Feb. 21, 1967 E. G. FRIDRICH 3,305,289

ELECTRIC LAMP MANUFACTURE

Filed May 9, 1963 3 Sheets-Sheet 1

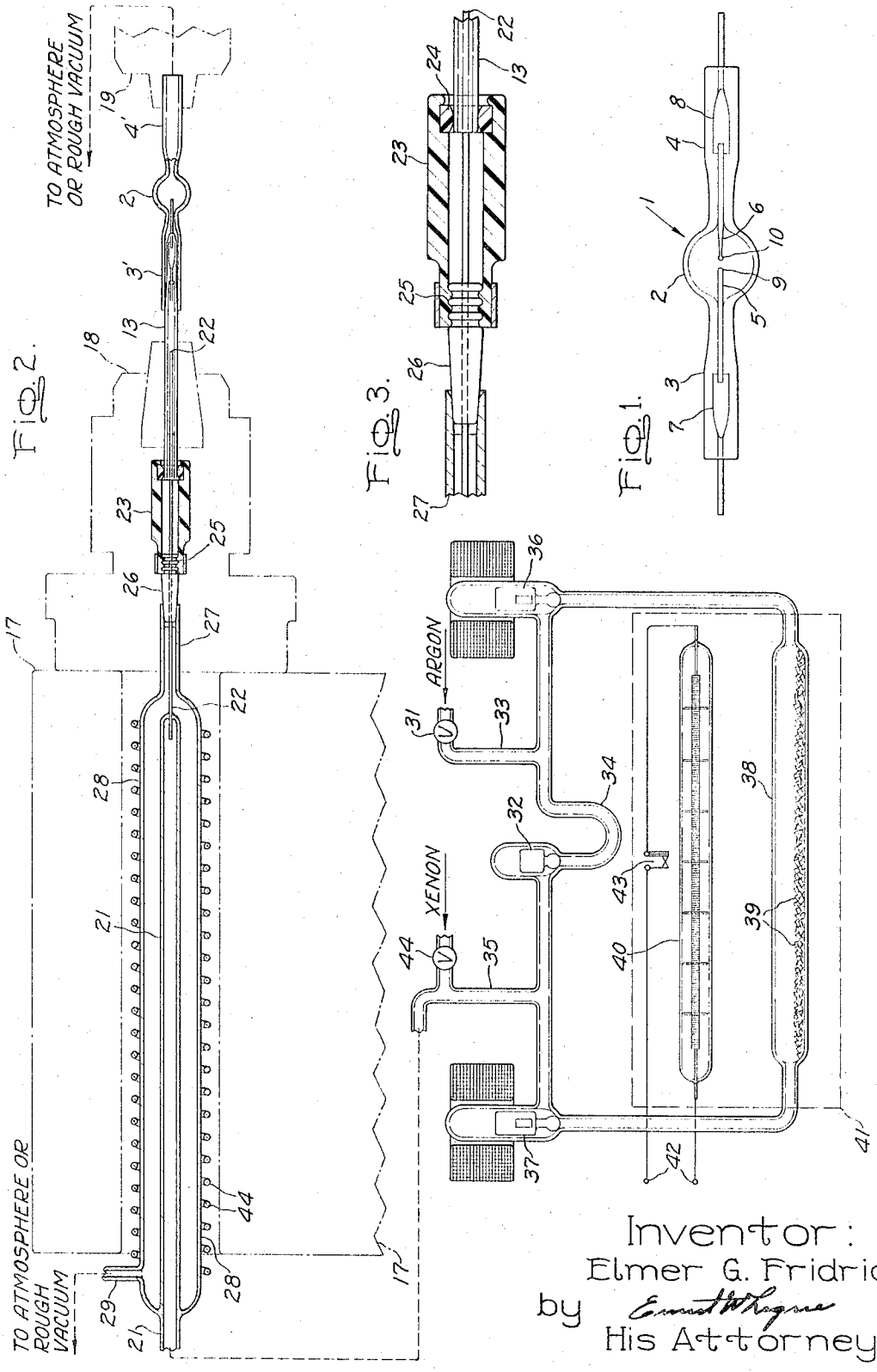


Fig. 2.

Fig. 3.

Fig. 1.

Inventor:
Elmer G. Fridrich
by Ernest W. Hogue
His Attorney

Feb. 21, 1967 E. G. FRIDRICH 3,305,289

ELECTRIC LAMP MANUFACTURE

Filed May 9, 1963 3 Sheets-Sheet 2

Fig. 4.

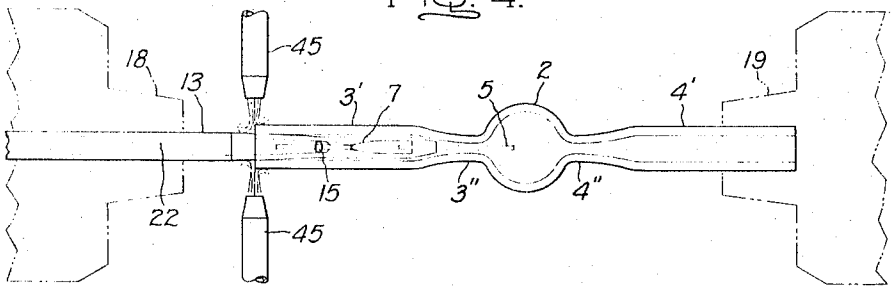


Fig. 5.

