Nov. 11, 1941. W. J. GEIGER ET AL 2,262,176

EXHAUSTING AND SEALING METHOD AND APPARATUS

Filed Oct. 7, 1938

Fig. 1.

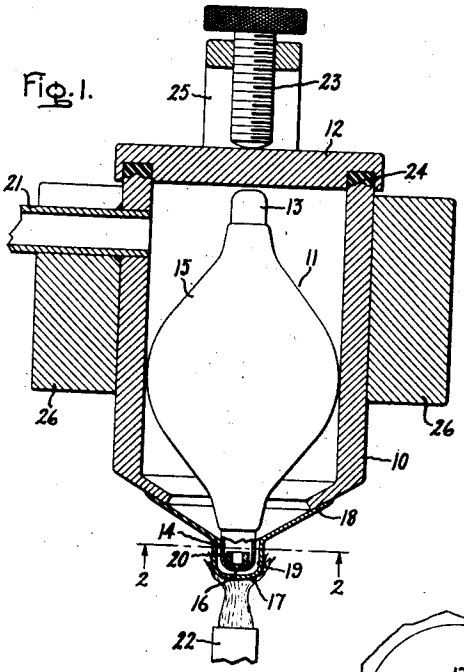


Fig. 3.

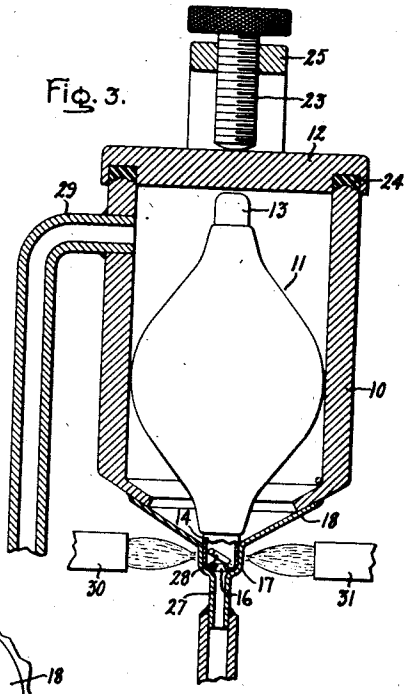


Fig. 2.

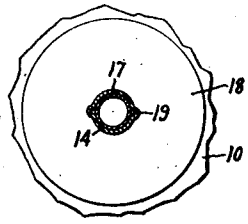


Fig. 5.

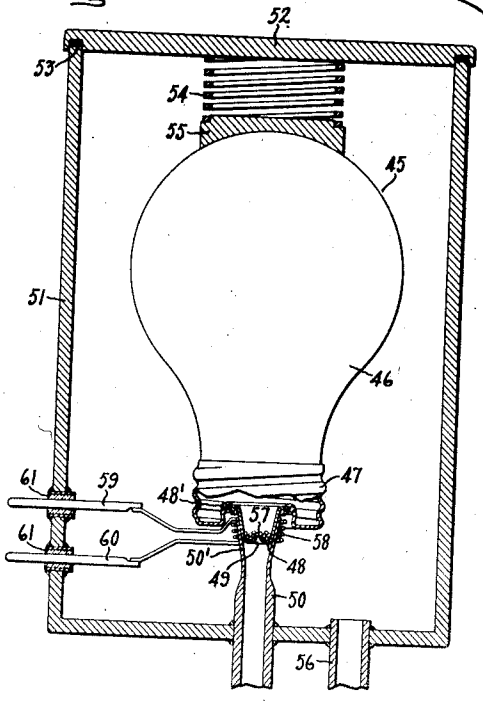
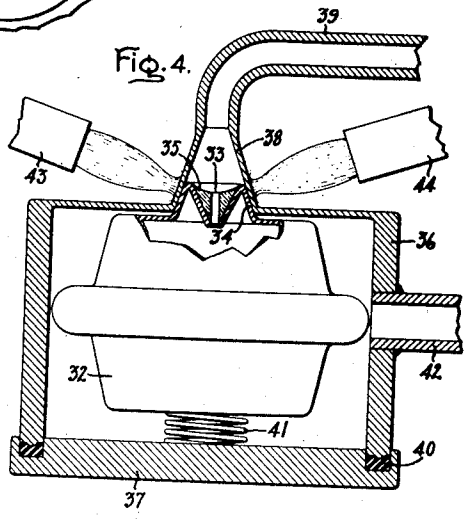


Fig. 4.



