2 Sheets—Sheet 1.

C. W. SIEMENS.

ELECTRIC LAMP.

No. 255,466. Patented Mar. 28, 1882.

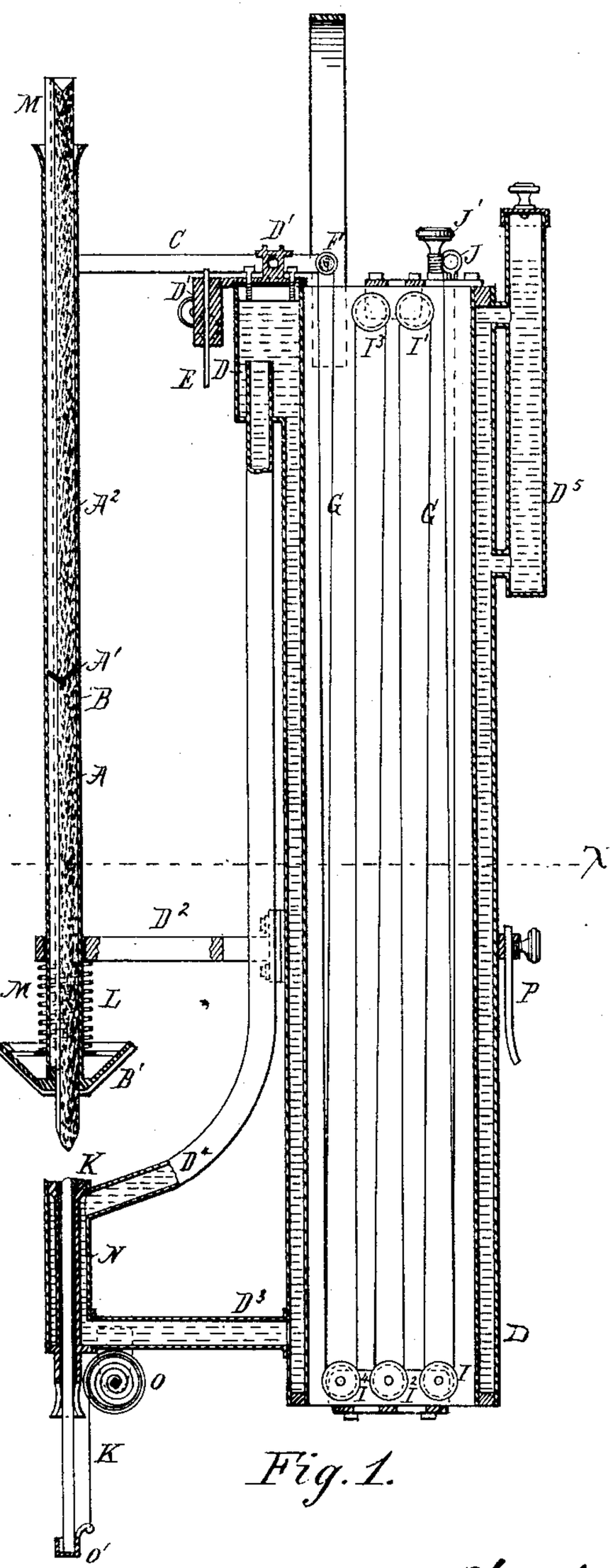

Fig. 1.

Witnesses.

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Inventor.

Charles W. Siemens

by C. A. Whitman

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2 Sheets—Sheet 2.

