Oct. 29, 1940. W. J. GEIGER ET AL 2,219,891

EXHAUSTING AND SEALING METHOD AND APPARATUS

Filed Oct. 7, 1938

Fig. 3.

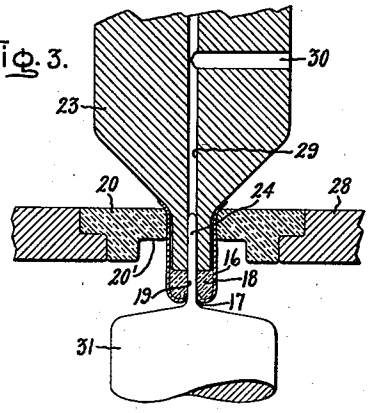


Fig. 1.

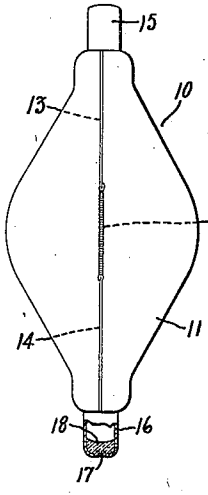


Fig. 2.

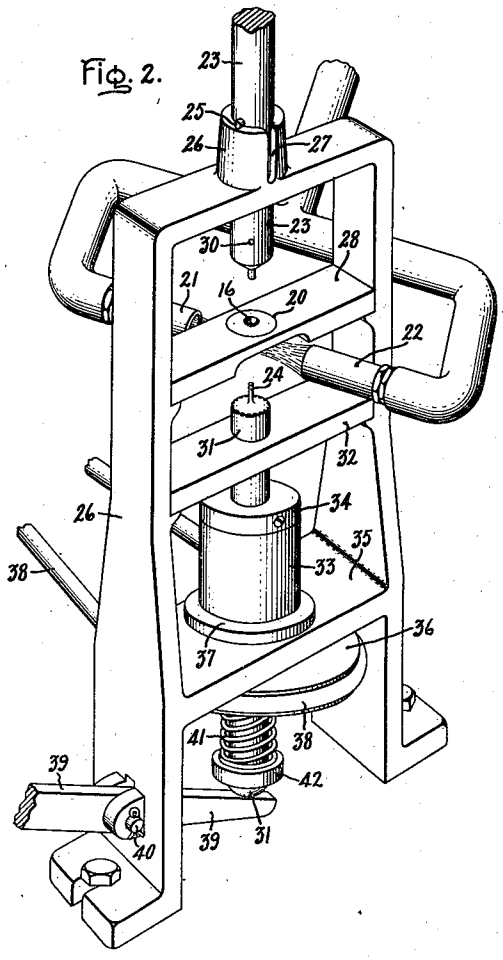


Fig. 4.

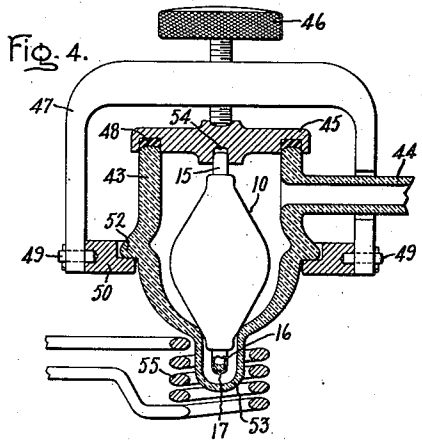
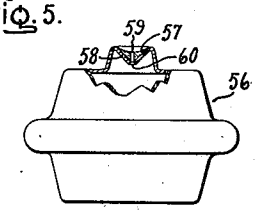


Fig. 5.



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UNITED STATES PATENT OFFICE

2,219,891

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. 233,792

9 Claims. (Cl. 176—3)

Our invention relates to methods and apparatus for sealing the enclosing vessels of electric lamps and other like devices and more particularly to a method and apparatus for sealing an exhaust aperture through a metal portion of the wall of said vessels.

When the enclosing vessel of an electric lamp, radio tube, mercury switch or other device includes a portion of metal, the preferred method of exhausting the air therefrom is through an aperture in said metal portion while said vessel is enclosed in a sealed chamber. Both the chamber and the vessel are exhausted at the same time by this arrangement and finally, after the operation is complete, other means within said chamber is caused to heat said metal portion until a readily fusible body positioned adjacent the aperture and in contact with the metal portion is melted and flows over the aperture to seal the vessel. Difficulty has been experienced with this method of operation since the aperture is not always closed as the fusible body does not always seal properly to the metal of the vessel and is not always correctly positioned so as to flow over the aperture.

