

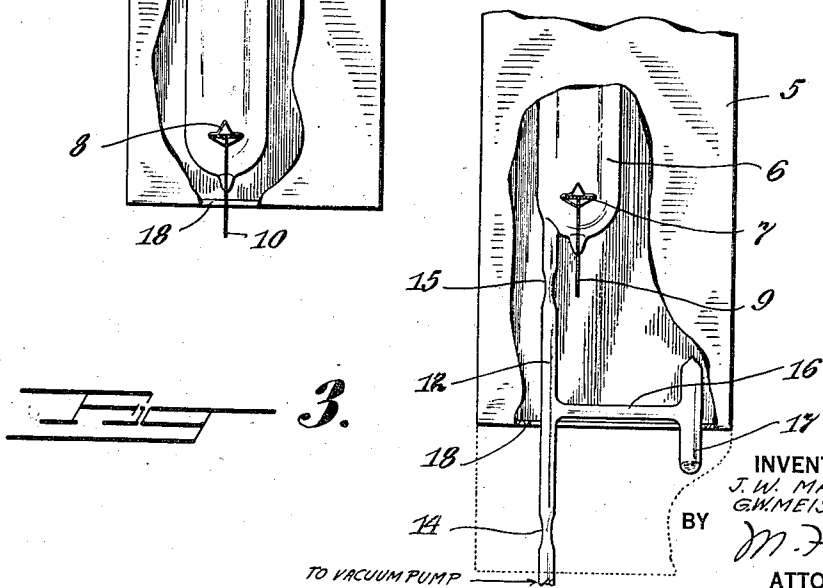
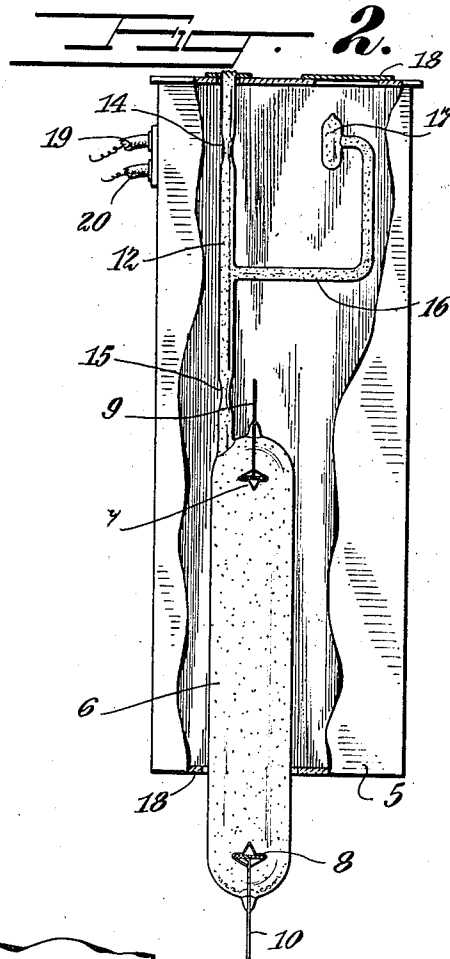
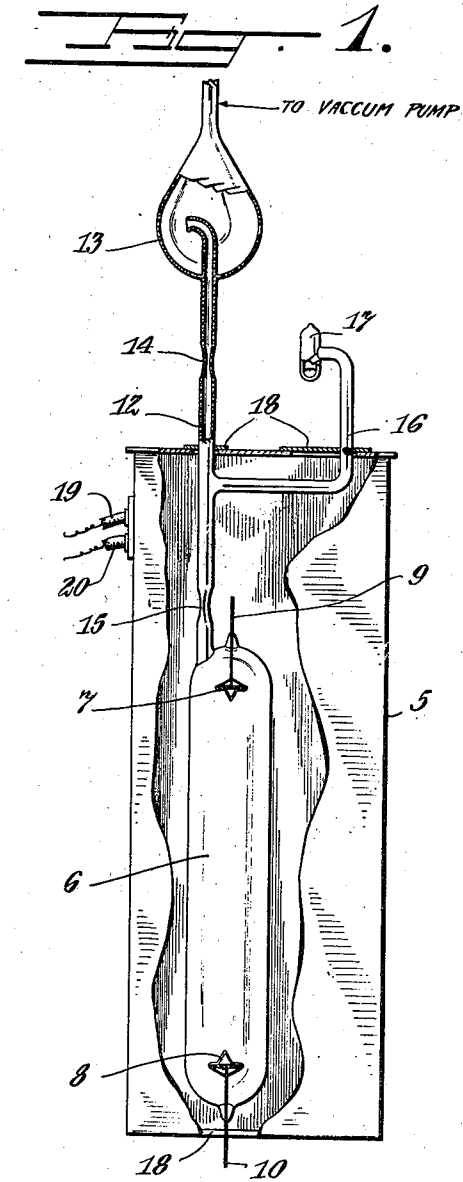
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METHOD OF EXHAUST

