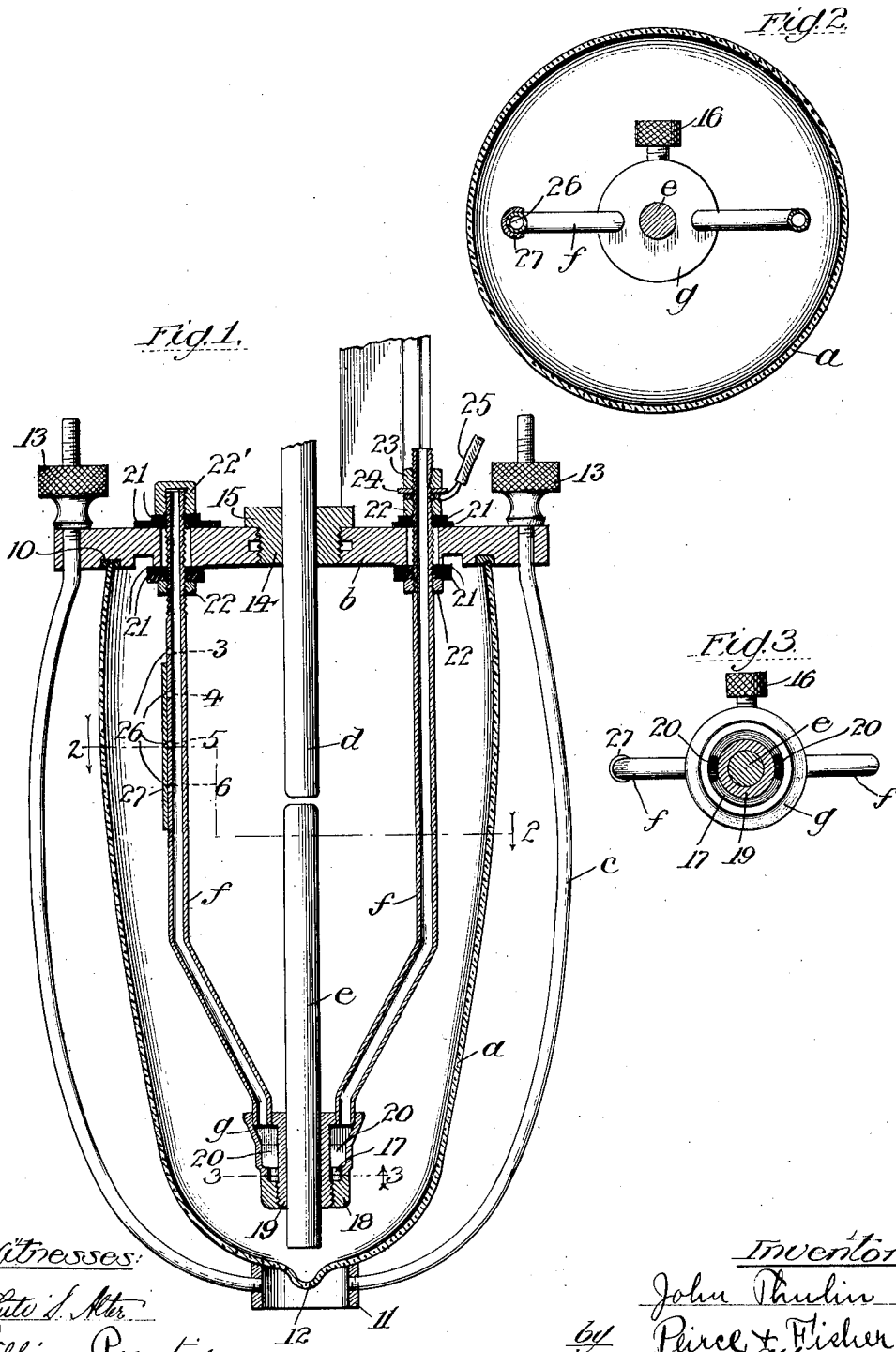


J. THULIN.
ELECTRIC ARC LAMP.
APPLICATION FILED MAY 1, 1905.

1,060,382.