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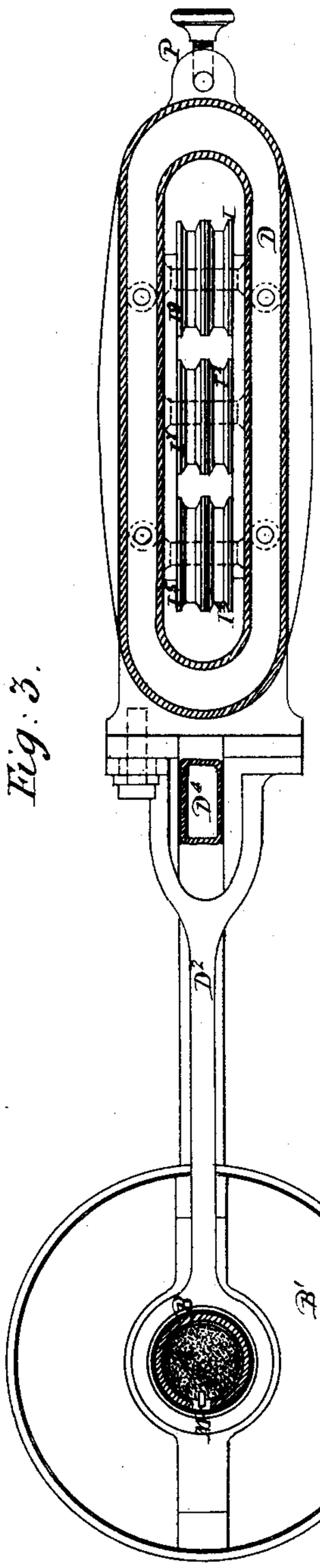

Fig. 3.

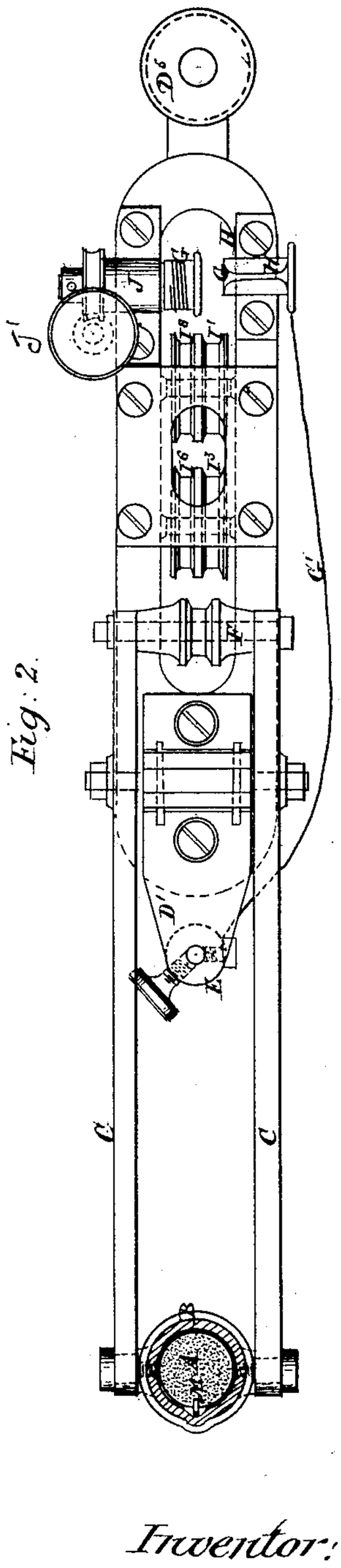

Fig. 2.

Attest:

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Inventor:

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UNITED STATES PATENT OFFICE.

CHARLES W. SIEMENS, OF QUEEN ANNE'S GATE, WESTMINSTER, ENGLAND.

ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 255,466, dated March 28, 1882.

Application filed September 16, 1879. Patented in England May 27, 1879.