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2,262,176

EXHAUSTING AND SEALING METHOD AND APPARATUS

Walter J. Geiger, Cleveland Heights, and Wilson Davidson, Cleveland, Ohio, assignors to General Electric Company, a corporation of New York

Application October 7, 1938, Serial No. 233,793

10 Claims. (Cl. 176—3)

Our invention relates to a method and apparatus for exhausting electric lamps and other sealed vessels and more particularly to apparatus for sealing said vessels while they are retained wholly or partially in a chamber in which they are exhausted.

By placing the unsealed vessel in a closed chamber and exhausting both the chamber and the vessel, the need for the usual lengthy exhaust tubing is eliminated but considerable difficulty is then experienced in sealing said vessel before the chamber is opened and the vessel is taken out. If the vessel is an incandescent lamp bulb having one of the particular metal and glass constructions shown in Patent No. 2,116,384, filed March 2, 1937, Paul O. Cartun, and Patent No. 2,191,346, filed April 30, 1937, A. Greiner, or a mercury switch of the type shown in Walker Patent 2,101,115, more than the usual difficulty and expense is experienced in attaching an exhaust tube thereto and there is a greater desirability for using the chamber type exhausting method. Such metal and glass vessels are usually most easily exhausted through an aperture in the metal portion which is then closed by sealing a body of fusible material over the exhaust opening.

One of the objects of our invention is to provide a satisfactory method and apparatus for sealing the exhaust opening in a vessel by melting a readily fusible material over said opening. Another object of our invention is to provide a method and apparatus for heating the fusible material from a source located outside of the exhaust chamber. A novel feature of our apparatus is the heating of the portion of the vessel adjacent its exhaust opening to melt the said fusible material by heat transferred from a highly heat-conductive portion of the container in contact therewith. Other features and advantages of our invention will be apparent from the detailed description thereof which follows and from the accompanying drawing of species thereof.

In the drawing, Fig. 1 is a vertical section through apparatus comprising our invention with a double-ended electric lamp in place therein; Fig. 2 is a section through the apparatus of Fig. 1 taken along the line 2—2; Fig. 3 is a vertical section through a modified form of apparatus; and Figs. 4 and 5 are similar vertical sections of other modifications illustrating the exhaustion of a mercury switch and a large type lamp respectively.

The apparatus shown in Figs. 1 and 2 comprises an inverted bell housing 10 of minimum size to accommodate a single double-ended lamp 11 of the type shown in the above-mentioned application of A. Greiner. The lamp 11 is placed in the bell housing 10 after removal of the cover plate 12 which is then replaced in the position shown and together with said bell housing 10 completely encloses the lamp 11 in a sealed chamber. The lamp 11 has metal terminal thimbles or caps 13 and 14 at opposite ends which are sealed directly into the walls of the vitreous bulb 15 and is completely closed up except for the aperture 16 in terminal thimble 14. In position in the bell housing 10, the apertured thimble 14 is located in the appendage or well member 17 in the highly heat-conductive bottom 18 thereof which conforms very closely to the shape of said thimble except for a groove or channel 19 extending down the sides and across the bottom thereof. The bottom portion 18 of the chamber is preferably made of nichrome or other metal which may be silver soldered to the main portion of the chamber or container 10. The groove 19 in the bell housing bottom 18 forms a passage to aperture 16 in the thimble 14 which permits the bulb 15 to be exhausted and gas filled at the same time as the interior of the bell housing 10. The bottom 18 of the bell housing 10 in this instance is formed by a separate thin piece of a corrosion-resistant chrome-iron alloy brazed thereto. The lamp 11 is provided with a bead or ring 20 of a glass or other fusible material suitable for sealing the aperture 16 in the thimble 14. The bead 20 rests against the interior surface thereof but does not obstruct the flow of gas through said aperture 16.

