No. 797,629. PATENTED AUG. 22, 1905.

B. A. STOWE.

ELECTRIC ARC LAMP.

APPLICATION FILED MAY 25, 1904.

2 SHEETS—SHEET 1.

Fig. 1.

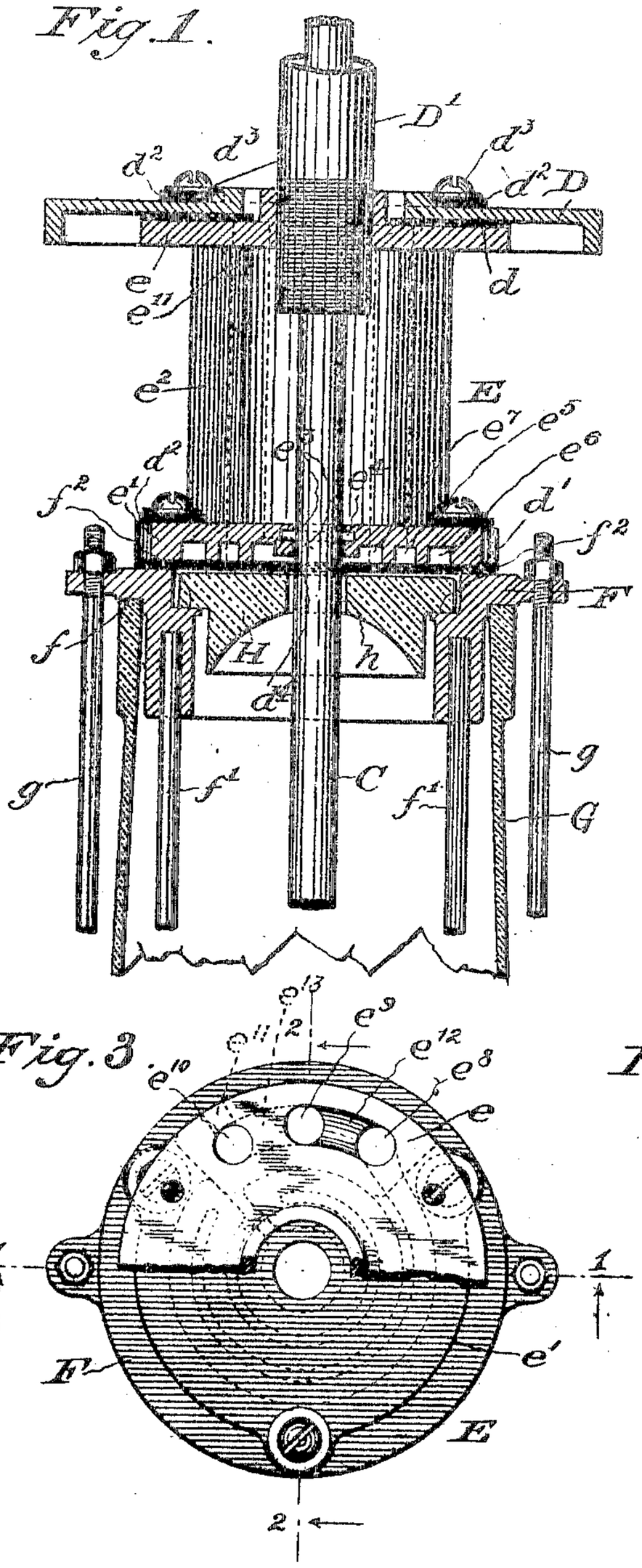


Fig. 2.