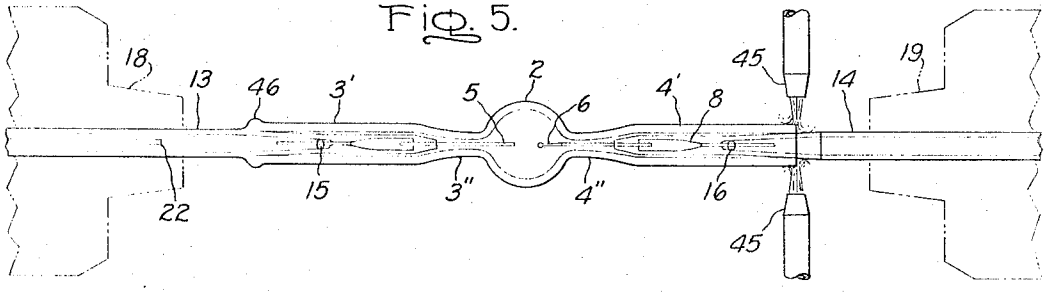


Fig. 6.

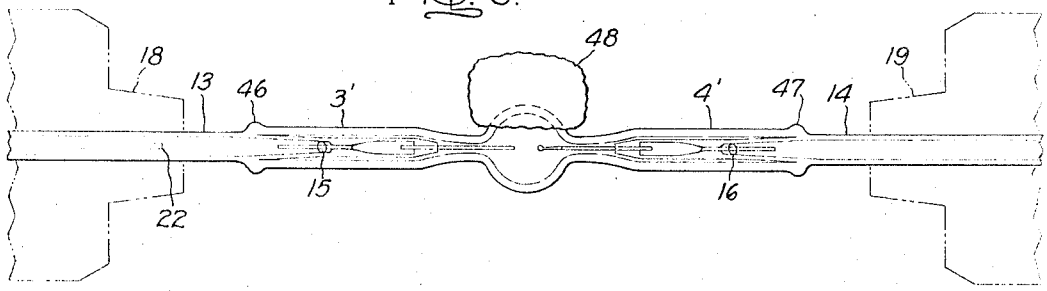
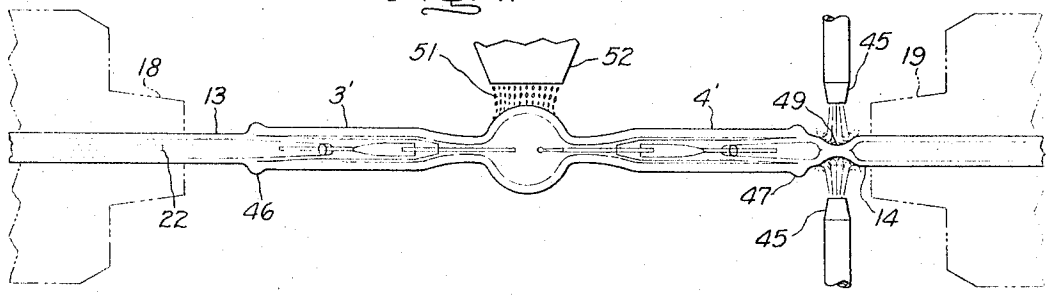


Fig. 7.



Inventor:
Elmer G. Fridrich
by Ernest W. Legree
His Attorney

Feb. 21, 1967 E. G. FRIDRICH 3,305,289

ELECTRIC LAMP MANUFACTURE

Filed May 9, 1963 3 Sheets-Sheet 3

Fig. 8.

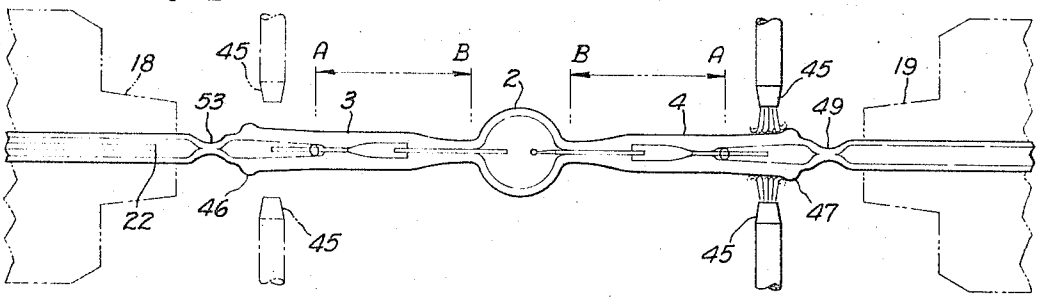
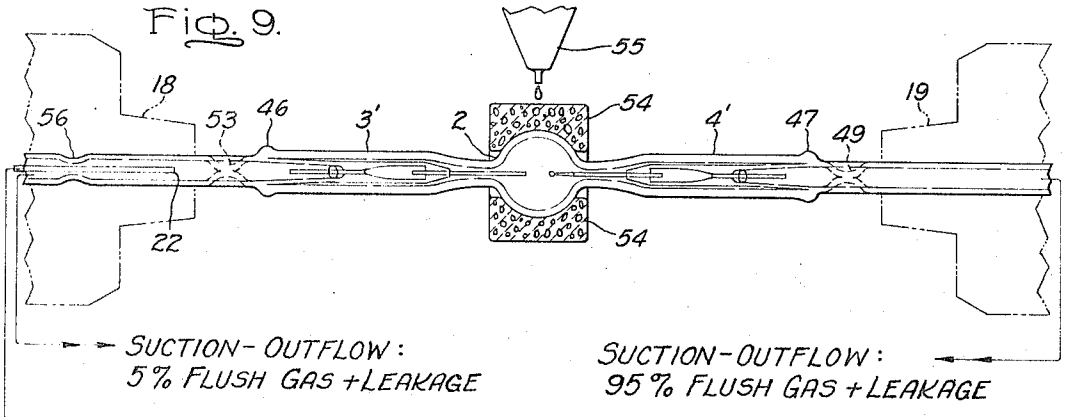


Fig. 9.