Once the lamp 11 is properly located in the chamber formed by the bell housing 10, said chamber and lamp 11 are exhausted by means (not shown) connected thereto through pipe 21. The lamp 11 and chamber are then preferably flushed with a gas and again exhausted before the exhausting operation is completed, whereupon heat is applied to the terminal thimble 14 and the bead 20 fused down over the aperture 16 therein. The bead 20 is heated by means of the flame from burner 22 which is directed onto the outer surface of the well 17 in the bell housing 10 and quickly fuses said bead 20 because of the good conduction of the thin walls of the well 17 and the close contact of said well 17 and the thimble 14. The bead 20 is preferably made of a vitreous material such as a low melting point glass and may, for instance, be made from solder, a resin or other material which will seal the aperture satisfactorily upon cooling and which will have sufficient body when melted to close the aperture 16. The volume of the bead 20 should be such that it does not run out of the thimble 14 and into the well 17. After a given heating period sufficient to fuse the bead 20 and seal it to the thimble 14, the flame is withdrawn from the well 17 and the fused bead is allowed to cool whereupon the hold down screw 23 is turned back and the cover plate 12 is removed and the lamp 11 withdrawn. The cover plate 12 is provided with

a gasket 24 which assists in making an air-tight seal to the bell housing 10 and is easily removed since the arm 25 in which the screw 23 is threaded swings out of position. Since the bell housing 10 absorbs some heat from the flame from burner 22 even though the conducting bodies are reduced to a minimum, additional means such as the block 26 are required to cool it. The block 26 may, for instance, be a portion of an indexed turret carrying a plurality of the chambers 10 and may provide means for cooling the bell housing 10 by the flow of water.

The modification of our apparatus shown in Fig. 3 differs from that just described only in the shape of the well 17 which conforms completely to the shape of the terminal thimble 14 and has a tubular portion 27 extending therefrom by which the lamp 11 is exhausted. A short length 28 of solder which has been inserted through the aperture 16 in the thimble 14 is used in this case to seal the aperture 16 and, after the lamp 11 and chamber have been exhausted through the pipes 29 and 27, flames from burners 30 and 31 are caused to play on the well 17 to melt said solder 28. This type well 17 allows any overflow of the sealing material to be withdrawn from the well 17 before it becomes sealed thereto.

In Fig. 4 is shown a modification of our apparatus suitable for sealing a mercury switch 32 of the general type shown in Walker Patent 2,101,115 which issued December 7, 1937. The switch 32 as shown is complete except for being exhausted and then gas filled through the opening 33 in the conical raised boss 34 on one side thereof and the sealing of said opening 33 by the fusion of the vitreous material 35 already sealed to the boss 34. In our apparatus, the switch 32 is located within a chamber formed by the bell housing 36 and the plate 37. The boss 34 on said switch is located within an appendage member 38 of said chamber constituting an end of the pipe or conduit 39. The plate 37 engages the bell housing 36 through the gasket 40 which seals the chamber and supports a spring 41 which engages and supports the switch 32. The appendage 38 and the outer portion of the boss 34 are both conical and the expanding force of the spring 41 pushes the switch 32 upward so that the boss 34 is forced into the appendage and makes reasonably good contact with the walls thereof.

Both the switch 32 and the chamber in which it is contained are in turn exhausted and then gas filled at the same time through pipes 39 and 42. Following these operations, the flames from burners 43 and 44 are directed onto the walls of the appendage 38 and the heat conducted to the vitreous material 35 very quickly causes it to soften and flow over the opening 33 in said boss 34 to seal it. The burners 43 and 44 are then withdrawn and, after the vitreous material 35 has cooled, the chamber is opened and the completed switch 32 removed.

