May 5, 1931. I. LANGMUIR 1,804,349

INCANDESCENT LAMP

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Fig. 1.

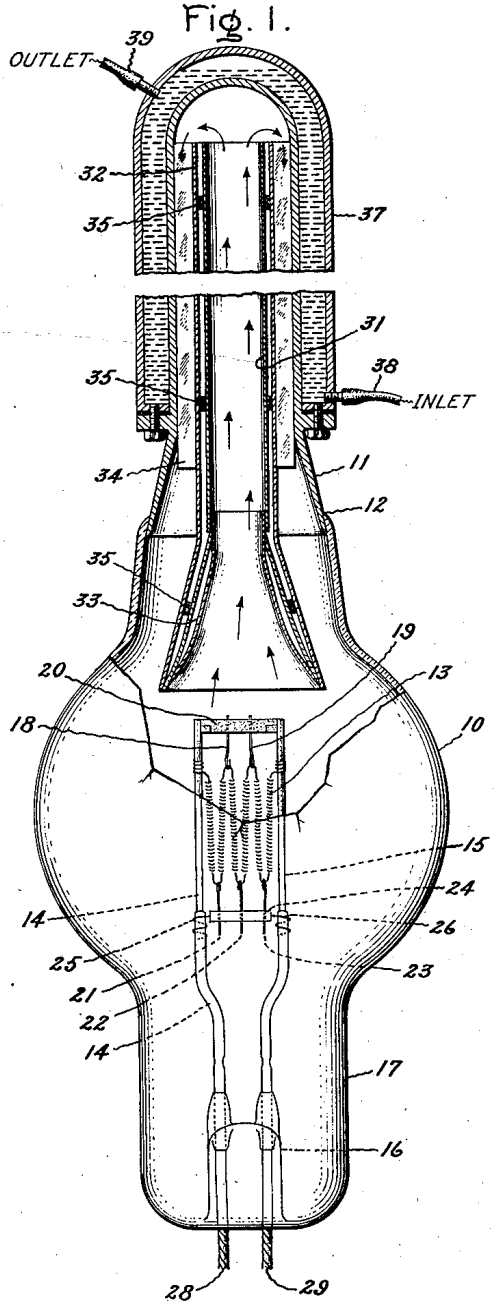


Fig. 2.

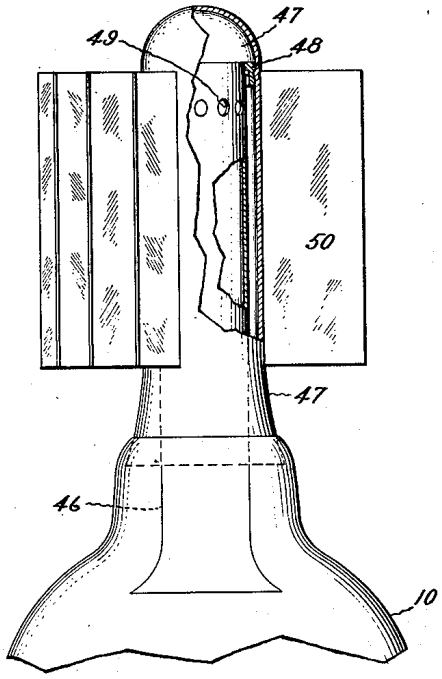


Fig. 5.

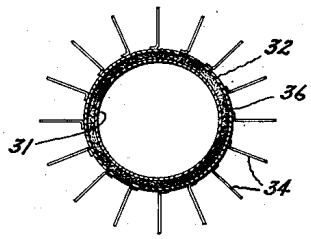


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Fig. 3.