SUCTION - OUTFLOW:
5% FLUSH GAS + LEAKAGE

SUCTION - OUTFLOW:
95% FLUSH GAS + LEAKAGE

INFLOW:
100% FLUSH GAS (Ar) + Xe + I_2

Inventor:
Elmer G. Fridrich
by Ernest W. Hogue
His Attorney

United States Patent Office 3,305,289 Patented Feb. 21, 1967

3,305,289

ELECTRIC LAMP MANUFACTURE

Elmer G. Fridrich, South Euclid, Ohio, assignor to General Electric Company, a corporation of New York

Filed May 9, 1963, Ser. No. 279,270
10 Claims. (Cl. 316—21)

This invention relates to the manufacture of electric lamps or devices by a flush filling process. While not restricted thereto, the invention is particularly useful in connection with compact source quartz discharge lamps using the iodine regenerative cycle to maintain the envelope wall clear.

The common practice up to now in the manufacture of discharge lamps has been to seal the inleads and electrodes into the envelope and thereafter exhaust the envelope through an exhaust tube, introduce the filling, and tip off the exhaust tube. An exhaust tip is inevitably a source of weakness. In an envelope operating at temperatures substantially higher than the ambient, an exhaust tip tends to provide a cool spot which may adversely affect the operation of the lamp, for instance by condensation of metal vapors. Another disadvantage especially pronounced in compact source lamps is the optical defect which the exhaust tip introduces. This may readily be seen in the lamp illustrated in my Patent 3,067,357, "Electric Discharge Lamp Electrode," wherein a compact source lamp operating with molten electrodes in an ionizable medium including iodine vapor has an exhaust tip in the center of the bulb. The exhaust tip detracts appreciably from the usefulness of the lamp when it is intended for an optical projection system.

Therefore one object of the invention is to provide a method of processing lamps, including filling and sealing off, which eliminates completely the need for a conventional exhaust tube.

In the quartz iodine lamp of my earlier-mentioned patent, foliated molybdenum inleads are used which are sealed into the quartz tube or envelope by the now conventional pinch-sealing technique. Pinch-sealing involves of course a radical deformation of the ends of the tube, which is all the more pronounced the smaller the size of the tube or envelope. Another object of my invention is to provide a processing method which avoids the deformation caused by pinch-sealing and which is suitable for quartz lamps.

In compact source short arc-gap lamps, accurate alignment an dspacing of the electrodes is essential in order to achieve stable and reproducible lamps, as regards both optical and electrical characteristics. Therefore, another object of the invention is to provide a processing method which permits accurate alignment and spacing of electrodes.

Briefly stated, in a preferred processing technique according to the invention, electrodes pre-pinched into quartz seal tubes are sealed into tube-like necks or extensions of a quartz bulb in such fashion as to form hermetic seals relative to the outside but leaving a continuous passageway through the bulb. This permits the bulb to be processed with a continuous flow of inert gas such as argon through it, so that oxidation of the inleads and electrodes or contamination of the interior is prevented. Preferably this is done while the bulb is supported by its seal tubes and rotating in a glass lathe. Even though the bulb is of quartz, under these circumstances it may be sotfened and worked to achieve accurate alignment and positioning of the electrodes.

A condensable filling such as iodine may be introduced into the bulb by entraining it as a vapor along with the argon and causing it to condense in the bulb. Xenon may also be introduced into the bulb by entraining it along with the argon and chilling the bulb with liquid

nitrogen to condense the xenon. When the desired filling has been introduced, the seal tubes are sealed off and then the necks or bulb extensions are collapsed over the enclosed seals and seal tubes by application of flame thereto. The projecting ends of the seal tubes which are no longer necessary may then be broken or cut off in order to expose the ends of the inleads, and the lamp is complete.

For further features and advantages and for a better understanding of the invention, attention is now directed to the following description of a preferred mode of practicing the invention, to be read in conjunction with the accompanying drawings. The features of the invention believed to be novel will be more particularly pointed out in the appended claims.

In the drawings wherein like symbols denote corresponding parts throughout the several views:

FIG. 1 illustrates a typical compact source short arc-gap quartz lamp produced according to the invention.

FIG. 2 illustrates in partly diagrammatic form apparatus used in the practice of my invention.

FIG. 3 is an enlarged sectional view of the coupling to the end of the lamp.

FIGS. 4 to 8 all show the lamp seized between headstock and tailstock of a glass lathe and illustrate successive stages in its processing.

FIG. 9, in similar fashion to FIGS. 4 to 8, illustrates a modification for introducing xenon into the lamp.