Another modified form of the apparatus of our invention is shown in Fig. 5. This apparatus is especially adapted to seal a large electric lamp 45 of the type disclosed in Cartun application Serial No. 128,617, filed March 2, 1937, which comprises a bulb 46, a threaded metal base shell 47 sealed thereto and a metal eyelet 48 secured to said shell 47 by a glass seal 48'. The lamp 45 is completely closed up except for the aperture 49 in the eyelet 48 which is frustro-conical and fits snugly in the tapered upper end portion or member of the pipe 50. A closed chamber is formed about the lamp 45 by the housing 51 and the cover plate 52 which are sealed by a gasket 53. The lamp 45 is held down by a shoe 55 which is pressed by a spring 54 engaging the cover 52. The expanding force of the spring 54 forces the eyelet 48 into the conical end 50' of the pipe or conduit 50 which connects the lamp 45 to means (not shown) for exhausting and gas filling said lamp 45 in the manner desired. Since the eyelet 48 and the pipe 50 make only a relatively weak seal therebetween, the chamber is exhausted and gas filled at the same time as the lamp 45 by means connected thereto through pipe 56. In this particular instance, a plurality of loose pebbles or granules 57 of a low melting point glass are located within the eyelet 48 and, when the gas filling is completed, the resistance coil 58 is caused to heat these granules 57 until they are melted down over the aperture 49 in said eyelet 48. The resistance coil 58 is supported by the terminal posts 59 and 60 which are insulated from the housing 51 by the bushings 61. The lamp 45 is removed after sufficient time has elapsed to permit the fused mass formed by the granules 57 to cool.

The lamp 45 may be exhausted as follows: The chamber or container 51 and lamp 45 are both evacuated, the chamber through conduit 56 and the lamp through conduit 50. The lamp is flushed through conduit 50 in the regular manner with nitrogen, an adequate number of flushes being used to insure cleaning up the lamp. Since the chamber 51 has been evacuated, any leakage at the seal between the cap or eyelet 48 and the end portion 50' of conduit 50 will have no effect on the lamp. The lamp is then filled with argon through conduit 50. While the lamp is being filled, nitrogen is supplied to the chamber 51 through conduit 56 at a rate which is regulated so that the pressure in the chamber is at all times approximately equal to the argon pressure in the lamp. Since the seal between eyelet 48 and conduit end 50' is fairly good and the pressure inside the lamp is roughly equal to the pressure outside of the lamp, any tendency for diffusion of nitrogen through the seal is slight and negligible contamination of the argon filling will result. The gas loss is at a minimum because no argon escapes into the chamber. Any slight contamination of the argon may be compensated by the use of slightly purer argon for the filling. The lamp is then tipped or sealed by passing current through heater 58 to melt the glass pebbles 57 and seal the exhaust opening 49.

The use of this type of exhaust has several advantages which cannot be derived from the type of equipment used at the present time. A broken lamp will have no effect on the quality of other lamps since each lamp is closed off in the chamber under vacuum. Moreover, the lamp may be filled to any desired degree of pressure, including pressures greatly above atmospheric, because there is no pressure differential between the lamp and the atmosphere surrounding it.

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

1. The method of evacuating a vessel having an exhaust opening therein which comprises placing adjacent said exhaust opening a quantity of material more readily fusible than the portion of the vessel adjacent said opening, placing around the portion of the vessel adjacent its exhaust opening a highly heat conductive member

through which the vessel may be exhausted, evacuating the vessel through said member and then applying heat to said member from outside it to heat by conduction the portion of the vessel engaged thereby so as to fuse the said fusible material and seal the said exhaust opening without distorting the said portion of the vessel.

2. The method of evacuating a vessel having an exhaust opening therein which comprises placing adjacent said exhaust opening a quantity of material more readily fusible than the portion of the vessel adjacent said opening, placing around the portion of the vessel adjacent its exhaust opening a highly heat conductive member through which the vessel may be exhausted, evacuating the vessel through said member and maintaining the pressure of the atmosphere surrounding the vessel at substantially the same degree as the pressure within the vessel and then applying heat to said member from outside it to heat by conduction the portion of the vessel engaged thereby so as to fuse the said fusible material and seal the said exhaust opening without distorting the said portion of the vessel.