One object of our invention is to provide a method of operation assuring positive sealing of the fusible body to the metal of the vessel and positive sealing of the exhaust aperture by said fusible body.

Another object of our invention is to provide apparatus for permanently fastening the fusible body to the metal of the vessel so that the ease of handling said vessel is increased.

Still another object of our invention is to reduce the time required to seal the fusible body over the aperture following the exhausting of the vessel.

Other objects and advantages of the method and apparatus of our invention will be apparent from the detailed description which follows and from the accompanying drawing.

In the drawing, Fig. 1 is a side elevation of a miniature electric lamp sealed according to our invention; Fig. 2 is a perspective view of apparatus comprising our invention for sealing the fusible body to the metal terminal thimble of said lamp and thereafter making the exhaust opening therein; Fig. 3 is a section through the metal terminal thimble having the exhaust aperture therein and the portions of said apparatus engaging said thimble; Fig. 4 is a side elevation partially in section of apparatus for exhausting the electric lamp and sealing the exhaust aperture therein; and Fig. 5 is a side elevation also partially in section of a mercury switch at one stage in the course of being exhausted and sealed according to our invention.

Our method and apparatus as shown in the drawing is illustrated as applied to the manufacture of a double-ended lamp 10 of the type shown in Fig. 1 which is the subject of the Greiner application Serial No. 139,912, filed April 30, 1937. The lamp 10 comprises a bulb 11 which encloses the coiled filament 12 which in turn is connected through the leads 13 and 14 to the metal terminal thimbles or caps 15 and 16 on opposite ends of said bulb 11. The metal terminal thimbles 15 and 16 are fused to the edges of openings in the bulb 11 and are made from a material, such as an alloy of iron and chromium, having substantially the same coefficient of expansion as the glass of the bulb 11 so that a permanent seal therebetween is maintained. The thimbles 15 and 16 are alike except for the aperture 17 in thimble 16 through which the air is exhausted from the lamp 10. The exhaust aperture 17 in thimble 16 is sealed by a body 18 of glass, solder or other fusible material which partially fills the interior of said thmble 16 and adheres thereto.

According to our invention, the body 18 is fused to the thimble 16 and an exhaust opening 19 is made therein prior to the assembly of said thimble 16 with the other parts of the lamp 10. As shown in Figs. 2 and 3, the thimble 16 which is flared outward at the upper end is inserted into the opening in the bushing 20 until the flared portion rests thereagainst. An irregularly shaped mass of glass having substantially the same rate of expansion as the thimble 16 is then placed in said thimble and heated by the flames from the burners 21 and 22 until it melts and is fused to said thimble. The bushing 20 is preferably made from asbestos so as to prevent too rapid dissipation of the heat from the thimble 16 and is cut out at 20' so as to allow the flames to reach as much of the thimble as possible. Normally, the thimble 16 is covered with a thin coating of an oxide which prevents the glass body 18 from adhering thereto at first but gradually this oxide is absorbed by the glass body and it adheres quite uniformly thereto. When the glass body 18 is thoroughly sealed to the thimble 16, the rod 23 is rotated and lowered into the interior of the thimble 16 and the plunger 24 is raised until it passes through the exhaust aperture 17 and pierces the glass body 18. The rod 23 is normally supported by the engagement of the pin 25 extending from the side thereof with the frame 26 of the apparatus, and drops down when the rod 23 is rotated so

that said pin 25 enters the slot 27 in said frame 26. The reduced end of the rod 23 passes into the thimble 16 and may or may not engage the glass body 18, but it is of such a length and breadth as to prevent said glass body from being moved upward materially when the plunger 24 is pushed therethrough. The thimble 16 remains stationary during the entire period of operation of the apparatus as the insulating washer 20 is mounted in the bar 28 extending from both sides of the frame 26. On the other hand, the plunger 24 is of such a length as to pass completely through the glass body 18 and enter the axial passage 29 in the end of rod 23. The said passage 29 is only large enough to accommodate the plunger 24 and the glass adhering to it is wiped therefrom by the rod 23. In order to allow the rod 23 to pass freely into the thimble 16 and the plunger 24 into the passage 29, said opening is vented through the lateral passage 30. The relatively large mass of the rod 23 and the spindle 31 carrying the plunger 24 in relation to the glass body 18 causes considerable heat to be dissipated therefrom and said glass body 18 to be chilled so that an opening remains therein after the plunger 24 is removed therefrom.