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METHOD OF EXHAUST

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Our invention relates to discharge lamps and in its more specific aspects has particular reference to a novel method of exhausting such lamps, and especially high pressure mercury lamps, thereby making the production of lamps of this type much more economical than has been heretofore possible.

High pressure mercury lamps are dependent for successful operation upon several various factors with perhaps the most salient of these being the pressure and quantity of the mercury and the voltage applied. As the name implies the mercury used in such lamps is at a comparatively high pressure and the quantity thereof must be such as to become completely volatilized at operating temperatures of the lamp. Variations in either the quantity or pressure of the mercury necessitates a corresponding variation in the voltage required to sustain a discharge and these variables naturally effect the efficiency of light output of the lamps if the pressure becomes too low. In addition to the foregoing any decomposition or disintegration of the electrodes during operation of the lamp decreases its efficiency in many instances by forming a deposit upon the inner glass walls of the envelope as well as causing a change in pressure within the device.

In the prior art considerable time has been required to properly treat the electrodes and exhaust the lamp during its manufacture. While these requirements alone have been quite a problem perhaps the greatest has been the introduction of the precise quantity of mercury which when volatilized would be at the correct pressure to give the highest luminous output per watt and also maintain the operating voltages of the lamp more or less stable within relatively definite limits.

It is accordingly an object of our present invention to provide a method wherein the time normally required to properly exhaust a high pressure mercury lamp is materially decreased.

Another object of our present invention is to provide a method whereby not only the time normally required to properly exhaust a high pressure mercury lamp is considerably decreased but the introduction of substantially the precise quantity of mercury necessary for most efficient operation is facilitated.

Another object of our present invention is the provision of a high pressure mercury lamp wherein the time normally required to properly exhaust the lamp is materially decreased.

A further object of our present invention is the

provision of a high pressure mercury lamp wherein not only is the time normally required to properly exhaust the lamp materially decreased but in addition the lamp is provided with substantially the precise quantity of mercury which will be completely volatilized at the operating temperature of the lamp and consequently the correct pressure for most efficient luminous output per watt obtained.

Still further objects of our present invention will become obvious to those skilled in the art by reference to the accompanying drawing wherein

Figure 1 is an elevational view partly in section and with parts thereof broken away of one form of apparatus which may be employed in carrying out our novel method of producing a high pressure mercury lamp.

Fig. 2 shows the same apparatus as in Fig. 1 and the position of the lamp in a further step of our method, and

Fig. 3 shows a modification of the apparatus shown in Figs. 1 and 2 wherein the same steps of our method are followed but the position of the lamp during its process of production is inverted to that of the preceding modifications.

Referring now to the drawing in detail we have shown in Fig. 1 an electric furnace or oven having suspended therein a high pressure mercury lamp comprising an envelope 6 provided with the usual oppositely disposed electrodes 7 and 8, which are supported by suitable leading-in conductors 9 and 10 sealed to the glass envelope and extending exteriorly thereof. At the particular stage of production shown the envelope is sealed in the usual manner to a tube or conduit 12 extending exteriorly of the oven 5 and through a condensation receptacle, such as a mercury trap 13, to an evacuating pump (not shown) as is commonly used for exhausting purposes. This conduit 12, however, between the envelope 6 and the mercury trap 13, is provided with restrictions 14 and 15 having identical cross-sectional diameter openings with the end of the tube protruding a substantial distance into the trap 13 as shown in Fig. 1. Midway between these restrictions an angularly disposed conduit or tube 16 is connected to the conduit 12 which extends from a reservoir or the like 17, having sealed therein a predetermined quantity of mercury, and normally positioned outside of the oven 5 when the envelope 6 is entirely disposed therein, as more fully hereinafter described.

