(No Model.)

F. M., E. S. & H. F. HILDEBRANDT.

ELECTRIC ARC LAMP.

No. 542,589. Patented July 9, 1895.

Fig. 1.

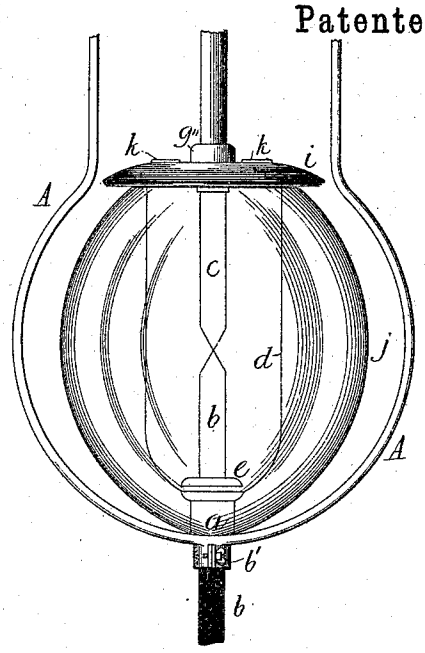


Fig. 2.

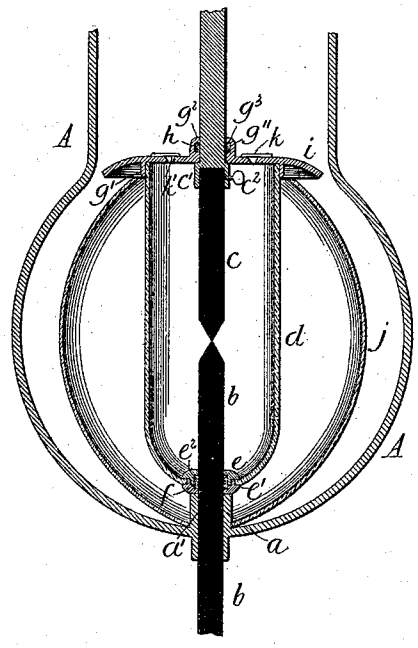
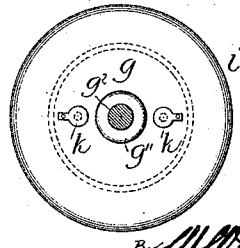


Fig. 3.



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UNITED STATES PATENT OFFICE.

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ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 542,529, dated July 9, 1895.

Application filed December 27, 1893. Serial No. 494,851. (No model.)

To all whom it may concern:

Be it known that we, FRANK M. HILDEBRANDT, EDWIN S. HILDEBRANDT, and HENRY F. HILDEBRANDT, citizens of the United States, residing at Baltimore, in the State of Maryland, have invented certain new and useful Improvements in Electric-Arc Lamps; and we do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention has reference to improvements in electric-arc lamps, and has for its object to obtain with a comparatively low voltage an improved quality of light and to increase the longevity of the carbons.

Various efforts have been heretofore made in this line of invention to obtain these objects, and principally by inclosing the arc in a chamber which is practically air-tight; and while the efforts have been attended with results not obtainable in the arc lamps commonly employed, which are open to the atmosphere, certain deficiencies in construction and operation detract from the efficiency of such arc lights and render the same impracticable so far as the attainment of the best results is concerned.

It being well understood by those versed in the art to which this invention relates that the burning of an arc light in the open atmosphere is attended with many disadvantages—such as rapid consumption of the carbons, an unsteadiness of light, and high voltage required—and the causes which lead thereto being well known in the art we will not enumerate same specifically more than to state that by inclosing the arc in an air-tight chamber all of the detrimental influences of the atmosphere on the arc light are prevented.

In all of the arc lamps, so far as we are aware, in which are employed an inclosing air-tight chamber the casing forming such chamber has been made of a comparatively large diameter, which in practice militates against the maintenance of incandescence of the gases during the burning of the arc light and which necessitates an increased voltage by reason of the decreased degree of conductivity due to the rarefaction of the gases. If the casing which incloses the arc is made of a comparatively large diameter the maintenance of the gases in a luminous condition is rendered impossible for the reason stated; but with a casing of comparatively small diameter, such as we employ, the gases around the arc are heated thereby to a luminous or incandescent condition, and the result is a light of increased quality and candle-power and radiating area. Again, no provision of a successful nature appears to have been made for permitting the excess of gases to escape and thus prevent the bursting or breaking of the casing surrounding the arc light.

By our invention all of the above-cited objections are overcome and we are enabled to produce an arc lamp requiring comparatively low voltage and by which the life of the carbons is considerably lengthened and an improved quality of light obtained.

We will now describe in detail the construction and operation of our improved arc lamp, and attention is called in connection with such description to the accompanying drawings, which form a part of this specification, and in which—

Figure 1 is an elevation of enough of an arc lamp to illustrate our improvements. Fig. 2 is a vertical central section of the same; and Fig. 3 is a top view of the casing, showing the construction of valve employed.

The same letters of reference denote the same parts in the figures of the drawings.