Referring to FIG. 1, the illustrated lamp 1 comprises a quartz envelope having a generally spherical central portion or bulb 2 provided with generally cylindrical extensions 3, 4 which will be referred to as necks. The electrodes 5, 6 consist of short lengths of tungsten wire which are welded to the foliated ends of molybdenum inlead wires 7, 8 extending through the necks, the foliated portions providing the hermetic seals. The illustrated lamp is intended for direct current operation and the anode 5 is rod-like and rounded at the end 9, while the cathode 6 includes a tapered portion which attains its smallest diameter immediately before the ball point or spherical tip 10. As taught in my earlier-mentioned patent, the lamp operates with substantially molten tips and the balled or rounded ends on the electrodes may be formed after completion of the lamp by operating it at a current or loading sufficient to melt back the electrodes. The lamp contains an ionizable filling which includes an inert gas such as argon or xenon, and a halogen, preferably iodine or a substance which releases iodine at a high temperature. The iodine regenerative cycle maintains the electrodes stable in size and shape and eliminates envelope darkening. By way of example, the illustrated lamp may have an over-all length of about 6 centimeters and the bulb portion may have an internal diameter of about 7 millimeters. It will be observed that the bulb has no exhaust tube tip and is optically perfect, the lamp itself being symmetrical end for end except for the specific electrode structure.

The starting materials in making a lamp by my process are a preformed quartz bulb 2 such as illustrated in FIG. 4, which is the same in external configuration as the finished lamp except that the necks 3', 4' at this stage are tubular and slightly larger in diameter than in the finished lamp; and a pair of pre-pinched seal tubes 13, 14 (FIGS. 4 and 5). Seal tubes 13, 14 comprise tungsten electrodes 5, 6 welded to molybdenum foil inleads 7, 8 sealed into the solid fused ends of thin-walled quartz tubes; the foil inleads are mostly conveniently sealed in by pinch-sealing wherein the end of the quartz tube is heated to plastically and mechanically pinched or pressed down upon the foil. The seal tubes have passageways extending through from the outer ends to

the lateral apertures 15, 16 to the rear of the solid fused portions close to where the molybdenum inleads flare out into the foil portions. The quartz bulb is preferably formed by the simultaneous shrinkage and upset of quartz tubing as taught in my copending application Serial No. 279,229, now Patent No. 3,263,852 filed of even date and entitled "Bulb Manufacture." However this is not essential and the bulb may be formed in any convenient fashion resulting in the desired configuration. For instance it may be made by butting and joining together three pieces of quartz tubing comprising a short central portion of slightly larger diameter to form the bulb portion, and smaller diameter portions on each side to form the necks. The sealing of the electrode inleads into the ends of the seal tubes may be done in any convenient fashion, for example by pinch-sealing or by vacuum collapse. The apertures 15, 16 behind the fused seal bodies are conveniently formed by grinding through the side of the quartz tube. Preferably the fused seal bodies have conical noses or tips and the necks of the bulb are shrunk down slightly at 3", 4" to limit the penetration of the seal bodies.

The joining of the various parts and the processing of the lamp is done in a glass lathe of generally conventional construction, partly illustrated in diagrammatic fashion in FIG. 2. Reference may be made to my aforementioned copending application for a detailed illustration of a suitable lathe. The lathe comprises a headstock 17 including a Jacob's chuck 18 and a movable tailstock including a Jacob's chuck 19. The lathe includes conventional drive means for rotating the head and tailstock chucks synchronously in unison, along with facilities for shifting the tailstock toward or away from the headstock to vary the gap inbetween. Conventional parts of the glass lathe have been illustrated in phantom, that is in broken lines in FIG. 2, and parts shown in solid lines are additions or modifications pertinent to the invention for the purpose of controlling gas flow through the lamp during processing and for introducing the iodine filling. Processing of the lamp requires that it be revolved at several revolutions per second in the glass lathe. This means that rotating slip joints must be provided and it is quite impractical to attempt a hermetic seal at a slip joint under such circumstances. My process avoids the need for hermetic seals at the slip joints and relies instead upon providing a rate of gas flow at such joints which is greater than the rate of back diffusion of the atmosphere.

As illustrated in FIG. 2, argon is supplied through an internal glass tube 21, and a hollow molybdenum needle 22, henceforth referred to as a snorkel, to a point within seal tube 13. A reasonably tight but not hermetic joint is made to the end of the seal tube by means of a coupling comprising a Teflon sleeve 23 encompassing at its front end a silicone rubber sealing ring 24 which engages the end of seal tube 13. At its rear end, the Teflon sleeve makes a rotating fit with the serrated end 25 of a tantalum tube 26. The other end of the tantalum tube is conically tapered and makes a tight fit with the ground end of glass tube 27 which extends external tube 28 forming a concentric gas passage around internal tube 21. Seal tube 13 is gripped in the jaws of headstock chuck 18 and revolves with it along with Teflon sleeve 23 of the coupling. Glass tubes 28 and 27, along with tantalum tube 26, are stationary and the relative rotation or slip occurs at the serrated junction 25. Coupling tube 29 at the other end of glass tube 28 may be vented to the atmosphere or connected to a rough vacuum system. When simply vented to the atmosphere, argon must be supplied through the snorkel to the lamp at a pressure above atmospheric and at a rate great enough to overcome the diffusion of the atmosphere into the system through the various joints, in particular the joints at 24 and 25. By applying rough vacuum to coupling tube 29, argon may be supplied at a pressure less than atmospheric and like results achieved. In such case, a similar coupling must be provided in the tailstock at the right end of the glass lathe to make a reasonably tight connection to seal tube 14, and rough vacuum must also be applied thereto. It will be appreciated that part of the argon which enters the lamp through the snorkel will flow back to the left and exit through the end of seal tube 13, while part will flow to the right and exit through the end of seal tube 14. Restrictions may be placed in the ends of the seal tubes to control and limit the rate of argon flow.