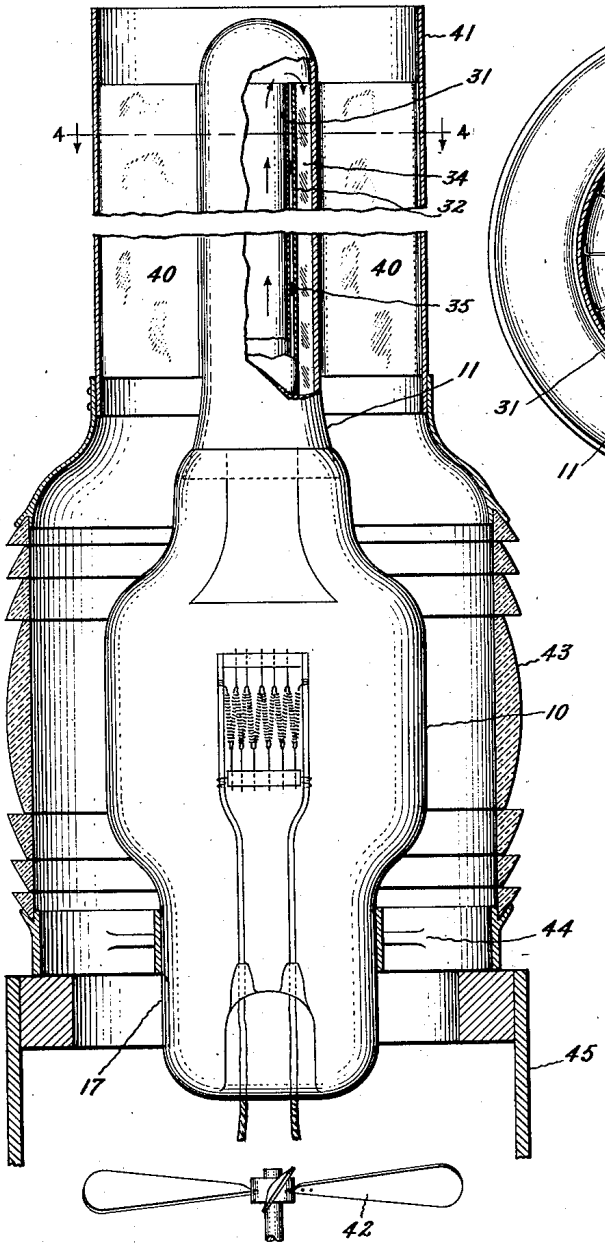
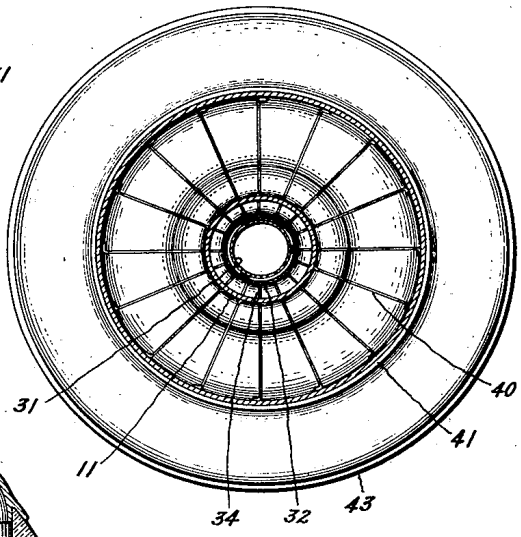



Fig. 4.

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Patented May 5, 1931 1,804,349

# UNITED STATES PATENT OFFICE

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## INCANDESCENT LAMP

Application filed July 10, 1928. Serial No. 291,677.

The present invention comprises an improvement in gas-filled radiant energy devices, such as incandescent lamps which is of particular utility in connection with lamps of extremely high candle power, such for example as employed for lighting areas, such as aviation fields, arenas, playing fields or for lighthouse service.

An increase in candle power in gas-filled incandescent lamps as heretofore constructed necessitated also an increase in size of the bulb. Increased light output, of course, required a greater energy input and hence the dissipation of greater amounts of heat. Practical limitations of the size of the bulb limited the largest of such lamps to an energy input of about thirty kilowatts. The life of lamps of such large wattage was so materially shortened that the lamps were useful for only very special purposes for which long life was not essential. The short life was due primarily to blackening of the envelope resulting from water vapor liberated by overheating of the glass.

In accordance with my invention I have devised a new lamp structure providing for energetic cooling of a heated gas in the lamp without heating any glass parts to a deleterious extent.

As will be pointed out with greater particularity in the appended claims, one of the main features of novelty of lamps embodying my invention is the provision in an incandescent lamp of a metal cooling chamber which is sealed to the lighting bulb together with means for providing for an effective circulation of the heated gas through a cooled metal duct and from thence back to the lighting bulb.

As a consequence of my invention, lamps of materially higher power than heretofore available are provided in convenient sizes with a commercial length of life and high illuminating efficiency.

My invention will be more fully explained in connection with the accompanying drawing in which Fig. 1 is a view of a lamp embodying my invention which is partly in vertical section and partly in perspective; Fig. 2 is a fragmentary elevation of a modification, also shown partly in section; Fig. 3 is an elevation of another slightly modified lamp shown mounted in a lens housing; Fig. 4 is a horizontal section taken on lines 4—4 of Fig. 3; and Fig. 5 is a horizontal section of modified chimney containing solid heat insulation.

Referring to Fig. 1 of the drawing, the lamp here illustrated comprises a hermetically sealed envelope consisting in part of a bulbous lighting chamber 10 consisting of glass, or other suitable transparent material, and a dome-shaped cooling chamber 11 consisting of copper or other suitable metal; the tapered rim of the cooling chamber being fusion-sealed at 12 to the glass of the lighting chamber. The envelope contains a filling of argon, nitrogen or other gas which is inert with respect to the lighting body 13 when operating at incandescence. The gas preferably has such pressure that at operating temperatures of the lamp it is approximately at atmospheric pressure. As the preparation of the envelope and the purification of the gas in the manufacture of incandescent gas-filled lamps are well known they will not be described herein.