Prior to positioning the oven 5 about the lamp it is first exhausted by the vacuum pump to a

substantial degree of evacuation. While on the vacuum pump the electrodes 7 and 8 are treated by induction heating to liberate occluded gases which are pumped off by the vacuum pump to prevent their absorption by the glass walls of the envelope. After this preliminary treatment the envelope is positioned within the oven 5, or the latter moved so as to surround the lamp, in the manner shown in Fig. 1 with the oven being substantially sealed at the points of egress of the conduits 12 and 16 by suitable gaskets, covers, or the like 18.

The electric oven is then heated, by electrical energy from a suitable source (not shown) through conductors 19 and 20 extending thereto, while the vacuum pump (not shown) is operated. During this step the lamp is heated in the oven 5 at a temperature of 560° C., or higher, for approximately ten minutes with the mercury within the reservoir remaining in its original liquid state due to it being disposed exteriorly of the oven 5 and consequently not heated to any appreciable extent. After this period of preliminary heating the oven may be removed and the electrodes further treated by induction heating for a brief period of approximately three minutes to still further remove any occluded gases therefrom.

An inert gas, such for example as argon, at a pressure of 3 to 5 mm. is then introduced to the lamp and the latter energized for the purpose of seasoning, by the passage of a current of approximately 5 amperes between the electrodes 7 and 8, for a period of ten minutes or longer with the lamp apparently improving the longer the period of burning with argon gas.

Upon completion of this step the gas is pumped off by the vacuum pump and the oven raised to the second level, as shown in Fig. 2, which enables a portion of the envelope 6 to protrude exteriorly of the oven 5 while the mercury reservoir 17 is now positioned interiorly thereof along with the greater portion of the envelope.

The mercury is accordingly volatilized passing through the conduit 16 to the juncture with the conduit 12 midway between the restrictions 14 and 15 where it diffuses. A small quantity of mercury passes through the restriction 14 and is lost in the trap 13 but the greater portion thereof, however, condenses as hereinafter explained and passes through the restriction 15 to the envelope 6 and is condensed at the lower exteriorly protruding portion of the envelope.

Repeated tests have indicated that with the restrictions 14 and 15 being, as before stated, of substantially the same cross-sectional diameter and the conduit 16 connected midway between these restrictions, in the manner shown in the drawing, approximately 80% of the original quantity of mercury within the reservoir 17 is condensed in the envelope while the remaining 20% accumulates in the trap 13. This particular phenomenon may perhaps be attributed to the vertical position of the conduit 12 having the restrictions 14 and 15 therein as well as the length of the projecting portion of the conduit 12 interiorly of the trap 13. During volatilization of the mercury and its diffusion at the juncture of the conduits 12 and 16 the normal tendency is for the mercury to equally distribute itself.

However, the trap 13 is at all times positioned exteriorly of the oven 5 and a small quantity of the mercury will condense in the trap 13 and surround the inner projecting portion of the conduit 12. This cools the upper end of the conduit

12 sufficiently to cause a condensation of small quantities of mercury prior to its passing out the end of the conduit into the trap with the result that it gravitates in the direction of the envelope 6 to be revolatilized with the greater proportion thereof finally condensing in the latter and augmenting the quantity of the volatilized mercury directly diffused in the envelope.

Moreover, it should be stated that it is the usual practice to provide at least one restriction adjacent the envelope for the sole purpose of facilitating tipping off of the device and in order to produce the result herein stated we find it necessary to provide the additional restriction. However, if the internal diameter of the tube 12 is uniform and proportioned relative to the quantity of mercury within the reservoir 17 we find both restrictions may be dispensed with. Nevertheless, even in this latter event the juncture of the tube 16 with the tube 12 should be spaced equidistant between the envelope 6 and the trap 13 for the purpose of effecting equal diffusion of the volatilized mercury which will again condense in the envelope 6 in approximately the proportions previously stated.