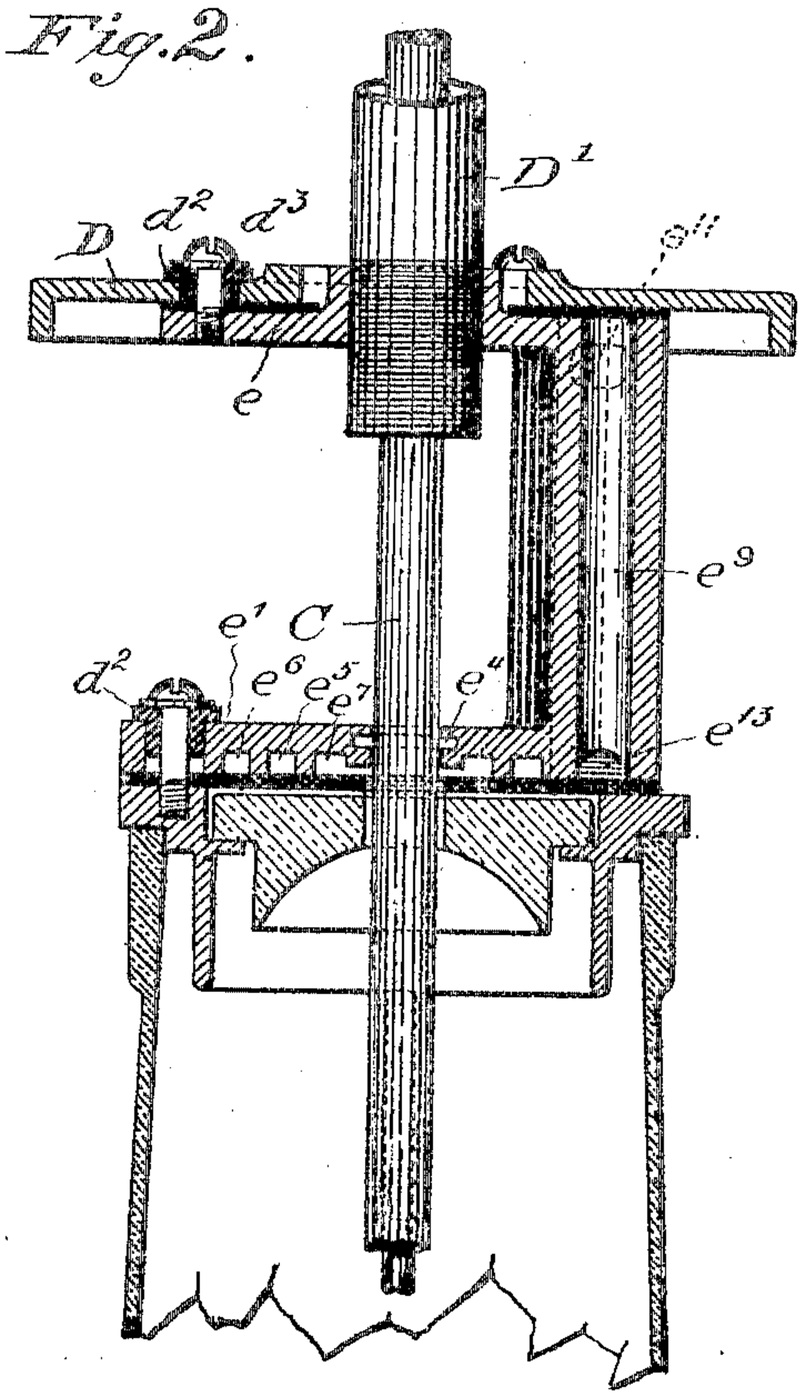
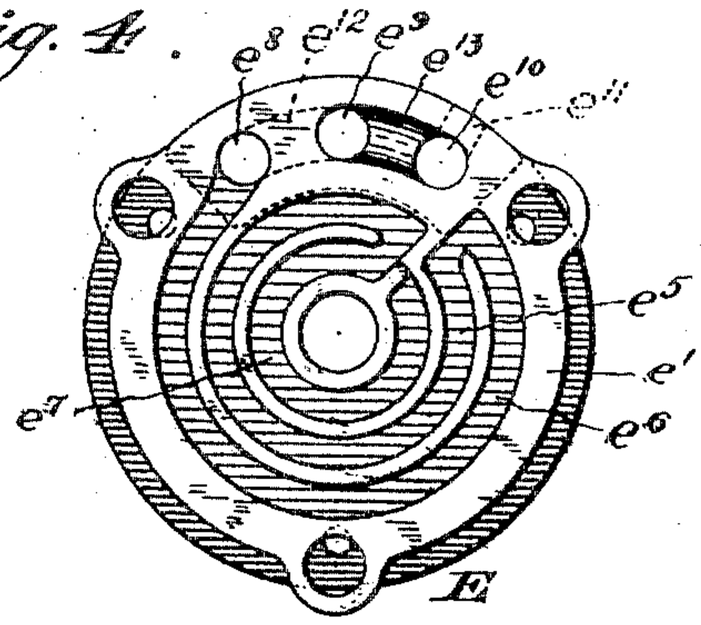


