(No Model.)

L. B. MARKS.

ELECTRIC ARC LIGHT.

No. 552,190. Patented Dec. 31, 1895.

Fig. 1.

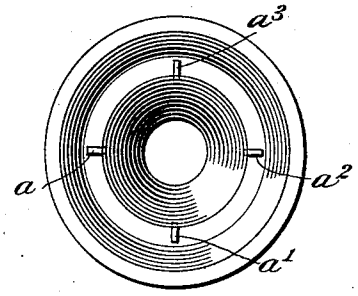
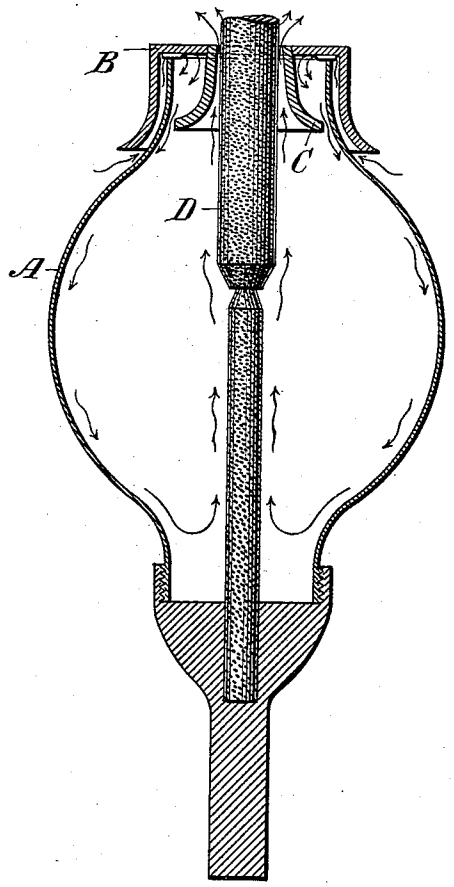


Fig. 2.



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LOUIS B. MARKS, OF NEW YORK, N. Y., ASSIGNOR TO THE ELECTRIC ARC LIGHT COMPANY, OF SAME PLACE.

ELECTRIC-ARC LIGHT.

SPECIFICATION forming part of Letters Patent No. 552,190, dated December 31, 1895.

Application filed October 9, 1894. Serial No. 525,372. (No model.)

To all whom it may concern:

Be it known that I, LOUIS B. MARKS, a citizen of the United States, residing in the city, county, and State of New York, have invented certain new and useful Improvements in Electric-Arc Lighting, of which the following is a specification.

This invention relates to electric-arc lamps in which the arc burns within an inclosing transparent or translucent envelope to which the air has limited access. In lamps of this character heretofore patented by me (especially as described in Letters Patent No. 521,936, dated June 26, 1894) a special construction was arranged to prevent as far as practicable access of oxygen to the inclosing cylinder or envelope. It has been found that by reason of the exclusion of oxygen in this type of lamp the ohmic resistance of the arc stream is increased and hence the arc requires a comparatively high-potential drop to insure steadiness. With a low-potential drop the light is unsteady and the efficiency of the light is decreased and the negative electrode tends to "build," thus impairing the practical operation of the lamp. There is also a marked tendency to deposit free carbon in the cylinder.

My present invention is designed to maintain a low-potential drop across the arc in the various stages of service of a pair of electrodes, and at the same time maintaining a perfectly steady and efficient light to prevent the "building" of the negative electrode and the formation of "nibs" on the tip of the negative to improve the character of the contiguous points of the electrodes and preserve a desirable distribution of light and a uniform angle of illumination.

In prior lamps having an inclosed arc in which a prolonged life of the electrodes was attained, special care was taken to maintain an obstructed access of outside air to the arc while the lamp was in action, so that the carbon would be consumed very slowly. Means for allowing the exit of gas from the inclosing envelope were provided in the form of a valve in the envelope, the valve being normally closed, so as to prevent the admission of air.

I have discovered that by regulating the temperature of a stream of heated air and so directing the application of the latter to the interior of the inclosing envelope that when entering the envelope the convection currents formed by the gases within will carry the air in a uniform direction with relation to the arc and the cylinder greatly improved results may be obtained as far as the operation of this type of lamp on existing commercial circuits is concerned. No valve is used; but the envelope is provided with means for continually maintaining a steady circulation of gases, egress of gas and ingress of air or oxygen being carried on continuously and simultaneously. The limited quantity of air which is admitted may be directed over a path parallel to the arc and electrodes or otherwise distributed so that the zone included between horizontal planes through the tips of positive and negative electrodes, respectively, receives the amount of oxygen desired. My present invention thus involves a method of feeding an arc within an inclosure with a limited supply of oxygen and providing means whereby this supply may be maintained uniform and continuous. In the ordinary arc light oxygen has unobstructed access to the arc and carbon points. In the various types of inclosed arcs means are provided to exclude as far as possible the ingress of air or oxygen. The chief advantage of the exclusion of an oxidizing agent in the inclosed arc lies in the great prolongation in longevity of electrodes. Incident to the exclusion of oxygen, however, are the increased resistance of the arc-stream, the shortening of the arc for a given drop of potential, the flattening of the carbon points, the unsteadiness and inefficiency of the light at small potential differences, and the building of the negative at these potential differences. The increased resistance of the arc-stream under the conditions just mentioned was the basis of an application for which Letters Patent were granted to me and another, No. 520,996, dated June 5, 1894. It was found that under some conditions over twice the normal drop of potential was necessary to efficiently run the form of inclosed arc alluded to.