The processing of the lamp is done for the most part with only argon flowing through. This is accomplished by opening valve 31 controlling the admission of argon from a regulated supply, whereupon the gas pressure lifts up check valve 32 and the gas flows through tube sections 33, 34 and 35 into internal tube 21 and thence through snorkel 22 into the lamp. As a practical matter, it is desirable to maintain a slight flow of argon through the system at all times in order to prevent entry of air and contamination. To provide iodine, magnetic valves 36, 37 are actuated. The check valve then seats and forces the argon flow to detour through tube reservoir 38 in which iodine crystals indicated at 39 are disposed. The iodine tube reservoir is maintained at a temperature sufficiently elevated to achieve a substantial pressure of iodine vapor. This is accomplished by a heat lamp 40, both the reservoir and the lamp being enclosed within a heat reflecting box indicated by broken lines at 41. The heat lamp may be energized from the usual 115–120 volts A.-C. source at terminals 42 and, conveniently, the temperature may be regulated by a thermostatic switch 43. The argon vapor flowing through reservoir 39 entrains iodine vapor and carries it into the lamp bulb where it may be condensed by chilling the bulb. To prevent condensation of iodine in the tubing system, it is preferably insulated and supplementary heat may be applied as by means of a resistance heater 44 coiled around external glass tube 28. Xenon may be supplied alone by opening xenon regulating valve 44, or together with argon by simultaneously opening valve 44 and argon regulating valve 31. Xenon may be collected in the bulb free of argon by chilling the bulb with liquid air, as will be more fully explained hereafter.

The sequence in forming, gas filling and sealing the lamp may be followed in FIGS. 4 to 8. One of the seal tubes, conveniently seal tube 13 of the anode pre-pinched seal, is mounted in headstock chuck 18 and the bulb 2 is mounted by its neck 4' in tailstock chuck 19, as shown in FIG. 4. The tailstock is displaced towards the headstock and the seal body penetrates neck 3' to the point where the nose of the seal body butts the constriction 3" at the entrance to the spherical portion 2 of the envelope. The argon flow flushes air out of the system to prevent oxidation of the molybdenum inleads and tungsten electrodes. The flow must be great enough to assure leakage of argon at any joint or opening in the system at a rate greater than that of air diffusion into the system; a typical rate of flow is 150 milliliters per minute. Heat is applied to the junction of seal tube 13 and the end of neck 3' by means of oxyhydrogen burners 45. As the quartz becomes plastic, the tailstock is moved back and forth a fraction of an inch, thereby working the quartz to achieve an upset and create a good joint, as shown at 46 in FIG. 5. Since both headstock and tailstock chucks are rotating in unison meanwhile, axial alignment is assured.

After the juncture has fused, the tailstock chuck may be disengaged and moved out of the way. It is desirable at this stage to bake the bulb thoroughly in order to drive out any impurities. This may be done by moving the flame slowly from end to end of the lamp body. The impurities are flushed out by the argon flow and probably include deposits of silicon monoxide on the inside wall. While impurities are still present, the quarts exhibits bright red glowing areas and striations under the applied heat; after the impurities have been driven out, the quartz remains clear at the same temperature.

Seal tube 14 of the cathode pre-pinched seal is now en-

gaged in tailstock chuck 19 and the tailstock is again advanced to the left until the nose of the seal body butts the constriction 4'' in neck 4', as shown in FIG. 5. The flame from the oxyhydrogen burners is brought into play and the quartz worked as before to form a juncture 47 between the end of neck 4' and seal tube 14, as shown in FIG. 6. The gap between the electrodes may be accurately adjusted at this stage by moving the tailstock while the quartz is soft at the juncture 47. If necessary, the first juncture 46 may be resoftened to permit further adjustment to be made and to locate the interelectrode gap centrally in the bulb. The adjustment is made by manipulating the tailstock to work the quartz, that is pushing or pulling to compress or stretch the quartz at whichever one of the junctures is softened. It will be appreciated that inasmuch as the junctures 46, 47 are beyond the apertures 15, 16 in the seal tubes 13, 14, there is an open passage through the arc tube and the argon flow is maintained at all times through the bulb.