Fig. 3.

Fig. 4.



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2 SHEETS—SHEET 2.

Fig. 5.

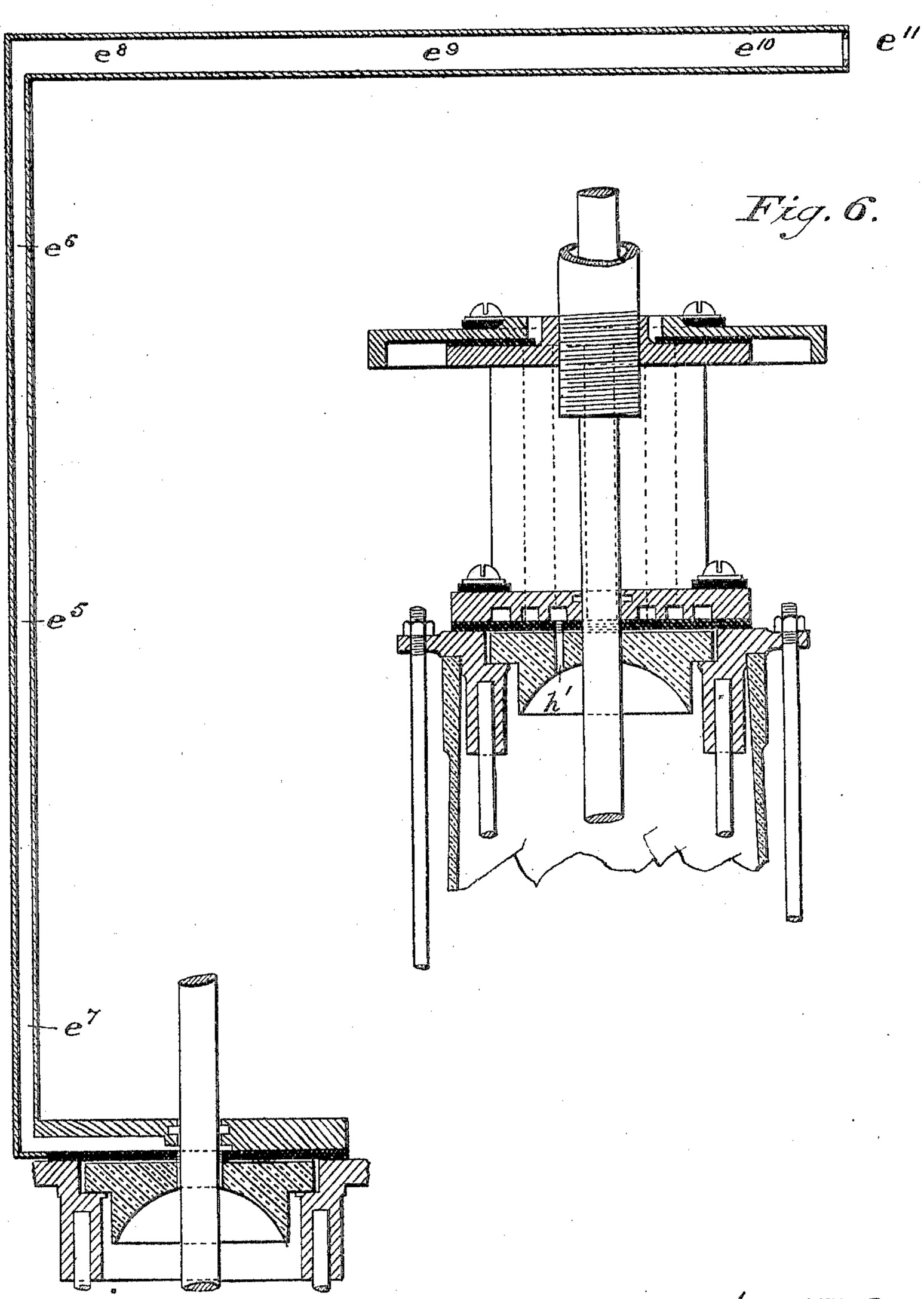

Fig. 6.

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UNITED STATES PATENT OFFICE.

BERNARD A. STOWE, OF CLEVELAND, OHIO, ASSIGNOR TO THE JANDUS ELECTRIC COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO.

ELECTRIC-ARC LAMP.

No. 797,629. Specification of Letters Patent. Patented Aug. 22, 1905.

Application filed May 25, 1904. Serial No. 209,658.

To all whom it may concern:

Be it known that I, BERNARD A. STOWE, a citizen of the United States, and a resident of Cleveland, county of Cuyahoga, and State of Ohio, have invented a new and useful Improvement in Arc-Lamps, of which the following is a specification, the principle of the invention being herein explained and the best mode in which I have contemplated applying that principle, so as to distinguish it from other inventions.

My invention relates to inclosed arc-lamps, and particularly to the means embodied therein which affect the consumption of the carbons and the chemical and physical action of the gases within the arc-chamber.

One object of the invention is to effect a minimum consumption of carbon per unit of time, and a further object is to regulate and control the interchange of gases between the arc-chamber and the atmosphere, so as to maintain a practically uniform mixture of the gases contained in the arc-chamber, thereby effecting a steady and uniform burning at the arc.

The annexed drawings and the following description set forth in detail certain mechanism embodying the invention, such disclosed means constituting but one of various mechanical forms in which the principle of the invention may be used.

In said annexed drawings, Figure 1 represents a vertical axial section of a portion of an inclosed arc-lamp embodying my invention, portions of the lamp cut by the plane of section being shown in elevation. Fig. 2 represents a vertical axial section of such lamp portion, similar to that shown in Fig. 1, but taken upon a plane at right angles to the plane of section of said Fig. 1. Fig. 3 represents a broken plan of that part of the lamp structure which I designate by the term "expansion-chamber member," showing also the top ring of the arc-chamber connected therewith. Fig. 4 represents a bottom plan of said member. Fig. 5 represents a diagrammatic view of the means for regulating and controlling the interchange of gases previously referred to, and Fig. 6 represents a section of a part of a modified form of lamp embodying certain features of my invention.