Patented Apr. 29, 1913.



Witnesses:
Lillian Prentice

Inventor:
John Thulin
by Pierce & Fisher
Attorneys

UNITED STATES PATENT OFFICE.

JOHN THULIN, OF CHICAGO, ILLINOIS, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, OF ONE-FOURTH TO LOUIS A. FERGUSON AND ONE-FOURTH TO PETER J. SMITH, OF CHICAGO, ILLINOIS, AND ONE-FOURTH TO CLARA FAY EASTMAN, OF MONROVIA, CALIFORNIA.

ELECTRIC-ARC LAMP.

1,060,382.

Specification of Letters Patent.

Patented Apr. 29, 1913.

Application filed May 1, 1905. Serial No. 258,164.

To all whom it may concern:

Be it known that I, JOHN THULIN, a citizen of the United States, and a resident of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Electric-Arc Lamps, of which the following is declared to be a full, clear, and exact description.

The invention relates to electric arc lamps of the type employing an arc-inclosing bulb and seeks to provide simple and effective means by which the amount of air within the bulb may be properly proportioned in keeping with the different current strengths employed to maintain the carbon consumption at a minimum.

The invention consists in the features of construction, combination and arrangement of parts hereinafter set forth, illustrated in the accompanying drawings and more particularly pointed out in the appended claims.

It is customary practice to provide an arc-inclosing globe or bulb within which the ends of the carbon electrodes extend to cut down the amount of air present, the gas in the bulb being largely carbon monoxid and carbon dioxid. In such a construction, the carbon consumption is materially less than if the arc were exposed directly to the air. The vent passage leading from the interior of the bulb is usually elongated or tortuous so that the expansion and contraction of the gas therein, due to the "puffing" of the arc, will not draw outside air into the bulb. But some oxygen is necessary and indeed, sufficient air must be present to prevent the deposition of carbon on the negative electrode in a mushroom formation. This necessary air in lamps now commonly in use finds access to the bulb at the opening in the end plate or cap through which the movable electrode extends, which is not and cannot be conveniently made tight. With such constructions, the admission of air cannot be satisfactorily regulated, but in order to keep the carbon consumption at the desired low minimum, the amount of air should be regulated in keeping with the amount of the current and the size of the carbons employed.

In accordance with the present invention, suitable means are provided by which the amount of air within the arc-inclosing globe

may be accurately regulated to suit different conditions. The best results have been attained by making the opening through which the movable carbon passes as nearly air tight as possible and by providing a vent passage of such length and size that a proper interchange of gas within the bulb and air from without is effected there-through. I have discovered that the minimum amount of air required for the proper burning of the lamp varies with the amount of current used and the size of the carbons employed, so that, in order to keep the carbon consumption at the desired low minimum, it is necessary to regulate the amount of air in accordance with the variations of current and differences in size of the carbon employed. I have further discovered that the amount of air admitted through a vent passage arranged for the interchange of air and gas therethrough cannot be satisfactorily regulated by means of a valve or like device, but a satisfactory regulation may be effected by properly proportioning the length and diameter of the vent passage or tube in accordance with the amount of current and size of the carbon. In other words, the invention is designed to provide a tube or passage of considerable length, but of sufficient cross section to permit the proper interchange of air and gas therethrough, the size and length of said tube being proportioned in accordance with the amount of current and the size of the carbon employed, to admit the desired minimum amount of air. Means are also preferably provided to vary the effective length of the passage so that the lamp may be employed with different amounts of current.

In the drawings, Figure 1 is a vertical section of the lower portion of an arc lamp with the preferred form of the invention applied thereto. Figs. 2 and 3 are cross sections on lines 2—2 and 3—3 respectively of Fig. 1.