The incandescent body, or radiator, which in this case consists of a heavy filament or wire of tungsten of concentrated shape, is connected to supporting leads 14, 15. The latter are sealed in the usual way into a stem 16 projecting into the elongated neck 17 of the lamp envelope which constitutes a prolongation of the lighting chamber extending downwardly opposite the cooling chamber 11. The filament 13 consists of a closely wound helix of well-known form, the helix being bent into a plurality of loops, the up-

per intermediate bends of which are supported by anchors 18, 19 which are embedded in an insulating support 20. This support in turn is affixed to the lead wires 14, 15. The lower intermediate bends of the filament 13 are supported by the anchors 21, 22, 23 which extend upwardly from the insulating support 24. The latter is affixed to the leads 14, 15 by supporting wires 25, 26. Current is supplied to the filament 13 through external conductors 28, 29 which are joined to the leads 14, 15.

In order to cause the heated gas arising from the incandescent filament during operation to pass through the cooling chamber in a continuous stream, a metal chimney 31 is provided which extends from the region just above the filament to the upper part of the cooling chamber. Surrounding the chimney 31 and separated therefrom by a space is a wall member 32 which conforms with the shape of the chimney 31 and provides together with the outer wall 11 of the cooling chamber an annular space or duct for the return of the heated gases to the lighting chamber, the path of the gases being indicated by arrows. As the outer wall of the cooling chamber is maintained at a desired low temperature, (as will be described presently), the gases in their path from the chimney 31 downwardly through the annular space, intermediate the walls 32 and 11 become progressively cooled in their downward path.

In order that these gases may not be reheated by contact with the hot lower portion of the chimney 31, the heat insulating space between the chimney 31 and the wall 32 is provided. As shown in the drawing a second heat insulating space 33 may be provided at the inlet of the chimney. The respective metal wall members are separated from each other by refractory spacing members 35. If desired, these spacing members, which consist of refractory heat insulating material, such as alumina or magnesia, may be varied in size so as to occupy more or less of the space between the walls 31 and 32.

Fig. 5 illustrates a modification in which the heat insulation 36 between the chimney 31 and the surrounding jacket 32 consists entirely of solid material, such as mica, or alumina.

In order to increase the dissipation of heat in the space 33 a plurality of heat conducting plates, or fins, 34 may be provided between the wall members 11, 32. These fins, shown in horizontal section in Fig. 4, are joined by welding, or brazing in good heat conducting relation to the outer metal wall 11 and the inner metal wall 32. The heated gases in descending through the annular cooling space give up their heat not only to the inner wall 32 and the outer wall 11 but also to the heat conductors 34 and as a consequence are efficiently cooled in their return path to the lighting chamber. The gases also deposit upon the surfaces of the cooling chamber vaporized material from the lighting body and thus reduce obscuration of the glass walls by such material.

The dome-shaped chamber 11 may be cooled either by the circulation of water, or other liquid, which is supplied to a jacket 37 by an inlet tube 38 and carried away by an outlet tube 39, or by the circulation of air, or other gas. In an air cooled lamp external cooling fins preferably are supplied as shown at 40 in Figs. 3 and 4. The circulation of air may be made more positive by surrounding the fins 40 by an outer wall, or enclosure, 41 and providing a fan 42. The positive draft thus created may be utilized to cool externally the lighting bulb 10, and, for this reason the enclosure preferably extends also about this bulb as illustrated. The enclosure around the light-emitting part of the lamp may be constituted by a lens 43, as shown in Fig. 3.

As shown in this figure the neck 17 of the incandescent lamp rests on a support 44 which in turn rests on a pedestal 45. This pedestal serves also to support the lens 43 with its upwardly projecting chimney 41.

The circulation of the cool gases outside of the lamp envelope and the heated gases inside of the envelope proceeds in opposite directions and thus constitutes an efficient counter-cooling system whereby overheating of the glass portions of the lamp is prevented. As a consequence the lamp may be caused to operate with a high input of energy without danger of undue heating and blackening, thus affording a powerful lighting device of moderate size without unduly shortening the operating life of the lamp.