Said invention is embodied in a structure E, hereinbefore referred to as an "expansion-chamber member," together with certain other elements hereinafter described. Said structure consists of an upright member or body portion e^2, formed with a laterally-projecting upper flange e and a lower laterally-projecting flange e'. The upper flange e is secured to the floor-plate D and forms the connecting mechanical supporting medium between the center tube D′ and the lower portion of the lamp. The said expansion-chamber member is insulated from the floor-plate and from a ring F, to which the globe G is directly attached by means of mica sheets d and d' and insulating-bushings d^2 d^2, surrounding the fastening-screws d^3 d^3, as will be readily understood. Ring F is provided with a flange f, to the lower surface of which the glass globe G is secured by means of the rods g g in the usual manner. To the barrel or body portion of the said ring F is secured the yoke f', which supports the negative carbon, as will be also readily understood. The interior of the ring is formed with a shoulder f^2, upon which is seated a porcelain disk H, forming the dome of the arc-chamber. This disk is provided with a central opening h, which registers with openings d^4 and e^3, formed in the mica sheets d' and flange e', respectively, said openings h, d^4, and e^3 together forming a channel for receiving the positive carbon C. Opening e^3 is of a diameter as small as it is possible to make it and still allow the carbon to move through it freely, and intermediately of its ends is a groove e^4, which forms a check against the passage of gases which may tend to pass through the aperture from within or without. The apertures d^4 and h are made of equal diameter and markedly larger than the diameter of the carbon, so that gas may pass freely through same around the carbon.

Intersecting the lower plane surface of flange e' are two concentric grooves e^5 and e^6, joining each other and of comparatively small cross-sectional area. The inner end of groove e^5 opens into a central groove or chamber e^7 surrounding the carbon, and hence communicates with openings d^4 and h, and so with the arc-chamber. These grooves and the central chamber e^7, excepting as noted, are closed at the bottom by the mica sheets and form an attenuated duct for the passage of gases. The outer end of groove e^6 communicates with the end duct e^8 of a series of connected ducts including in addition to e^8 similar ducts e^9 and e^{10}, the latter communicating with the atmos-

phere through the medium of an aperture e^{11} of constricted diameter, Figs. 1, 3, and 4, shown in dotted lines. These ducts e^8, e^9, and e^{10} are most conveniently formed by boring perpendicularly through the body of the expansion-chamber member and then connecting ducts e^8 and e^9 at the top with a groove e^{12} and ducts e^9 and e^{10} with a groove e^{13}. Duct e^{10} communicates with the atmosphere through the medium of a constricted opening e^{11}. The mica sheets d and d' close these grooves e^{12} and e^{13} to form ducts. The cross-sectional area of ducts e^8, e^9, and e^{10} is made markedly greater than that of the attenuated duct formed by grooves e^5 and e^6, and they form a chamber intermediate of the said attenuated duct and outer atmosphere which will contain a required volume of gas, as will hereinafter appear, the attenuated duct and chamber together forming a continuous elongated duct, as diagrammatically shown in Fig. 5. The chamber formed by ducts e^8, e^9, and e^{10} I shall hereinafter refer to as the "expansion and diffusion chamber," and, as previously noted, it is interposed between the attenuated duct and the atmosphere. The volume of said expansion and diffusion chamber and attenuated duct combined is made such that it will be greater than the difference between the volume of the gaseous contents of the arc-chamber at a given temperature and pressure and the volume of such same gaseous contents at a given pressure and the maximum temperature imparted to it during the lamp's operation.