Any suitable form of arc lamp may be employed and the arc-inclosing bulb or globe may be of any desired shape. In the form shown, the bulb *a*, which surrounds the carbons, is closed at its lower end, and its open, upper end is closed when in use by a cap or plate *b*, having an annular groove on its under face within which the upper edge of

the bulb fits. A supporting bow *c* carries a ring 11 at its lower end which fits over a tip 12 on the lower end of the bulb. The upper ends of the bow extend through openings in the cap or plate *b* and have thumb nuts 13 threaded thereon, which engage the upper face of the plate and secure the bow and bulb in position. Other arrangements of the arc-inclosing bulb may be employed without departure from the essentials of the invention.

Cap *b* is provided with an opening through which the shiftable positive electrode *d* extends, and, in order that the joint may be as tight as possible, a thimble 14 is provided. This thimble, preferably formed of brass, is threaded into an opening in the cap plate with its shouldered portion 15 in engagement with the upper face thereof, and is provided with a central opening bored and finished to snugly fit the carbon *d*. By providing a separate thimble of soft metal, it can be readily renewed when there is any wear in the opening and so prevent leakage of air and gas around the upper carbon.

The lamp-supporting means and the devices for regulating the shiftable upper carbon *d* may be of any suitable or desired arrangement.

The lower carbon *e* may be supported from the cap plate in any suitable manner, but preferably a U-shaped vent tube *f* is arranged within the bulb and is provided at its lower end with a ring or annular support *g*, within which the lower carbon is held by a thumb screw 16.

The support *g* is provided with an annular channel or passage 17, formed partly in the main body thereof and partly within a ring-shaped cap piece 18, threaded over a central boss 19 on the lower end of the support. Passages 20 lead from the annular channel 17 to the sections or limbs of the vent tube *f*.

The upper ends of the U-shaped vent tube pass through openings in the top plate and are secured thereto and insulated therefrom by washers 21 and nuts 22. A nut 23 and washer 24 secure one of the conductors 25 of the current supply to the tube *f*. One end of the vent tube is open to the outer air while the nut 22' forms a cap to close the opposite end. Adjacent the closed end of the tube, it is provided with a hole or a series of holes 26 opening within the bulb. By this preferred arrangement, a vent tube is provided of considerable length, as is desired, which also forms a support and conductor for the lower carbon, and the vent tube is arranged within the bulb out of the way of the regulating clutch and other parts of the lamp. It is obvious that any suitable form of support for the carbon may be arranged at the lower end of the U-shaped vent tube. It is also to be understood that

the vent passage and support for the lower carbon may be arranged otherwise than as set forth without departure from the essentials of the invention.

The vent passage is of considerable size so that the flow of gas therethrough will not be throttled and cause air to be drawn in through the opening for the shiftable electrode *d*. Good results have been obtained with a vent tube having an internal diameter of $\frac{1}{8}$ th of an inch. The passage is of considerable length so that air will not be too readily drawn in through the tube by the expansion and contraction of the gas therein due to the variations in temperature or "puffing" of the arc. Means are also provided for regulating the flow through the vent passage to keep the carbon consumption at the desired low minimum with currents of different strength. Such means is preferably arranged to vary the distance between the two ends of the passage or, in other words, to vary the effective volume or length of the passage, and this object may be effected in any desired manner. In the form shown, a series of openings 26 are arranged lengthwise of the tube and are controlled by a slide valve 27 in the form of a split sleeve surrounding the tube. By shifting the valve over the openings or holes, the distance between the points at which the vent passage opens into the bulb and into the outside air may be varied. It is obvious that other arrangements of regulating openings and valves for the vent passage could be employed. I have found that in this manner, the carbon consumption may be varied and kept at the desired low minimum with different current strengths.

In certain prior constructions, air has been admitted to the arc-inclosing globe at one point while the gas is discharged therefrom at another point so that circulation through the globe or arc chamber is maintained. In the present construction, however, the inclosing globe or arc chamber communicates with the outer air through an elongated passage through which an interchange of air and combustion gas is effected, and there is, in consequence, no circulation properly speaking through the arc chamber.