The next step consists in providing the iodine filling within the bulb 2. Magnetic valves 36, 37 (FIG. 2) are actuated to divert the argon flow through the iodine reservoir so that argon with entrained iodine vapor now flows through the bulb. The bulb is chilled by applying a refrigerant such as a block of Dry Ice (solid CO_2) to it as indicated at 48 in FIG. 6. Iodine condenses as a solid in the chilled bulb while the argon continues through. The quantity of iodine condensing is determined as the product of time, by rate of flow, by quantity of iodine per unit volume of argon, the latter depending on the temperature of the iodine tube reservoir. The right side of the lamp is now sealed off by playing the oxyhydrogen flame on seal tube 14 just beyond juncture 47. Surface tension of the quartz causes the walls to neck down as shown at 49 in FIG. 7, and upon fusing, a hermetic seal results; however the seal tube is not severed and continues to support the lamp from the tailstock chuck. Meanwhile it is desirable to continue cooling the bulb 2 which contains the iodine and this may be done by a block of Dry Ice 48 as before. Alternatively, a spray of cold water may be used, as indicated at 51, originating from a spray nozzle 52. The supply of argon through the snorkel continues, but the argon no longer flows through the bulb and merely leaks back out the end of the left seal tube 13, thereby preventing contamination of the lamp.

The next step consists in providing an inert gas, in this case argon, at such a fill pressure within the bulb as will result in the desired pressure under operating conditions of the lamp. An atmospheric fill pressure presents no particular problem: seal tube 13 is merely sealed off. Where a fill pressure less than atmospheric is desired, suction or rough vacuum may be applied to the end of seal tube 13; since the rate of argon flow through the snorkel is limited, the pressure of argon in the bulb is reduced commensurately. The bulb now contains solid iodine and is filled with argon at the desired pressure less than atmospheric. Seal tube 13 is then sealed off by necking down at 53, as shown in FIG. 8, but without severing the tube. The bulb is now completely sealed off at both ends and gas no longer flows through. The final step consists in running the oxyhydrogen flame along the necks 3', 4' of the bulb over the longitudinal extents A to B, as indicated by the arrows, in order to collapse them down on the seal bodies. The end results are fused solid quartz necks 3, 4 with the molybdenum inleads hermetically sealed in them and with the electrodes extending through into the bulb 2, as illustrated in FIG. 8. The lamp is then removed from the glass lathe and the quartz portions beyond sections A are severed by means of a fine cut-off wheel and discarded, thereby exposing the ends of the molybdenum inleads. The lamp is now complete and has the form illustrated in FIG. 1.

Where a fill pressure which is greater than atmospheric at room temperature is desired, the bulb may be chilled appropriately before sealing off. Thereafter, upon warming to room temperature, the desired supra-atmospheric pressure is obtained.

Where a xenon and iodine filling is desired, since xenon is relatively very expensive, it is preferable to use argon for the flush gas and the same steps are observed up to the point where the bulb is ready to receive the charge of iodine (FIG. 6). The same procedure may be used as before to provide the iodine, that is flushing it through with argon while the bulb is chilled with Dry Ice. However it is more convenient to provide the filling of both xenon and iodine at the same time in the following manner. A restriction is placed in the seal tube through which the snorkel or capillary feed tube penetrates in order to limit the flush gas flow out through that seal tube and force the major portion of the flow through the envelope. Any suitable kind of constriction can be used; as illustrated in FIG. 9, seal tube 13 may merely be partly collapsed by necking it down at 56 at a point to the left of the end of the snorkel tube. Suitably, the constriction may be proportioned to provide 5% outflow to the left through seal tube 13, and 95% flow to the right through the bulb and eventually out through seal tube 14. Suction or rough vacuum is applied to the seal tubes at both ends of the bulb at a pressure less than 200 millimeters of mercury, for instance 50 millimeters of mercury. Air leakage at the left rotating swivel joint is swept out to the left with the 5% gas flow, whereas air leakage at the right swivel joint is swept out to the right.

A covering of porous material is placed around the bulb, suitably a split block of asbestos as indicated at 54 in FIG. 9, and liquid nitrogen is dripped thereon from a container 55. Alternatively, asbestos cord may be wrapped around the bulb. The liquid nitrogen saturates the asbestos wrapping and the bulb is cooled close to the boiling point of nitrogen, namely 195.8° C. The xenon regulating valve 44 is now opened and magnetic valves 36, 37 are also actuated to detour the argon flow through the iodine tube reservoir. The argon inflow thus entrains both xenon and iodine vapors, both of which condense and collect as solids within the bulb. Since 95% of the flush gas goes through the bulb, very little of the expensive xenon is wasted. At the boiling point of nitrogen, argon has a residual vapor pressure of approximately 200 millimeters of mercury; since the rough vacuum applied to the system is approximately 50 millimeters of mercury, the argon does not condense but remains a gas and most of it goes right through.

Seal tube 14 is now sealed off by necking down at 49, as indicated in dotted lines, and this ends gas flow through the bulb. Some argon will remain in the xenon and iodine filled bulb; the lower the terminal pressure used, the lower the residual amount of argon. The rate of gas flow may be reduced at this time and the degree of suction applied to the left seal tube may be increased in order to further reduce the residual argon in the bulb; the left seal tube is then sealed off by necking down at 53 as indicated in dotted lines. The lamp may then be processed to completion by collapsing down the necks and cutting off the ends in the manner previously described. It is desirable to continue chilling the bulb with liquid nitrogen while the oxyhydrogen flames are played along the necks in order to prevent a rise in pressure above atmospheric within the bulb while the quartz is soft. The same method may be used to provide a filling of xenon alone, or xenon with other vaporizable substances by entraining the desired substances in vapor form with the flush gas.