3. The method of evacuating and filling a vessel having an exhaust opening therein which comprises placing adjacent said exhaust opening a quantity of material more readily fusible than the portion of the vessel adjacent said opening, placing said vessel in a chamber, placing around and in fairly gas-tight contact with the portion of the vessel adjacent its exhaust opening a highly heat conductive end of a conduit, evacuating the vessel through said conduit and simultaneously evacuating said chamber, filling the vessel through said conduit with a gas and simultaneously filling said chamber with a gas while maintaining the gaseous fillings in said vessel and chamber at substantially the same pressure, and then applying heat to the said end of the conduit from outside it to heat by conduction the portion of the vessel engaged thereby so as to fuse the said fusible material and seal the said exhaust opening without distorting the said portion of the vessel.

4. In an apparatus for exhausting and sealing a vessel having a conical metal portion with an exhaust opening in the end thereof and a readily fusible material adjacent said opening, an exhaust conduit having a conical end portion shaped to receive the said conical portion of the vessel, means for pressing together the interengaging conical portions of said conduit and vessel to render the joint therebetween substantially gas-tight, and means located externally of and adjacent the said conical end portion of the conduit for heating it to conduit heat therefrom to the said conical metal portion of the vessel to fuse said fusible material to seal the said exhaust opening.

5. Apparatus for exhausting and sealing a vessel having a metal thimble-shaped portion with an exhaust opening in the end thereof and a readily fusible material disposed adjacent thereto comprising a chamber for enclosing the vessel, an appendage to said chamber shaped to receive and snugly engage the said thimble-shaped portion of the vessel, a conduit connected to said chamber for exhausting it, another conduit connected to said appendage and communicating with the exhaust opening in said vessel for exhausting it, and means located externally of and adjacent the said appendage for heating it to conduct heat therefrom to the said thimble-shaped portion of the vessel to fuse the fusible material.

6. Apparatus for exhausting and sealing a vessel having an exhaust opening therein with a readily fusible material disposed adjacent thereto comprising a highly heat conductive member shaped to engage and closely surround the portion of said vessel adjacent its exhaust opening, means associated with said member for connecting the vessel with a source of vacuum, and means located externally of and adjacent said member for heating it to conduct heat therefrom to the portion of the vessel engaged thereby to fuse said fusible material.

7. Apparatus for exhausting and sealing a vessel having an exhaust opening therein with a readily fusible material disposed adjacent thereto comprising a chamber for enclosing said vessel, a highly heat conductive member associated with said chamber and shaped to engage and closely surround the portion of said vessel adjacent its exhaust opening, means for connecting said chamber and vessel to evacuating means, and means located externally of and adjacent said member for heating it to conduct heat therefrom to the portion of the vessel engaged thereby to fuse said fusible material.

8. Apparatus for exhausting and sealing a vessel having an exhaust opening therein with a readily fusible material disposed adjacent thereto comprising a chamber for enclosing said vessel, a portion of a wall of said chamber being shaped to engage a substantial portion of said vessel adjacent the exhaust opening therein, means for connecting said chamber and vessel to evacuating means, and means located externally of said chamber and adjacent the said vessel-engaging portion of said chamber wall for heating it to conduct heat therefrom to the portion of the vessel engaged thereby to fuse said fusible material.

9. Apparatus for exhausting and sealing a vessel having an exhaust opening therein with a readily fusible material disposed adjacent thereto comprising a chamber for enclosing said vessel, a portion of a wall of said vessel being shaped to engage a substantial portion of said vessel adjacent its exhaust opening with the interior of said vessel in communication with said chamber through said exhaust opening, means for connecting said chamber to a source of vacuum, and means located externally of said chamber and adjacent the said vessel-engaging portion of said chamber wall for heating it to conduct heat therefrom to the portion of the vessel engaged thereby to fuse said fusible material.

10. The method of evacuating a vessel having an exhaust opening therein which comprises placing adjacent said exhaust opening a quantity of material more readily fusible than the portion of the vessel adjacent said opening, placing said vessel in a chamber with the said portion thereof engaging a substantial part of a highly heat conductive portion of said chamber, evacuating the said chamber and vessel, and then applying heat from the exterior of the chamber to the said heat conductive portion of said chamber to heat by conduction the portion of the vessel engaged thereby so as to fuse the said fusible material and seal the exhaust opening without distorting the said portion of the vessel.

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