Referring to the said drawings by letter, A denotes the frame which supports the several parts of the lamp and which may be of any ordinary construction, as may also be the mechanism for controlling the feeding of the positive carbon, which is not here shown. This frame has at its lower end an annular collar *a*, through the opening *a'* of which the negative carbon *b* is inserted and held by a suitable clamp *b'*, as shown. *c* is the positive carbon secured to its holder *c'*, its upper end being socketed and held by a set-screw c^2. Surrounding the arc is a casing *d* of glass, which is in general form cylindrical and of small diameter, the lower end, however, being

reduced or contracted to permit of a connection with a ring or collar *e*, which, as shown, is formed in two parts secured together and provided in its outer side with an annular recess *e'* to receive the contracted end of the casing, and also in its inner side with an annular recess e^2, which receives an asbestos packing-ring *f*. This packing-ring serves the double purpose of excluding air, and, in conjunction with the clamp *b'*, of maintaining the lower or negative carbon in position. The upper end of the casing is normally closed by a cover *g* of metal having a depending annular flange *g'*, which closely fits the casing to prevent entrance of air at this point.

Centrally of the cover is an upwardly-extending integral collar *g''*, and g^3 is an opening through the cover and collar for the reception of the rod of the holder *c'*, which fits the same closely but is capable of longitudinal movement. This connection is made air-tight by an asbestos packing-ring *h*, which is placed in an annular recess g^3, formed in the inner side of the collar *h'*. The cover *g* is extended to form an annular shield *i*, which is inclined downward slightly and extends outward sufficiently to cover the opening in the top of the globe *j*, which latter surrounds the casing and is secured at its lower end to the frame, as shown. The object of this globe is to protect the casing from rain, snow, hail, and cold currents of air, which if allowed to come into contact with the casing when the latter is in a heated condition would cause it to fracture, and a further advantage due to this arrangement is that the air between the globe and casing being heated to a considerable degree by the latter the gases are maintained at an even temperature. By the employment of the shield *i* with the globe the casing is practically inclosed and protected from atmospheric influences. We provide for the escape of the gases when expanded by heat a valve or valves *k*, which are arranged to normally close by the action of gravity or of springs a vent or vents formed in the cover.

Our preferred construction of valve is illustrated in the drawings, and consists of a piece of metal having a requisite spring, which is fixedly secured at one end to the top of the cover and has its other end above the vent, a packing *k'* of asbestos being interposed between the valve and its seat to prevent leakage. When the pressure of the gases reaches a predetermined degree the valve or valves are forced upward and the excess of pressure of gas allowed to escape gradually. This provision is made for the purpose of preventing the bursting of the cylinder by the pressure exerted by the heated gases; but we propose to make the glass for the casing of sufficient thickness to withstand considerable pressure, inasmuch as we have found that the best results are attained with a dense body of gas as compared with a rarefied body.

It will be noticed that by our construction the carbons are entirely within the cylinder, and consequently there is no exposure either to atmospheric or other damaging influences. The holder-rod moreover serves as the support for the upper end of the casing and maintains the position of the same in a much more rigid manner than could be accomplished by extending the positive carbon through and beyond the cylinder and making the carbon serve as the support.

The casing, as has been previously stated, is air-tight against the admission of air; but by reason of the valved openings the excess of pressure of the gases is allowed free vent. When the circuit is closed the air in the casing is robbed of its oxygen, and after a short time the entire body of the gas-chamber becomes highly luminous, being filled with an incandescent vapor of carbon, which results in a light emanating from all parts of the casing, soft, steady, and highly luminous. The heated gases by their expansive force effectually prevent the admission of air to the interior of the envelope, and consequently a very slow consumption of the carbon is the result. Such small particles of carbon as are carried through the arc or rendered incandescent therein are deposited in the negative electrode and serve to build up said electrode and maintain the position of the arc practically stationary above the heavier gases which collect at the bottom of the casing, while a very slow destruction of the positive electrode proceeds. In time a light deposit will be formed upon the inner wall of the casing; but the heat of the inclosed gases when the envelope is of substantially the size specified is sufficient to maintain this deposit in an incandescent condition, adding to the effectiveness of the light and the rapidity with which the highly-luminous condition is effected. The lamp as constructed will require a comparatively low voltage for its operation, and we attribute this result to the dense body of conducting-gas maintained in close relation to the arc, by which its resistance is materially lowered and the voltage necessary to maintain its action. The small arc-inclosing casing prevents dissipation of the gases and maintains them at a greater density than would be possible with a large envelope. Besides conserving the energy in a manner already described the gases glow with increased brilliancy by reason of the greater density.

The operation will be clearly understood by those versed in the art, and it is not necessary to explain the same here more than to give the directions for inserting the carbons.

The lower or negative carbon is inserted from beneath without disturbing any of the parts other than by loosening the thumb-screw of the clamp, which is a matter of short movement. The upper or positive carbon is inserted by merely detaching the cover from the casing and moving the same upward on the holder-rod the required distance and by loosening the thumb-screw of the holder, in-

serting the upper end of the carbon in the socket, tightening the screw, and lowering the cover to its place. While the cover is removed the collar which secures the lower end of the casing to the frame will maintain the position of the casing, and, if desired, the upper end of the latter may be slightly tapered, as may also the depending flange on the cover, in order that when the cover is being replaced the same may automatically center the casing.