The processing of a specific lamp with specific fillings which has been described herein in detail is intended by way of illustrative example of the invention only. The advantages of the invention are greatest with compact short arc-gap lamps, particularly because it is in this type of lamp that the exhaust tube tip eliminated by the invention is most objectionable. However my process

can equally well be used with long arc-gap elongated discharge lamps, with lamps constructed of other material than quartz, and to lamps containing radically different fillings than the inert gas and iodine filling which has been described here. For instance by providing a mercury vaporizer instead of an iodine vaporizer, my process may be used to manufacture high pressure mercury vapor lamps. It is intended by the appended claims to cover any modification of this nature falling within the true spirit and scope of the invention.

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

1. The method of making an electric lamp comprising:
providing a vitreous envelope having a bulb portion with tubular neck portions on opposite sides, and a pair of vitreous seal tubes each having an inlead sealed through a solid front end portion of the tube and a passageway extending through the tube up to an aperture behind the solid portion;
inserting the solid portions of the seal tubes into said neck portions;
applying heat to form hermetic junctures between the ends of the neck portions and the seal tubes at points beyond said apertures while flushing inactive gas through the seal tubes to prevent oxidation of the inleads;
and thereafter sealing off the seal tubes and collapsing the neck portions onto said solid portions to fuse the portions together into solid vitreous necks.

2. The method of making an electric lamp comprising:
providing a vitreous envelope having a bulb portion with tubular neck portions on opposite sides, and a pair of vitreous seal tubes each having an inlead sealed through a solid front end portion of the tube and a passageway extending from the rear end of the tube up to an aperture behind the solid portion;
inserting the solid portion of one seal tube into one neck portion and applying heat to form a hermetic juncture between the end of the neck portion and the seal tube while spinning the envelope and seal tube in unison and flushing inactive gas through the seal tube to prevent oxidation of the inlead;
inserting the solid portion of the other seal tube into the other neck portion and, as before, forming a hermetic juncture between the end of said other neck portion and said other seal tube;
and thereafter sealing off the seal tubes and collapsing the neck portions onto said solid portions to fuse the portions together into solid vitreous necks.

3. The method of making an electric lamp comprising:
providing a vitreous envelope having a bulb portion with tubular neck portions on opposite sides, and a pair of vitreous seal tubes each having an inlead and electrode sealed and projecting through a solid front end portion of the tube and a passageway extending from the rear end of the tube up to an aperture behind the solid portion;
inserting the solid portion of one seal tube into one neck portion and applying heat to form a hermetic juncture between the end of the neck portion and the seal tube while spinning the envelope and seal tube in unison and flushing inactive gas through the seal tube to prevent oxidation of the inlead;
inserting the solid portion of the other seal tube into the other neck portion and, as before, forming a hermetic juncture between the end of said other neck portion and said other seal tube;
working said junctures while spinning the envelope and flushing inactive gas therethrough in order to adjust the gap between the electrodes;
and thereafter sealing off the seal tubes and collapsing the neck portions onto said solid portions to fuse the portions together into solid vitreous necks.

4. The method of making an electric lamp comprising:
providing a vitreous envelope having a bulb portion with tubular neck portions on opposite sides, and a pair of vitreous seal tubes each having an inlead sealed through a solid front end portion of the tube and a passageway extending from the rear end of the tube up to an aperture behind the solid portion;
inserting the solid portion of one seal tube into one neck portion;
supplying an inactive gas into said envelope through a snorkel tube extending into said seal tube at a rate sufficient to overcome diffusion of atmosphere into said envelope;
applying heat to form a hermetic juncture between the end of the neck portion and the seal tube while spinning the envelope and seal tube in unison;
inserting the solid portion of the other seal tube into the other neck portion;
applying heat to form a hermetic juncture between the end of said other neck portion and said other seal tube while spinning the envelope and said other seal tube in unison;
providing a filling within said bulb portion;
and thereafter sealing off the seal tubes and collapsing the neck portions onto said solid portions to fuse the portions together into solid vitreous necks.

5. The method of making an electric lamp comprising:
providing a quartz envelope having a bulb portion with tubular neck portions on opposite sides, and a pair of quartz seal tubes each having an inlead sealed through a solid front end portion of the tube and a passageway extending from the rear end of the tube up to an aperture behind the solid portion;
inserting the solid portion of one seal tube into one neck portion and applying heat to form a hermetic juncture between the end of the neck portion and the seal tube while spinning the envelope and seal tube in unison and flushing inert gas through the seal tube to prevent oxidation of the inlead;
inserting the solid portion of the other seal tube into the other neck portion and, as before, forming a hermetic juncture between the end of said other neck portion and said other seal tube;
sealing off one seal tube and supplying inert gas into the envelope through a snorkel tube extending into the other seal tube while applying suction to the end of said other seal tube;
and thereafter sealing off said other seal tube and collapsing the neck portions onto said solid portions to fuse the portions together into solid vitreous necks.

6. The method of making an electric lamp comprising:
providing a vitreous envelope having a bulb portion with tubular neck portions on opposite sides, and a pair of vitreous seal tubes each having an inlead sealed through a solid front end portion of the tube and a passageway extending from the rear end of the tube up to an aperture behind the solid portion;
inserting the solid portions of the seal tubes into said neck portions;
applying heat to form hermetic junctures between the ends of the neck portions and the seal tubes at points beyond said apertures while flushing inactive gas through the seal tubes to prevent oxidation of the inleads;
collecting a desired quantity of a discharge supporting medium within the bulb portion by flushing inactive gas in which said medium is entrained through the envelope while chilling the bulb portion in order to condense the medium within it;
applying heat to seal off the seal tubes at points beyond said hermetic junctures;
and applying heat to the neck portions to collapse them onto said solid portions and fuse the portions together into solid vitreous necks.