Consequently in order to obtain a desired quantity of mercury within the envelope 6 it is only necessary to place a predetermined amount within the reservoir 17 which exceeds the quantity desired in the envelope by approximately 20% and upon completion of the process the correct desired amount will condense in the envelope. Upon complete volatilization of the mercury with attendant condensation of the desired quantity within the envelope the oven is removed, about 5 mm. of argon added, and the lamp tipped off thus completing the finished lamp.

The construction and operation of apparatus as shown in Fig. 3 is identical to that just described relative to Figs. 1 and 2 with the exception that the lamp 6 in this particular modification is upright and the first position of the oven 5 being as shown in full lines while the second portion thereof is shown by the dotted lines in this figure. Moreover, we have found that the voltage required to sustain a discharge in a high pressure mercury lamp using a definite quantity of mercury is quite uniform and by facilitating the introduction of the desired amount of mercury therein by our novel process the operating voltage required can accordingly be substantially predetermined.

It thus becomes obvious to those skilled in the art that we have provided a novel method for the production of a high pressure mercury lamp wherein the time normally required to properly exhaust the same is materially decreased. Inasmuch as the introduction into the lamp of the desired quantity of mercury for most efficient operation is facilitated by our apparatus, not only is a more economical production of lamps of this type obtained but in addition the voltage necessary to sustain operation of the lamp can be predetermined.

Although we have shown and described one specific embodiment of our present invention we do not desire to be limited thereto as various other modifications of the same may be made without departing from the spirit and scope of the appended claims.

What is claimed:

1. The method of producing a discharge device having a preselected quantity of readily volatilizable material therein which comprises sealing in communication with the interior of

the envelope of the device one end of a tube which extends through a condensation receptacle to a vacuum pump, connecting a reservoir containing a preselected quantity of the readily volatilizable material to the tube at a point equidistant between the envelope and the condensation receptacle, exhausting the envelope, simultaneously heating the envelope and reservoir to volatilize the material within the latter accompanied by a diffusion of the material and attendant condensation of the greater proportion of the diffused material in the envelope, and sealing off the device after complete volatilization of the material within the reservoir.

2. The method of producing a discharge device having a preselected quantity of readily volatilizable material therein which comprises sealing in communication with the interior of the envelope of the device one end of a tube having restrictions therein of substantially equal cross-sectional bore which extends through a condensation receptacle to a vacuum pump, connecting a reservoir containing a preselected quantity of the readily volatilizable material to the tube at a point equidistant from the restrictions therein, exhausting the envelope, simultaneously heating the envelope and reservoir to volatilize the material within the latter accompanied by a diffusion of the material and attendant condensation of the greater proportion of the diffused material in the envelope, and sealing off said device after complete volatilization of the material within the reservoir.

3. The method of producing a discharge device having a preselected quantity of readily volatilizable material and an inert gas therein which comprises sealing in communication with the interior of the envelope of the device one end of a tube having restrictions of substantially equal cross-sectional bore which extends through a condensation receptacle to a vacuum pump, connecting a reservoir containing a preselected quantity of the readily volatilizable material to the tube at a point midway between the restrictions therein, exhausting the envelope, simultaneously heating the envelope and reservoir to volatilize the material within the latter accompanied by a diffusion of the material and attendant condensation of the greater proportion of the diffused material in the envelope, introducing an inert gas in said envelope, and sealing off said device after complete volatilization of the material in said reservoir.

4. The method of producing a discharge device having a preselected quantity of mercury which will become completely volatilized at the operating temperature of the device and attain a predetermined pressure which comprises sealing in communication with the interior of the envelope of the device one end of a tube which extends through a condensation receptacle to a vacuum pump, connecting a reservoir containing a preselected quantity of mercury to the tube midway between the envelope and the condensation receptacle, exhausting the envelope, simultaneously heating the envelope and reservoir while maintaining one portion of the envelope at a lower temperature than the greater heated portion to volatilize the mercury in the reservoir accompanied by a diffusion and attendant condensation of a small quantity thereof in the condensation receptacle with the greater proportion condensing in the cooler portion of the envelope, and sealing off the device after com-

plete volatilization of the mercury within the reservoir.