As heretofore indicated, the vent tube or passage is of considerable length, and of such cross section as to permit the proper interchange of air and gas, the proportions of the tube or passage as to length and cross section being determined in accordance with the amount of current and the size of carbon used. With an air chamber or inclosing globe of ordinary size, and with carbons $\frac{1}{8}$ ths of an inch in diameter, a vent tube $\frac{1}{8}$ th of an inch in internal diameter has been found to give satisfactory results with a current of 6 amperes, provided the length of the passage from the outlet to the opening

26 nearest thereto is approximately 9 inches. With the additional vent holes 26 placed approximately $\frac{3}{8}$ ths of an inch apart longitudinally of the tube and beyond the lowest hole, the proper adjustment of the slide valve 27 admits of the lamp being employed to produce the favorable conditions hereinbefore set forth, with currents of 5, 4 and 3 amperes respectively, according to the distance of the particular hole, uncovered by the slide valve, from the outlet end of the passage, for example, in the form shown, when 3 amperes are used, the first or upper hole 26 is uncovered, when 4 amperes are employed, the second, and so on, and the exterior of the tube is marked with a corresponding scale.

Small sizes of carbons are more readily heated than those of larger size and are incandescent for greater distances from their points, so that they are more efficient. They have not been employed extensively heretofore because of their short life and excessive cost of maintenance. With the improved form of lamp, it has been possible to employ carbons as small as $\frac{1}{16}$ ths of an inch in diameter, which do not require trimming oftener than lamps previously employed having $\frac{1}{2}$ inch carbons, and which, with 3 amperes only, will give as much or more light than 5 ampere lamps employing carbons of $\frac{1}{2}$ inch diameter.

It will be noted that the vent openings 26 in the vent tube *f* are located at a point adjacent the arc but on the outer side of the tube away from the arc. By this arrangement, it is found in practice that the vent tube is not liable to clog up with carbon.

I have also found that my improvement may be advantageously employed in lamps designed to use small size carbons which are found to materially increase the efficiency of the light but which have not heretofore been largely used as they have necessitated frequent trimming of the lamp. But I have discovered that while the total carbon consumption varies with the amount of air present, the percentage consumption of the lower negative or fixed carbon varies with the current density of the carbons. That is to say, as the size of the carbon decreases or as the amount of current increases, the percentage consumption of the negative or fixed carbon decreases. With my improved gas or air check which is adjustable in accordance with the current used, a lamp having small sized carbons will have the desired long life (*i. e.* need not be frequently trimmed) and the lamp may be employed with currents of different strength.

It is obvious that numerous changes may be made in the details of construction without departure from the essentials of the invention.

Having described my invention, what I

claim as new and desire to secure by Letters Patent is:—

1. In an electric arc lamp, a substantially air-tight arc-inclosing globe communicating with the outer air through an elongated vent or diffusion passage of small diameter for the interchange therethrough of air and combustion gas, the length and diameter of said passage being definitely proportioned in accordance with the size of carbon employed and the amount of current for which the lamp is designed to admit only the necessary amount of air, whereby the carbon consumption is maintained at a minimum, substantially as described.

2. In an electric arc lamp, a substantially air-tight arc-inclosing globe communicating with the outer air through an elongated vent or diffusion passage of small diameter for the interchange therethrough of air and combustion gas, the length and diameter of said passage being definitely proportioned in accordance with the size of carbon employed and the amount of current for which the lamp is designed to admit only the necessary amount of air, whereby the carbon combustion is maintained at a minimum and means for varying the effective length of said passage in accordance with the varying amounts of current used, substantially as described.

3. In an electric arc lamp, the combination of an arc-inclosing bulb, a cap closing the end of said bulb having an opening through which the fixed carbon slides, an elongated vent or diffusion tube of small diameter supported by said cap and extending within the bulb to form a support for the fixed carbon, said tube communicating with the outer air and with the interior of said bulb for the interchange therethrough of air and combustion gas, the diameter of said tube and the distance between the inlet and outlet thereof being definitely proportioned in accordance with the size of carbon employed and the amount of current for which the lamp is designed, to admit only the necessary amount of air, substantially as described.

4. In an electric-arc lamp, the combination with an arc-inclosing bulb, a cap closing the end of said bulb having an opening within which the movable carbon snugly fits, a vent tube arranged within the bulb and extending through said cap and a slide valve shiftable longitudinally of said tube and coöperating with a series of openings therein for varying its effective length.