The shortening of the arc for a given drop of potential due to surrounding the arc by an inclosing medium and excluding oxygen has made it necessary in commercial operation of inclosed arcs to employ a higher drop per inclosed arc than would be necessary for open-air arcs, for a certain length of arc is required in order to produce a steady light, and in the case of the inclosed arc a greater potential difference is necessary to secure this length of arc than in the case of the open-air arc. This follows naturally from the increased resistance of the inclosed arc, as explained before. If the attempt be made to operate the inclosed arc at as low-potential drops as open-air arcs, unsteadiness of the light results. Because of the flattening of the carbon points due to being consumed in the absence of an oxidizing agent the light is largely obscured and the illumination effective only in a small zone. Moreover, if operated at as low a potential drop as an open-air arc, the negative electrode invariably builds and a mushroom-shaped formation results. This formation consists largely of graphitic carbon. The nib thus formed breaks off eventually at its neck and flickering and unsteadiness of the light results.

My present invention is designed to overcome or modify the actions just alluded to, and to provide for the production of an inclosed arc which is applicable to commercial arc-light circuits as they now exist.

A highly-important result which follows from the distribution of air-currents as described herein is that the resistance of the arc-stream, instead of being considerably increased, as is the case with other inclosed arcs, remains practically the same as in an open-air arc. The length of arc for a given drop of potential is therefore not less than but practically the same as that of an open-air arc of the same drop of potential.

Because of the flow of convection currents of arc-gases admixed with atmospheric air the electrodes do not burn blunt as in ordinary inclosed arcs, but have much the same shape as points formed in open air. The crater formed in the positive is substantially uniform in curvature, while the apex of the negative is quite pointed and well centered with reference to the crater of the positive. Thus there is practically no obscuration of light as in the usual inclosed arcs where the electrodes burn to blunt points. The light is steady and efficient at practically as low drop of potential as with open-air arcs. There is no building of the negative electrodes. There is no deposit or nib on the negative, the carbon-vapor from the positive being converted into gas and following the path of the convection currents. By virtue of the direction of currents in the envelope the carbon deposit that would otherwise accumulate on the tip of the negative and form a nib is attacked by a stream of oxygen-bearing gas and converted to carbon oxide, which is carried out of the envelope in line with the upward convection currents. The position of the negative tip is maintained practically stationary in the envelope.

Various provisions may be made for directing the entering air over a path proper to attain the results above referred to. One form of construction which I have found to be successful in practice is to provide separate ducts for the outgoing and ingoing gases and so obstruct the progress of the gases through the ducts that air will be slowly but continuously and uniformly admitted and directed by deflectors into the path normally taken by the convection currents existing in the envelope.

The several features of novelty of the invention will be more particularly hereinafter described, and will be definitely indicated in the claims appended to this specification.

In the accompanying drawings, which illustrate one way of carrying out my invention, Figure 1 is a top plan view, and Fig. 2 a side elevation, partly in section, of a pair of carbons surrounded by an envelope provided with ingress and egress ducts in accordance with my invention.

An envelope A provided at the top with a loosely-fitting cap B touches the cylinder only at four projections a a' a^2 a^3, in the center of which is a circular or conical tube C, through which the positive electrode D is fed to the arc. The negative electrode, by reason of its slower rate of consumption, may be smaller in diameter than the positive. The outer portion of the cap is enlarged into a bell-shaped flange, the rim of which is brought closely adjacent to the exterior wall of the envelope. Thus there is provided a narrow annular passage for the outside air into the envelope, one of the walls of this passage being formed by the envelope, which, by reason of its high temperature, heats the entering air in transit into the envelope. The tubular opening through which the electrode feeds may with advantage be made slightly conical in shape, the enlargement at the top being only a little greater than the diameter of the electrode, so as to permit a free feed of the latter and to afford an obstructed egress for gases from the envelope.

The lower part of the tube may with advantage be flanged away from the electrode, as shown, this form serving as a deflector for the upward currents around the positive carbon, the flange at the same time forming a deflecting-wall for the ingoing air and directing the latter outwardly toward the walls of the envelope. The tendency with this arrangement is for all egress to take place by way of the central tubular opening and all ingress by way of the bell-shaped chamber.

An investigation of the convection currents within the envelope when a lamp is in operation will show that the gases heated in the neighborhood of the arc rise in the central portion and fall in the outer portions of the envelope, thus creating a down-going current

in the outer parts of the envelope and an upgoing current around the electrodes, as shown by the arrows in the drawings.