Let it be assumed that the arc-chamber is filled with gases at a normal or atmospheric degree of temperature and that the arc has just been established. Hence such gases soon become highly heated and expand. A certain amount of such expanded gas will hence seek outlet from the arc-chamber, and such outlet it readily finds in the openings h and d^4 surrounding the carbon. Through these openings it finds its way into chamber e^7. The opening e^3, together with the gas-checking groove e^4, offers a resistance to its passage therethrough, such as in the presence of the easy path offered by the attenuated duct, the passage formed by the grooves e^5 and e^6, and the expansion and diffusion chamber, to allow substantially no efflux of such expanded gas therethrough. Said gas will hence pass into said duct and passage and push out before it the atmospheric air or other gases contained therein until the entire duct and expansion and diffusion chamber is filled therewith. The temperature condition surrounding the operating-lamp and the character of the arc-chamber gases thus reach a state which may be considered broadly constant, but vary actually between a maximum and minimum of temperature, and hence a maximum and minimum of density, of said gases. In the lamp constructions heretofore used these changes I have found produce marked and deleterious effects upon the economical operation of the lamp, among which are principally found imperfect and uneconomical consumption of the carbon, due to direct admission of atmospheric air and consequent admission of excess of oxygen. By means of my above-described construction such results are prevented in the following manner: Assuming that the conditions have reached a state of general constancy previously referred to, in which the temperature varies between certain limits and that at a given instant the gases are at their minimum temperature, a rise in temperature resulting from varying conditions at the arc will now be followed by expansion of the gases and a consequent expulsion of part of the gases from the expansion and diffusion chamber, and a fall from such increased temperature will effect an influx of air from the exterior into such chamber. Such action constitutes what is ordinarily referred to as the "breathing" of the lamp. Now by causing the combined volume of the attenuated duct and the expansion and diffusion chamber to be greater than the difference between the volume of the gases contained in the arc-chamber at such above-mentioned minimum temperature and the volume of such gases at the maximum temperature attained during the operation of the lamp it will be seen that at no time will atmospheric air be admitted directly into the arc-chamber as a result of such breathing. The attenuated form of the passage through which the gases are exhaled and inhaled keeps a certain volume of arc-chamber gases interposed between the arc-chamber and atmosphere. The required amount of oxygen is, however, permitted to reach the arc-chamber by diffusion through such interposed volume of gases, the length and volume of the attenuated duct and of the expansion and diffusion chamber being designed so as to permit of the introduction of the proper amount of oxygen by such method. The expansion and diffusion chamber has also another and very important function. Being interposed between the attenuated duct and the constricted opening into the atmosphere and being of larger cross-sectional area than said duct, the gases contained within it act as a cushion to prevent the sudden expulsion of gases from the duct. It is well known that at times, owing to various causes, the gases in the arc-chamber suddenly expand and must find a vent. Were it not for the expansion-chamber the gases would be expelled through the duct into the air, and this action would be followed by the inhalation of air, and hence of oxygen, disturbing the uniform conditions of gas mixture required in the arc-chamber. Under these conditions the expansion and diffusion chamber acts as a cushion or damper to prevent the sudden expulsion or flushing of the gases from the at-

tenuated duct and in this manner greatly assists in the maintenance of uniform gas-mixture conditions in the arc-chamber.

Fig. 6 shows opening *h'* into arc-chamber independent of the space around carbon. This arrangement, while a good one, tends to set up a local circulation of air downward along the carbon into the arc-chamber and thence through the independent opening into the duct to the atmosphere. This local circulation results from the heated rising column of air in the expansion-chamber. I therefore prefer to adopt the form of construction shown in Fig. 1, which shows the outlet from the arc-chamber around the carbon, as previously described.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed provided the means stated by any one of the following claims or the equivalent of such stated means be employed.

I therefore particularly point out and distinctly claim as my invention—

1. In an arc-lamp, the combination with an inclosure forming an arc-chamber, of a member connected therewith embodying an elongated duct and including a chamber of enlarged cross-sectional area and an elongated attenuated portion, said duct establishing communication between said arc-chamber and the atmosphere, and said chamber provided with an outlet of constricted cross-sectional area communicating with the atmosphere.

2. In an arc-lamp, the combination with an inclosure forming an arc-chamber, of means connected therewith embodying an elongated duct establishing communication between the arc-chamber and the atmosphere, said duct including an elongated attenuated portion and a portion of enlarged cross-sectional area, said latter portion communicating directly with the atmosphere.

3. In an arc-lamp, the combination with an inclosure forming an arc-chamber, of a member connected therewith formed with a passage for admitting a carbon and provided with an elongated duct establishing communication with the atmosphere and communicating with the interior of said arc-chamber through the medium of said passage, that portion of the latter connecting said chamber with said duct forming an opening immediately around the carbon which will afford a comparatively free passage for gases therethrough.