5. In an electric arc lamp, the combination with an arc-inclosing bulb, of a cap closing the end of said bulb having an opening through which the movable carbon slides, and a U-shaped vent tube supported from said cap and extending downwardly within said bulb and including at its lower portion a support for the fixed carbon, one of the

limbs of said tube communicating at its end with the outer air and the other limb thereof opening into the bulb.

6. In an electric-arc lamp, the combination with an arc-inclosing bulb, of a cap closing the end of said bulb having an opening through which the movable carbon slides, a U-shaped vent tube supported from said cap and extending downwardly within said bulb and including at its lower portion a support for the fixed carbon, said tube communicating at one end with the outer air and having openings at its opposite end within the bulb, and means cooperating with said openings for adjusting the effective length of the passage within said tube.

7. In an electric-arc lamp, the combination with an arc-inclosing bulb, of a cap closing the end of said bulb having an opening through which the movable carbon slides, a U-shaped vent tube supported from said cap and extending downwardly within said bulb, said tube communicating at one end with the outer air and having a longitudinally extending series of openings adjacent its opposite end within the bulb, a valve sleeve mounted to slide on said tube and cooperating with said openings to vary the effective length of the passage through said tube.

8. In an electric arc lamp, the combination of an arc-inclosing bulb, a cap inclosing the end of said bulb having an opening through which the movable carbon slides, and a vent or diffusion tube comprising separate limbs supported at their upper ends by said cap and extending downwardly within said bulb and including a support for the lower fixed carbon, said limbs communicating at their lower ends and one of the limbs communicating at its upper end with the outer air, the other limb being closed at its upper end and having an opening within the bulb and located between its ends and at its outer side, the diameter of said tube and the effective length thereof between the inlet and outlet openings being definitely proportioned in accordance with the size of carbon employed and the amount of current for which the lamp is designed, to admit only the necessary amount of air, substantially as described.

9. In an electric arc lamp, the combination with an arc inclosing bulb, of a cap closing the end of said bulb, and a U-shaped vent tube supported from said cap and extending downwardly within said bulb and including a support for the lower fixed carbon, one of the limbs of said tube communi-

cating at its end with the outer air and the other limb having an opening communicating with the arc chamber within the bulb, the position of which opening is located in accordance with the size of carbon employed and the amount of current for which the lamp is designed to admit only the necessary amount of air, whereby the carbon consumption is maintained at a minimum, substantially as described.

10. In an electric arc lamp, the combination with an arc inclosing globe, of a cap therefor having an opening through which the movable carbon slides, a vent tube comprising separate limbs supported from said cap and extending downwardly within the bulb, one of the limbs of said tube communicating at its end with the outer air and the other limb having an opening within the bulb, and a support at the lower portion of said tube for the fixed carbon comprising an annular member having a passage or chamber formed therein communicating with both limbs of said vent tube, substantially as described.

11. In an electric arc lamp, the combination with an arc inclosing globe, of a cap therefor having an opening through which the movable carbon slides, a U-shaped vent tube supported from said cap and extending downwardly within the bulb, said tube communicating at one end with the outer air and having an opening at its opposite end within the bulb and a support at the lower portion of said tube for the fixed carbon, comprising an annular member formed of separate sections threaded together and having a passage or chamber therein communicating with both the limbs of said U-shaped vent tube, substantially as described.

12. In an electric arc lamp, the combination with an arc-inclosing bulb of a cap closing the end of said bulb having an opening through which the movable carbon slides, and a U-shaped vent tube supported from said cap and extending downwardly within said bulb and including at its lower portion a support for the fixed carbon, one of the limbs of said tube communicating at its end with the outer air and the other limb having an opening into the bulb at a point adjacent the arc but on the outer side of the tube away from the arc, said tube being closed to the interior of the bulb from said opening to its outer end.

JOHN THULIN.

Witnesses:

KATHARINE GERLACH,
LILLIAN PRENTICE.