The arrangement of the cap hereinbefore described deflects the ingoing air into the downwardly-moving portion of the convection current, where it is intimately mixed with the gases already formed in the envelope and raised in temperature, so that it is intensely hot by the time it reaches the arc. In the form of envelope shown in the drawings I have represented the bottom as closed and the outlet and inlet for the gases at the top. This, however, is not absolutely essential, although it is a convenient form to adopt in practice.

The essential feature of my invention is continuously and uniformly introducing limited quantities of air to the envelope and controlling the direction of their access to the arc and adjacent heated portions of the electrodes, so as to maintain a uniform condition of the arc in all stages of action of the lamp, a low drop across the arc and a uniform shape of the confronting electrodes. It is essential that electrodes of uniform texture be employed.

The rate of consumption of carbon in the inclosed arc, as described in my patents above referred to, is exceedingly small as compared with open-air arcs. Seven-sixteenths inch diameter by twelve inches total length are the dimensions of commercial plain carbons used in open-air arcs, and the average life is about seven hours. In the inclosed arc the average life of a pencil of the same length is more than ten times this amount, or over seventy hours. In the inclosed arc, as claimed in the present invention, about fifty hours has been attained in practice. The continual inflow of oxygen in the direction of the convection currents in the latter case accounts for the reduction in life. However, the reduction of life is accompanied by several advantages of the greatest commercial value, which latter more than compensate for the decrease in longevity of electrodes. One of these advantages, the reduction in resistance of the arc stream, due to presence of oxygen, is exceedingly valuable from a commercial standpoint, for with reduced resistance in the arc I am enabled to operate lamps at the voltages now commonly employed on open-air circuits.

It has been found that sixty to sixty-five volts are required for efficient operation of ordinary inclosed arcs. My present invention enables me to run at forty-five to fifty volts. Thus, assuming that I have a commercial ten-ampère constant-current circuit, each inclosed arc of the old type when applied to this circuit would require ten by sixty to ten by sixty-five or from six hundred to sixty hundred and fifty watts of energy. In the new type of inclosed arc the consumption of energy is reduced to from ten by forty-five to ten by fifty or four hundred and fifty to five hundred watts, a saving of over twenty per cent. A type of the ordinary constant-current machine now in use all over the country is designed to furnish an output of three thousand volts at nine and one-half to ten ampères. The capacity of such a machine, it will be seen, depends upon the number of volts consumed by each lamp on the circuit. The reduction from sixty to sixty-five to forty-five to fifty volts thus enables me to increase the number of lamps that may be efficiently operated on each machine by over twenty per cent. A three-thousand-volt machine will efficiently operate forty-eight inclosed arcs at sixty-two and one-half volts average each, whereas the same machine will operate sixty-three inclosed arcs at forty-seven and one-half volts average each, no allowance being made in either case for line losses.

I have found that with solid carbons the shape of the crater in the positive electrode depends largely on the character of the formation at the tip of the negative electrode. If the negative tip is blunt there will be no perceptible crater in the positive, the latter being also blunt. If the negative burn to a sharp point and be well centered the crater in the positive will be comparatively deep and well centered. The importance of the proper formation and contour of the points with reference to distribution of light has been explained before. I am enabled, by utilizing the convection currents in the cylinder, as previously explained, to maintain the negative pointed during the operation of the lamp, and also to preserve a uniform crater in the positive. Both of these conditions are very favorable for a steady arc.

It is well known that a long arc or one that requires an abnormally-large drop of potential produces a light rich in violet hue. This violet hue is objectionable for ordinary purposes of illumination. In my present invention, means having been provided for operating at normal potential drops, I have found that the presence of violet rays is largely reduced, the light being almost pure white. The best results have invariably been attained with small envelopes, such as referred to in my prior patents, when the envelope was three inches in diameter and four or five inches long, though I do not limit myself to any size. With a small cylinder the losses by radiation are very small, and gases can be kept at uniform temperature, &c.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. An arc lamp having a transparent or translucent inclosure around the arc, provided with a small inlet for air and ducts for leading the air in a uniform direction relatively to the arc.

2. An arc lamp having a transparent or translucent inclosure around the arc, a small ingress passage for air, an independent egress passage for the gaseous products of the arc,

and deflecting walls for directing the entering air upon the arc.

3. An arc lamp having a transparent or translucent inclosure around the arc provided with a narrow annular inlet for air, one of the inlet walls being formed by the cylinder whereby the air is heated before entering the arc chamber.

4. An arc lamp provided with a transparent or translucent inclosure around the arc, an opening in said inclosure for transit of the movable electrode, a tubular wall for said opening, a small inlet duct for air and means for directing the air toward the outer part of the inclosure.

In testimony whereof I have hereunto subscribed my name this 6th day of October, A. D. 1894.

LOUIS B. MARKS.

Witnesses:
IDA KING SMITH,
CARRIE L. MAXWELL.