As shown in Fig. 2, the spindle 31 is guided by the plate 32 carried between side portions of the frame 26 and is supported by a surrounding sleeve 33 which is engaged by the collar 34 carried by the said spindle 31. The sleeve 33 extends through the joining portion 35 of the frame 26 to the pulley 36 which is fastened thereto, and is supported by the outward extending flange 37 which rides on said portion 35 of the frame 26. Although the chilled condition of the plunger 24 tends to keep the glass of the body 18 from adhering thereto, further precautions are taken by rotating said spindle 31. The rotation is brought about by means (not shown) such as an electric motor which engages the pulley 36 through the belt 38 and is transferred to the spindle 31 through a key (not shown) carried thereby and engaging a longitudinal groove in the bore of the sleeve 33. The groove permits the longitudinal movement of the spindle 31 which extends through said sleeve 33 and is shifted by the lever 39 which pivots on the pin 40 carried by the frame 26. During the upward movement of the spindle 31, the spring 41 which is located about the lower end thereof and butts against the collar 42 thereon and the end of the sleeve 33 is compressed. The return movement of the spindle 31 is assisted by the expansion of the spring 41.

Following the sealing of the fusible body 18 to the thimble 16 and the forming of the opening therethrough, said thimble is removed from the apparatus shown and attached to the lead 14, the filament 12 and the bulb 11 in the manner disclosed in the Greiner application hereinbefore referred to. The lamp 10 has then only to be exhausted and sealed by heating the thimble 16 until the glass body 18 is softened and runs together, closing the opening therethrough.

As shown in Fig. 4, the lamp 10 is first placed in the bell housing 43 and is then exhausted through the tube 44. Access to the interior of the bell housing 43 is had through the cap 45 which is removable by loosening the thumb screw 46 and swinging the yoke 47 out of the position shown. The cap 45 engages the bell housing 43 through the rubber washer 48 contained within a circular recess therein and is pressed against said bell housing, so as to effectively seal the opening therein, by the thumb screw 46 carried by the yoke 47. The yoke 47 is pivoted on the pins 49 extending from the stationary plate 50 which in turn is apertured for the bell housing 43 and is engaged by the supporting flange 52 thereof. As shown, the lamp 10 is orientated in the bell housing 43 so that the terminal thimble 16 having the exhaust aperture 17 therein is located within the well 53, and the opposite terminal thimble 15 is located in the central well 54 in the cap 45. The lamp 10 rests on the portion of the bell housing 43 adjacent the well 53 but does not close said well 53 so effectively as to prevent it and the lamp 10 from being exhausted at the same time as the remainder of the bell housing 43. In this instance, the lamp 10 is not to be gas-filled and following exhaustion thereof high frequency current is passed through the coil 55 surrounding the well 53 so that the metal thimble 16 is heated until the fusible body 18 therein is softened and flows together. Since the bell housing 43 is a non-conductor and in this instance is made of glass, it is not affected by the high frequency currents in the coil 55. Relatively little current at from 15 to 60 megacycles frequency is satisfactory for this purpose, although the wall of the well 53 can be modified so that it engages the metal thmible 16 and transfers the heat thereto directly by conduction as shown in our co-pending application Serial No. 233,793, of even date. The cohesion of the glass body 18 quickly closes the exhaust opening therethrough and more positive results are secured and much less time is expended than if a loose mass of glass is located in the metal thimble 16 and is melted down and fused thereto after evacuation of the lamp.

Obviously, vessels of other devices such as the mercury switch 56 shown in Fig. 5 can be exhausted and sealed according to our invention. The switch 56 differs from the lamp 10 already described in that the fusible body 57 is sealed to an inwardly extending indentation 58 therein either at the same time or after all portions thereof have been assembled. In this instance, the fusible body 57 is sealed to the indentation 58 of the metal side of the mercury switch 56 and a hole 59 is pierced therethrough to the exhaust opening 60 therein following the thorough sealing of said fusible body 57 thereto. The exhausting and gas filling of the mercury switch 56 can, for instance, take place in either an apparatus of the type shown in Fig. 4 or in that shown in our co-pending application hereinbefore referred to.

