2, or otherwise suitably constructed.

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

1. An electric discharge device containing a filling that is vaporous during operation of the device, but readily condensible, and comprising an envelope having a region adapted to entrap the filling, and a cup-shaped shield occluding said region from the rest of the envelope interior, with a clearance or crack around said shield so small as to be closed by filling condensed in the device.

2. An electric discharge device containing a filling that is vaporous during operation of the

device, but readily condensible, and comprising an envelope resistant to the filling having a recess; a part susceptible to attack by the filling in said recess; and a cup-shaped shield resistant to the filling occluding said recess, with a crack or clearance between said shield and the circumjacent surface so small as to be closed by filling condensed in the device.

3. An electric discharge device containing a filling that is vaporous during operation of the device, but readily condensible, and comprising an envelope configured and arranged to have a relatively cool area including a recess adapted to entrap the filling, and a cup-shaped shield within said cool area occluding said recess, with a clearance or crack around said shield so small as to be closed by filling condensed by said cool area.

4. An electric discharge device containing a filling that is vaporous during operation of the device, but readily condensible, and comprising an envelope having a relatively cool region, and a cup-shaped shield occluding said region from the rest of the envelope interior having an extended wall in close proximity to the cool envelope wall, so that condensed filling shall accumulate in the extended crack between said walls and thus shut off said region from access of the vaporous filling.

5. An electric discharge device containing a filling that is vaporous during operation of the device, but readily condensible, and comprising an envelope having a recess adapted to entrap the filling; a mount attached to said envelope in said recess; and a shield associated with said mount and occluding said recess, with freedom for self-adjustment relative to both envelope and mount, and with a crack or clearance between the shield and the circumjacent envelope surface so small as to be closed by filling condensed in the device.

6. An electric discharge device containing a filling that is vaporous during operation of the device, but readily condensible, and comprising an envelope having a recess; a mount attached to said envelope in said recess and including a current lead extending inward into the interior of the envelope; and a cup-shaped shield traversed by said current lead and occluding said recess, with a crack or clearance between said shield and the circumjacent envelope surface so small as to be closed by filling condensed in the device.

7. An electric discharge device containing a filling that is vaporous during operation of the device, but readily condensible, and comprising an envelope having a recess adapted to entrap the filling; a mount attached to said envelope in said recess and including a current lead extending inward into the interior of the envelope; and a shield free for self-adjustment relative to both envelope and mount, having an extended bore therethrough for passage of said current lead and occluding said recess, with a crack or clearance around said lead in said bore, and between the shield perimeter and the circumjacent envelope surface, so small as to be closed by filling condensed in the device.

8. An electric discharge device containing a filling that is vaporous during operation of the device, but readily condensible, and comprising an envelope resistant to the filling configured and arranged to have a relatively cool zone; a mount including a portion that is susceptible to attack by the filling sealed to said envelope within said cool zone; and a cup-shaped shield resistant to the filling occluding the envelope at said cool zone, with a crack or clearance between them so small as to be closed by filling condensed by said cool zone.

9. An electric discharge device containing a filling that is vaporous during operation of the device, but readily condensible, and comprising an envelope resistant to the filling configured and arranged to have a relatively cool zone; a mount including a portion that is susceptible to attack by the filling sealed to said envelope, and a current lead extending inward therefrom; and a cup-shaped shield resistant to the filling sealed around said current lead to the inside of said portion and occluding the envelope with a loose fit in its said cool zone, so that condensed filling shall accumulate in the crack or clearance between said shield and the circumjacent surface and thus shut off the stem from access of the vaporous filling.

10. An electric discharge device containing a filling that is vaporous during operation of the device, but readily condensible, and comprising an envelope configured and arranged to afford a relatively cool region and have a recess adapted to entrap the filling; and a cup-shaped shield occluding said recess, with a crack or clearance between said shield and the circumjacent surface so small as to be closed by filling condensed in said cool region.

11. An electric discharge device containing a filling that is vaporous during operation of the device, but readily condensible, and comprising an envelope resistant to the filling having a recess; a mount including a portion that is susceptible to attack by the filling sealed to the envelope wall in said recess, and a current lead extending inward therefrom; and a cup-shaped shield resistant to the filling having an extended bore therethrough for passage of said current lead and occluding said recess, with a crack or clearance around said lead in said bore, and between the shield perimeter and the circumjacent surface, so small as to be closed by filling condensed in the device.

12. An electric discharge device containing a filling that is vaporous during operation of the device, but readily condensible, and comprising an envelope resistant to the filling; a mount including a stem that is susceptible to attack by the filling sealed to said envelope; and a cup-shaped shield resistant to the filling carried by said mount and having an extended wall in close proximity to the circumjacent envelope wall, so that the filling shall condense in the extended crack or clearance between them and thus shut off the stem from access of the vaporous filling.

13. An electric discharge device containing a filling that is vaporous during operation of the device, but readily condensible, and comprising a bulb resistant to the filling affording a relatively cool region and having a reduced neck; a mount including a portion sealed to said bulb in said neck and susceptible to attack by the filling; and a shield resistant to the filling occluding said neck with a crack or clearance between said shield and the circumjacent bulb surface so small as to be closed by filling condensed in said cool region.

14. An electric discharge device containing a filling that is vaporous during operation of the device, but readily condensible, and comprising a bulb resistant to the filling having a reduced neck; a mount including a stem that is suscepti-

ble to attack by the filling sealed to said neck, and current leads sealed through said stem; and a shield resistant to the filling occluding said neck and traversed by said current leads to the inside of the stem seal, and having a skirt extending back around the stem in close proximity to the circumjacent neck wall, so that the filling shall condense in the extended crack or clearance between said skirt and neck wall and thus shut off the stem from access of the vaporous filling.

15. An electric discharge device containing a filling that is vaporous during operation of the device, but readily condensible, and comprising a bulb resistant to the filling having a reduced neck; a mount including a stem that is susceptible to attack by the filling sealed to the bulb neck, and current leads sealed through said stem; and a shield resistant to the filling sealed around said current leads and loosely fitting in and occluding the bulb neck to the inside of said stem, with a crack or clearance between the shield and the circumjacent neck wall so small as to be closed by filling condensed in the device.

16. An electric discharge device containing a filling that is vaporous during operation of the device, but readily condensible, and comprising a bulb having a reduced neck flared away from the bulb proper; a mount including a stem sealed to the bulb neck by a pulled-down seal; and a shield carried by said mount externally flared in correspondence with the bulb neck and fitting loosely therein with a clearance or crack corresponding to the amount of pull-down of the seal, and so small as to be closed by filling condensing in the device.

17. A method of making an electric discharge device containing a filling that is vaporous during operation of the device but readily condensible, and comprising a bulb having a reduced neck flared away from the bulb proper, a mount including a stem sealed to the bulb neck, and a shield attached to said mount externally flared in correspondence with the bulb-neck and fitting loosely therein with a clearance or crack to be sealed by filling condensing in the device during operation; which method comprises inserting the mount in the bulb until said shield fits tight in said neck, fusing together the stem and the bulb neck with the parts substantially in this relation, and pulling down the stem and the mount relative to the bulb, while the fused joint is still soft, sufficiently to produce the desired amount of clearance between the flared neck and shield.

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