The construction and operation of valve employed are such that the excess of pressure of the gases is allowed to escape gradually and steadily, and consequently there is no fluctuating in the intensity of the light.

The arc may be located at any point within the casing; but we prefer to arrange the same centrally, as shown.

If desired, the covering may be insulated from the holder and rod by interposing between the collar and the rod a sleeve of glass or other non-conducting material, and in this case the recess for the asbestos packing is made in said sleeve.

By our invention we are able to produce an arc lamp in which all the difficulties heretofore experienced have been overcome. The carbons are entirely inclosed, and the globe, in conjunction with the shield on the cover, effectually protects the casing from all injurious influences. The operation of removing old carbons and of inserting new ones is a simple one, not requiring the removal of the casing, but simply the raising of its cover for applying the positive carbon and loosening a screw for the insertion of the negative carbon. The lamp, as a whole, is simple and can be made very attractive in appearance, and the light is of maximum power and devoid of flickering. The longevity of the carbons is increased to a very considerable extent and the voltage required to run the lamp is reduced to the minimum.

What we claim as our invention, and desire to secure by Letters Patent, is—

1. An arc lamp having the electrodes around the arc inclosed in a small transparent or translucent normally air tight casing, said casing being provided in its upper end with a valve or valves normally closed whereby the casing is filled with a highly luminous gas and the longevity of the electrodes is extended.

2. An arc lamp having its electrodes around the arc inclosed in a small transparent or translucent casing so arranged as to maintain the gases luminous in said casing and air tight against the ingress of air but affording egress for the heated gases developed by the arc.

3. An arc lamp having its electrodes around the arc inclosed in a transparent or translucent casing air tight at all points below the arc, so arranged as to maintain the gases luminous in said casing, means for preventing the ingress of air, and an outwardly opening valve or valves for permitting the discharge of gases.

4. An arc lamp having its arc inclosed in a small transparent or translucent casing air tight below the arc, so arranged as to maintain the gases luminous in said casing, a closely fitting opening to permit the feed of the positive carbon, and an outwardly opening normally closed valve or valves in the top of the casing adjacent to the heated gases.

5. An arc lamp having its arc inclosed in a small transparent or translucent casing air tight below the arc, so arranged as to maintain the gases luminous in said casing, a metallic closure having a closely fitting opening to permit the feed of the positive carbon, and means in the top of the casing for permitting the escape of the gases developed by the arc.

6. An arc lamp having its arc inclosed in a transparent or translucent casing air tight against ingress of air, so arranged as to maintain the gases luminous in said casing, and provided with a closure at the top having a closely fitting feed opening for the positive carbon.

7. An arc lamp having its arc inclosed in a small transparent or translucent casing so arranged as to maintain the gases luminous in said casing and air-tight against the ingress of air, a metallic closure for the top of the casing provided with a valve or valves for affording egress for the heated gases developed by the arc, and with a shield, and a globe surrounding the casing, the opening of which is covered by the shield.

8. An arc lamp having its arc inclosed in a transparent or translucent casing air tight below the arc, a closure for the top of the casing provided with a closely fitting feed opening for the positive carbon, and a valved opening in said closure.

9. An arc lamp having its arc inclosed in a transparent or translucent casing air tight against the ingress of air and so arranged as to maintain the gases luminous in said casing, means for permitting the escape of the gases produced by the arc, a closely fitting opening in the bottom of the casing for permitting the insertion from beneath of the negative carbon, and a closely fitting opening in the top of the casing for permitting the feed of the positive carbon, said carbons being entirely inclosed within the casing.

10. An arc lamp having its arc inclosed within a transparent or translucent casing air tight at its lower end, a closure for the top of the casing having a closely fitting opening for the feeding of the positive carbon provided with a packing of fire proof material for the purpose set forth.

11. An arc lamp having its arc inclosed within a transparent or translucent casing air tight against ingress of air and so arranged as to maintain the gases luminous in said casing and means for permitting the egress of the gases produced by the arc, said casing

having a contracted lower opening closed by a collar having a closely fitting opening for permitting the insertion from below of the negative carbon.

12. An arc lamp having its arc inclosed within a transparent or translucent casing air tight against the ingress of air, and having means for permitting the egress of the gases produced by the arc, the lower end of the casing being contracted and closed by a collar having a closely fitting opening to permit the insertion from below of the negative carbon, a recess in the collar, a packing of fire proof material, and a clamp for holding said carbon in position.

In testimony whereof we affix our signatures in presence of witnesses.

FRANK M. HILDEBRANDT.
EDWIN S. HILDEBRANDT.
HENRY F. HILDEBRANDT.

Witnesses to signatures of Frank M. Hildebrandt and Edwin S. Hildebrandt:
W. T. NORTON,
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Witnesses to signature of Henry F. Hildebrandt:
W. T. NORTON,
JOHN W. DUDLEY.