4. In an arc-lamp, the combination with an inclosed arc-chamber, of a member connected therewith embodying a horizontal or flanged portion and a body portion, said flanged portion provided with an attenuated duct communicating with the said arc-chamber; said body portion provided with a series of ducts forming a chamber of enlarged cross-sectional area, one end of said chamber communicating with the atmosphere and the other with said attenuated duct.

5. In an arc-lamp, the combination with an inclosed arc-chamber, of a member connected therewith embodying a flanged portion and an upright body portion, said flanged portion provided with a grooved lower surface forming an attenuated duct communicating with said arc-chamber; said body portion provided with a chamber of enlarged cross-sectional area connected with said attenuated duct and communicating with the atmosphere.

6. In an arc-lamp, the combination with an inclosed arc-chamber, of a member connected therewith embodying a flanged portion and a body portion, said flanged portion provided with an attenuated duct communicating with the said arc-chamber; said body portion provided with a chamber of a cross-sectional area greater than that of said attenuated duct, connected at one end with the latter and communicating with the atmosphere through the medium of a restricted opening.

7. In an arc-lamp, the combination with an inclosed arc-chamber, of a member connected therewith embodying a flanged portion formed with a number of grooves arranged in convolutions and connected with each other; and a body portion formed with a plurality of ducts of a cross-sectional area greater than that of said attenuated duct; said ducts of greater cross-sectional area connected in series to form a chamber, one end of such chamber connected with said attenuated duct and the other end connected with the atmosphere through the medium of a constricted opening.

8. In an arc-lamp, the combination of a globe-support, a member secured thereto and provided with a grooved under surface, insulating material interposed between such surface and said support; said grooved member having an opening for admitting a carbon and connected with a grooved portion of said member, and a member forming the dome of the arc-chamber and provided with an opening registering with and of greater diameter than said carbon-opening.

9. In an arc-lamp, the combination of a globe-support, a member secured thereto and provided with a central opening for receiving a carbon and with an elongated passage communicating therewith, a member forming the dome of the arc-chamber and formed with a central opening, forming, in conjunction with said first-named central opening, a continuous passage for receiving the carbon, the opening in said dome member forming a space surrounding the carbon free from obstruction to the natural flow of gas.

10. In an arc-lamp, the combination of an inclosure forming an arc-chamber, a member provided with a duct connecting same with the atmosphere, and a member forming the dome of the chamber, such dome member being provided with an opening of markedly

greater diameter than that of and traversed by the upper lamp-carbon, said opening forming the connection between said duct and said chamber.

11. In an arc-lamp, the combination of a globe-supporting structure, a globe secured thereto and forming an inclosed arc-chamber, said structure formed with a carbon-opening having its inner end of a diameter such as to form a passage immediately surrounding the carbon allowing a comparatively free flow of gases therethrough, said structure being also provided with an elongated duct including a portion of enlarged cross-sectional area, and having its inner end directly connected with said passage, its outer end being connected with the atmosphere, the outer end portion of said opening being provided with a gas-check for obstructing the flow of gas therethrough.

12. In an arc-lamp, the combination with an inclosure forming an arc-chamber, of means connected therewith provided with a passage for receiving a lamp-carbon, and connecting the interior of said inclosure with the exterior thereof, the outer end portion of said passage being of a diameter such as to obstruct the passage of gas past the carbon located therein, the inner end portion of the said passage being of a markedly greater diameter than that of the carbon so as to form a space immediately surrounding the carbon such as will allow a free flow of gases therethrough; said means further formed with a duct directly connected with such space and connecting the latter with the atmosphere.

13. An arc-lamp having an inclosed arc-chamber, such chamber being connected with an elongated duct consisting of a single elongated attenuated portion, and a single portion of enlarged cross-sectional area, the latter communicating directly with the atmosphere by means of a constricted opening.

Signed by me this 12th day of May, 1904.

BERNARD A. STOWE.

Attest:

A. E. MERKEL,

HENRY J. VOGT.