7. The method of making an electric lamp comprising:
providing a quartz envelope having a bulb portion with tubular neck portions on opposite sides, and a pair of

quartz seal tubes each having an inlead sealed through a solid front end portion of the tube and a passageway extending from the rear end of the tube up to an aperture behind the solid portion; inserting the solid portions of the seal tubes into said neck portions;

applying heat to form hermetic junctures between the ends of the neck portions and the seal tubes at points beyond said apertures while flushing inert gas through the seal tubes to prevent oxidation of the inleads;

collecting a desired quantity of iodine within the envelope by vaporizing it into the inert gas and flushing the inert gas through the envelope while chilling the envelope in order to condense the iodine within it;

applying heat to seal off the seal tubes at points beyond said hermetic junctures;

and applying heat to the neck portions to collapse them onto said solid portions and fuse the portions together into solid vitreous necks.

8. The method of making an electric lamp comprising:

providing a vitreous envelope having a bulb portion and tubular neck portions on opposite sides, and a pair of vitreous seal tubes each having an inlead sealed through a solid front end portion of the tube and a passageway extending from the rear end of the tube up to an aperture behind the solid portion;

inserting the solid portion of one seal tube into one neck portion and rotating the bulb and the seal tube in unison while so assembled by engaging them in synchronized chucks of a glass lathe;

supplying an inert gas into the envelope through a snorkel tube projecting into the seal tube at a rate greater than the diffusion of atmosphere thereinto through joints in the parts and through the ends;

applying heat to form a hermetic juncture between the end of the neck portion and the seal tube at a point to the rear of said aperture;

assembling the structure thus formed with the other seal tube inserted into the other neck portion and forming a juncture in similar fashion betwen the end of said other neck portion and the seal tube;

collecting a desired quantity of a discharge medium within said envelope by flushing an inert gas in which said medium is entrained through the envelope while chilling it to condense said medium within it;

applying suction to the ends of said seal tubes in order to reduce the pressure of inert gas within said envelope below atmospheric;

applying heat to seal off the seal tubes at points beyond the hermetic junctures;

and applying heat to the neck portions to collapse them onto the solid front end portions of said seal tubes and fuse the portions into solid vitreous necks.

9. The method of making a quartz discharge lamp having a filling of xenon comprising:

providing a quartz envelope having a bulb portion and tubular neck portions on opposite sides, and a pair of quartz seal tubes each having an inlead sealed through a solid front end portion of the tube and a passageway extending from the rear end of the tube up to an aperture behind the solid portion;

inserting the solid portion of one seal tube into one neck portion and rotating the bulb and the seal tube in unison while so assembled by engaging them in synchronized chucks of a glass lathe;

supplying argon gas into the envelope through a snorkel tube projecting into the seal tube;

applying heat to form a hermetic juncture between the end of the neck portion and the seal tube at a point to the rear of said aperture;

assembling the structure thus formed with the other seal tube inserted into the other neck portion and forming a juncture in similar fashion between the end of said other neck portion and the seal tube;

collecting a desired quantity of xenon within said envelope by entraining xenon with the argon and flushing the mixture through the envelope while chilling the bulb below the freezing point of xenon and applying suction to the ends of said seal tubes in order to reduce the pressure within said envelope below the vapor pressure of argon at the temperature of the bulb;

and applying heat to seal off the seal tubes and collapse the neck portions onto the solid front end portions of said seal tubes.

10. The method of making a quartz discharge lamp having a filling of xenon and iodine comprising:

providing a quartz envelope having a bulb portion and tubular neck portions on opposite sides, and a pair of quartz seal tubes each having an inlead sealed through a solid front end portion of the tube and a passageway extending from the rear end of the tube up to an aperture behind the solid portion;

inserting the solid portion of one seal tube into one neck portion and rotating the bulb and the seal tube in unison while so assembled by engaging them in synchronized chucks of a glass lathe;

supplying argon gas into the envelope through a capillary snorkel tube projecting into the seal tube; at a rate greater than the diffusion of atmosphere thereinto through joints in the parts and through the ends;

applying heat to form a hermetic juncture between the end of the neck portion and the seal tube at a point to the rear of said aperture;

assembling the structure thus formed with the other seal tube inserted into the other neck portion and forming a juncture in similar fashion between the end of said other neck portion and the seal tube;

collecting a desired quantity of xenon and iodine within said envelope by entraining xenon and iodine as a vapor with the argon and flushing the mixture through the envelope while chilling the bulb below the freezing point of xenon and applying suction to the ends of said seal tubes in order to reduce the pressure within of argon at the temperature of the bulb;

applying heat to seal off the seal tubes at points beyond the hermetic junctures;

and applying heat to the neck portions to collapse them onto the solid front end portions of said seal tubes and fuse the portions into solid vitreous necks.

References Cited by the Examiner

UNITED STATES PATENTS

1,461,155	7/1923	Madden et al.	316—19
2,417,361	3/1947	Herzog	316—19

RICHARD H. EANES, JR., *Primary Examiner.*

FRANK E. BAILEY, *Examiner.*