The advantages of my invention may be partly realized even when the upwardly rising heated gases and the downwardly flowing cooled gases are not heat insulated from each other as some cooling of the gases will occur in spite of the decreased cooling efficiency of such an arrangement. In Fig. 2 is illustrated such a lamp, the cooling chamber being shown partly in section, lighting parts of the lamp being broken away. In this figure, a single walled metal chimney 46 is provided, supported within the cooling dome 47 by holders 48. The heated gases rise from the lighting body (not shown) which is located just below the chimney 46, similar to the arrangement illustrated in Fig. 1, and pass upwardly through the chimney 46 into the upper end of the cooling dome 47. The gases may be emitted from the open upper end of the chimney 46 and from thence pass through passages into the annular space between chimney 46 and the dome 47 and also may

pass from openings 49 into this space. Outwardly projecting fins 50 are provided upon the exterior of the cooling dome 47 in order to carry away heat. The gases give up heat through the cooling dome 47 as they descend back into the lighting chamber 10.

Various changes and modifications may be made in the described device without departing from the spirit of my invention. The drawing is intended to illustrate the relation of the various members without, however, being drawn rigorously to scale.

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

1. An incandescent lamp comprising a gas-tight envelope consisting of a glass lighting chamber and a metal cooling chamber, a gas filling therefor, an incandescent body in said lighting chamber and a heat-insulated conduit communicating with said lighting chamber and extending through said cooling chamber in spaced relation thereto so as to afford a circulatory path for heated gas from said lighting chamber through said cooling chamber.

2. A high intensity incandescent lamp comprising an envelope constituted in part of glass members, an incandescable lighting body therein, a gas filling at a pressure approximating atmospheric pressure during operating of said lamp, a cooling means having an opening to said envelope for lowering the temperature of the heated gas stream arising from said lighting body when at incandescence sufficiently to prevent deleterious effect upon the glass members of said lamp, means for providing a circulatory passage for said gas stream through said cooling means and a plurality of longitudinal heat conducting members in said passage.

3. An incandescent lamp comprising an envelope constituted by a lighting chamber of transparent material and a cooling chamber of metal hermetically sealed to said lighting chamber, a gas in said envelope, a lighting body in said lighting chamber, means for supporting said lighting body, said means extending away from said cooling chamber, and means having an opening to said lighting chamber closely adjacent to said lighting body providing for a circulation of heated gases from said lighting chamber through said cooling chamber.

4. An incandescent lamp comprising a bulb having a tubular extension, a stem extending through said extension into said bulb, an incandescent body mounted upon said stem, a metal chamber communicating with said bulb at a region spaced away from said stem; a gas at substantial pressure in said bulb and chamber and a chimney arranged to conduct heated gases from the vicinity of said incandescent body through said metal chamber.

5. An incandescent lamp comprising a transparent bulb having an outwardly extending arm, an incandescent lighting body, current conveying terminals for said filament sealed into said arm, a cooling chamber consisting of metal of high heat conductivity sealed to said bulb and extending outwardly from said bulb opposite said arm, and a metallic chimney mounted within said cooling chamber but spaced away therefrom, said chimney being arranged to carry heated gases from the vicinity of said lighting body into a remote part of said cooling chamber.

6. An incandescent lamp comprising a lighting chamber constituted of transparent material, an incandescent body therein, a dome of metal sealed to said lighting chamber, a gas at substantial pressure contained within said lamp, a partition wall within said dome arranged to provide a cooling chamber communicating with said lighting chamber for the circulation of said gas, and a chimney located in poor heat conducting relation to said cooling chamber and arranged for carrying gas from the lighting chamber to said cooling chamber.

7. An incandescent lamp comprising a lighting chamber consisting of glass, a lighting body therein, a metal cooling chamber joined to said lighting chamber by a gas-tight seal, a gas contained in said chambers, and a gas-conveying duct leading from said lighting chamber to said cooling chamber and back to said lighting chamber, the ingoing and out-going parts of said duct being in poor heat-conveying relation to one another.

8. An incandescent lamp comprising a lighting chamber consisting of glass, said chamber having a tubular stem member, a lighting body sealed into said stem member, a gas in said chamber, a double walled metal cooling chamber extending outwardly opposite said stem from said lighting chamber, said chamber being provided with a plurality of heat-conductors extending between said walls, means for conveying heated gas from said lighting chamber through the space between said walls, and means for externally abstracting heat from said cooling chamber.

9. An incandescent lamp comprising a glass lighting bulb, a metal cooling chamber joined thereto, means for providing a circulating path for gases from said lighting bulb into and through said cooling chamber, an external housing surrounding and spaced away from said lamp, cooling fins extending longitudinally in said housing and joined in good heat conducting relation to said cooling chamber and positively acting means for producing a circulation of air about said lamp and in contact with said fins.

10. A radiant energy device comprising an envelope, a metal dome joined to said

envelope, a radiator operating at incandescence in said envelope, a gas filling for said device, and a duct within said dome communicating with said envelope having an inlet opening in immediate communication with the space adjacent said radiator, and an outlet opening spaced more remote from said radiator for the passage through said dome of heated gas arising from said radiator.

In witness whereof, I have hereunto set my hand this 9th day of July, 1928.

IRVING LANGMUIR.