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

1. The method of exhausting and thereafter sealing a vessel of the class described having a terminal member sealed thereto with an exhaust aperture therein which comprises sealing a body of readily fusible material to said terminal member over the exhaust aperture therein, making an opening through said body to said exhaust aperture, sealing said terminal to said vessel, exhausting the vessel through said exhaust aperture and the opening in said body and thereafter heating the body so that it again fuses and flows over the exhaust aperture and seals the vessel.

2. The method of exhausting and thereafter sealing a vessel of the class described having a terminal member sealed thereto with an exhaust aperture therein which comprises sealing a body of readily fusible material to said terminal member over the exhaust aperture therein, piercing the

body in alignment with the exhaust aperture while said body is still heated and plastic to form an opening therethrough, sealing said terminal member to said vessel, exhausting the vessel through said exhaust aperture and the opening in said body and thereafter heating the body so that it again fuses and flows over the exhaust aperture and seals the vessel.

3. The method of exhausting and thereafter sealing a vessel of the class described having a terminal member sealed thereto with an exhaust aperture therein which comprises sealing a body of readily fusible material to said terminal member over the exhaust aperture therein, piercing the body in alignment with the exhaust aperture while said body is still heated and plastic to form an opening therethrough and preventing substantial displacement of the body during the piercing operation to preserve the seal between said body and the terminal member, sealing said terminal member to said vessel, exhausting the vessel through said exhaust aperture and the opening in said body and thereafter heating the body so that it again fuses and flows over the exhaust aperture and seals the vessel.

4. Apparatus for preparing the exhaust aperture in a terminal member of the class described containing a body of readily fusible material adjacent said aperture comprising means for supporting said terminal member, means for heating the said terminal member adjacent its exhaust aperture to cause said body to be sealed to the terminal member and flow over the exhaust aperture therein, and means for piercing the body in alignment with the exhaust aperture in the terminal member to provide an opening therethrough.

5. Apparatus for preparing the exhaust aperture in a terminal member of the class described containing a body of readily fusible material adjacent said aperture comprising means for supporting said terminal member, means located adjacent thereto for heating said terminal member adjacent its aperture to cause said body to be sealed thereto and flow over the exhaust aperture therein, and a plunger arranged to pierce the fusible body and enter the exhaust aperture to form an opening therethrough.

6. Apparatus for preparing the exhaust aperture in a terminal member of the class described containing a body of readily fusible material adjacent said aperture comprising means for supporting said terminal member, means located adjacent thereto for heating said terminal member adjacent its aperture to cause said body to be sealed thereto and flow over the exhaust aperture therein, a plunger arranged to pierce the fusible body and enter the exhaust aperture while said body is still heated and plastic to form an opening therethrough, and means for rotating said plunger to prevent the fusible body from sticking thereto.

7. Apparatus for preparing the exhaust aperture in a terminal member of the class described containing a body of readily fusible material adjacent said aperture comprising means for supporting said terminal member, means located adjacent thereto for heating said terminal member adjacent its aperture to cause said body to be sealed thereto and flow over the exhaust aperture therein, a plunger arranged to pierce the fusible body and enter the exhaust aperture to form an opening therethrough, and means arranged to engage the fusible body to prevent substantial displacement thereof, said last-named means having a passage therein in alignment with and adapted to accommodate the portion of said plunger extending through said fusible body.

8. Apparatus for preparing the exhaust aperture in a terminal member of the class described containing a body of readily fusible material adjacent said aperture comprising heat insulating means for holding the said terminal member adjacent its exhaust aperture, means located adjacent thereto for heating said portion of the terminal member to cause said body to be sealed thereto and flow over the exhaust aperture therein, a plunger located on one side of said terminal member holder and arranged to enter said exhaust aperture and pierce the fusible body to form an opening therethrough, means for rotating said plunger to prevent the fusible body from sticking thereto, and a rod mounted at the opposite side of the said terminal member holder from said plunger and in alignment with the plunger, said rod being arranged to be brought into engagement with the fusible body to prevent substantial displacement thereof and having a passage in the end thereof in alignment with and adapted to accommodate the portion of said plunger extending through said fusible body.

9. The method of exhausting and thereafter sealing a vessel of the class described having a metallic terminal member sealed thereto with an exhaust aperture therein which comprises sealing a body of readily fusible vitreous material to said terminal member over the exhaust aperture therein, making an opening through said body of fusible material communicating with said exhaust aperture, sealing said terminal member to said vessel, exhausting said vessel through said exhaust aperture and said opening, and thereafter inductively heating said metallic terminal member adjacent said exhaust aperture to again fuse the said body of fusible material and cause it to seal the said exhaust aperture.

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