5. The method of producing a discharge device having a predetermined quantity of mercury therein which comprises sealing in communication with the envelope of the device a reservoir containing a preselected quantity of mercury, exhausting the envelope of said device, simultaneously heating the envelope and the reservoir to volatilize the mercury with diffusion thereof both toward and away from the envelope of the device, condensing a portion of the volatilized mercury diffused in the direction away from the envelope and allowing the same to gravitate to the envelope to augment that diffused therein, condensing all of the volatilized mercury diffused into said envelope together with that gravitating therein, and sealing off said device after complete volatilization of the mercury within the reservoir.

6. The method of producing a discharge device having a predetermined quantity of mercury therein which comprises sealing in communication with the envelope of the device a reservoir containing a preselected quantity of mercury, exhausting the envelope of said device, simultaneously heating the envelope and the reservoir to volatilize the mercury with diffusion of approximately 50% of the volatilized mercury toward and away from the envelope of the device, condensing a portion of the volatilized mercury diffused in the direction away from the envelope and allowing the same to gravitate to the envelope whereby the volatilized mercury diffused therein is augmented by approximately 30% of that diffused in a direction away from the envelope and constitutes approximately 80% of the original quantity contained in the reservoir, condensing all of the mercury in the envelope, and sealing off the device after complete volatilization of the mercury within the reservoir.

7. In an apparatus for producing a discharge device provided with an envelope having a predetermined quantity of a readily volatilizable material therein, a reservoir having sealed therein a predetermined quantity of said volatilizable material and connected in communication with the envelope of said device, a vacuum pump connected to said envelope for exhausting the same, means for heating said envelope and said reservoir to volatilize the material housed in the latter to cause diffusion thereof toward and away from said envelope, and means connected in communication with said envelope and said reservoir for condensing said volatilized material diffused in a direction away from said envelope and enabling the greater portion of said condensed material to gravitate to said envelope to augment the volatilized material diffused therein.

8. In an apparatus for producing a discharge device provided with an envelope having a predetermined quantity of a readily volatilizable material therein, a reservoir having sealed therein a predetermined quantity of said volatilizable material and connected in communication with the envelope of said device, a vacuum pump connected to said envelope for exhausting the same, an oven adapted to surround said envelope and said reservoir to volatilize the material housed in the latter to cause diffusion thereof toward and away from said envelope simultaneously with the exhausting of said envelope, and a condensing receptacle connected in communication with said envelope and said reservoir for condensing said volatilized material diffused in a direction away from said

envelope and operable to cause the greater proportion of said condensed material to gravitate to said envelope and augment the volatilized material directly diffused therein.

- 5 9. In an apparatus for producing a discharge device provided with an envelope having a predetermined quantity of a readily volatilizable material therein, a conduit sealed to said envelope and extending through a condensing receptacle to a vacuum pump for exhausting said envelope, 10 a reservoir having sealed therein a predetermined quantity of said volatilizable material and connected in communication with said conduit at a point equidistant from said envelope and said 15 condensing receptacle, means for heating said envelope and reservoir simultaneously with the exhausting of said envelope to volatilize said material and cause diffusion thereof toward said envelope and said condensing receptacle with the 20 greater portion of the material condensed by said receptacle gravitating toward said envelope and augmenting the quantity of said material directly diffused in said envelope.

10. In an apparatus for producing a discharge

device provided with an envelope having a predetermined quantity of mercury therein, a tube sealed to said envelope having restrictions therein of substantially equal internal diameter and extending through a condensing receptacle to a vacuum pump for exhausting said envelope, a reservoir having sealed therein a predetermined quantity of mercury and connected in communication with said tube midway between said restrictions, means for heating said envelope and reservoir simultaneously with the exhausting of said envelope to volatilize said material and cause substantially an equal diffusion thereof to said envelope and toward said condensing receptacle with the greater proportion of the material condensed by said condensing receptacle gravitating to said envelope and augmenting the quantity of said material directly diffused into said envelope whereby the total quantity finally condensed in said envelope constitutes substantially 20 80% of the original quantity disposed in said reservoir.

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