To all whom it may concern:

Be it known that I, CHARLES WILLIAM SIEMENS, of Queen Anne's Gate, Westminster, England, have invented an Improvement in Electric Lamps; and I do hereby declare that the following description, taken in connection with the accompanying drawings, hereinafter referred to, forms a full and exact specification of the same, wherein I have set forth the nature and principles of my said improvement, by which my invention may be distinguished from others of a similar class, together with such parts as I claim and desire to secure by Letters Patent—that is to say:

According to one part of my present invention, I cause the automatic advance or feed of a stick or tube of carbon forming the one pole of an electric lamp toward the other pole to be determined by the heat produced by the electric arc. A thin strip of zinc or other fusible metal is fixed in a longitudinal groove in the carbon rod or cylinder, so as to project slightly from its surface, the projecting edge of which strip bears against the stop on the carbon-holder, so that as it is melted at such point by the heat from the electric arc the carbon will be permitted to advance. By this arrangement the distance from the point of arrest to the end of the carbons will be practically a constant quantity, and consequently the gradual and uniform advance of the carbon will be effected without clock-work or mechanical regulators.

In order to provide for an uninterrupted feed of the carbon pole while the lamp is in operation, I fix on the end of each separate carbon rod a bead of gum or saccharine matter, which, in approaching the point of combustion, becomes heated so as to be first fused and then carbonized, so as to form a junction between the end of the rod and the contiguous end of the next following one.

The lamp may either be provided with two carbon poles, regulated as above described, or the negative pole may consist of a rod of steel or iron, which, in a similar manner to the carbon pole, is fed forward by spring-power or gravity against a stop as the end thereof is melted and consumed by the voltaic arc. The stop in this case consists of a hollow tubular holder of copper, through which water is made to circulate, so as to be maintained cool. The tube through which the iron or steel rod is fed is large enough to allow the rod to pass freely, but at or near the end which is presented to the other pole it is slightly reduced in diameter, so as to act as a stop. The electric arc is found to concentrate upon the end of the rod in preference to the surrounding cooled copper holder, and the extreme end of the rod being thus intensely heated it softens and yields to the pressure urging it forward, and thus, like the carbon pole, it is advanced in the measure of its consumption, which proceeds at a comparatively slow rate. The vapor given off by the burning metal is found to give definition and great brilliancy to the electric arc, and in order still further to add color and brilliancy to the flame, I in some cases make the iron or steel pole tubular, and fill it with tightly-rammed strontia, lime, manganese, or other earthy matter that will burn away with the iron.

The iron or steel rod or tube may also be provided with either a complete coating or a projecting fillet of zinc, similar to the carbon pole, which coating or fillet will bear against the tubular holder, and in melting away will allow the iron or steel rod or tube to be advanced through the holder, the contracted portion of which will in this case be large enough to allow the rod or tube to pass through.

The distance of the two poles, and consequently the length of the electric arc, is so regulated that the difference of potential between the two poles is practically constant. For this purpose the holder of either the positive or the negative pole is attached to a lever that is acted upon by a thin wire or strip of metal of high resistance, so arranged in connection with the circuit that when the normal distance of the poles is maintained an inappreciable quantity of the current will pass through such wire or strip of metal without passing through the lamp; but when, through the increase of distance of the poles, the resistance of the electric arc is also increased, a greater portion of the current will pass through the thin wire or metal strip, which, in acting upon the lever, will cause this to move the pole carried thereby nearer to the other pole, and thus restore the normal length of arc and dif-

ference of potential of the two poles. The wire or metal strip, in a stretched condition, is connected at one end or an intermediate point of its length by an insulated connection to the lever, so that on an increase of the quantity of the electric current passing through it it will become expanded by the increase of heat, and will allow the lever to move so as to approach the poles, while on a decrease of the current passing through it, consequent on a too near approach of the carbons, it will, in contracting, move the lever so as to separate the poles.

On the accompanying drawings, Figure 1 shows a vertical section of one modification of my before-described improved lamp. Fig. 2 shows a plan of the same. Fig. 3 shows a cross-section on line X X, Fig. 1.

The carbon rod A, constituting the positive pole, is carried in the iron tubular holder B, supported by the levers C, having their fulcra on an insulated bracket, D′, of the framing D, to which bracket the one terminal, E, of the circuit-wire is connected. The other ends of the levers C carry an ebonite roller, F, over which is led the loop of a thin metal wire or band, G, of high resistance, arranged as follows: The one end of the wire is fixed to an insulated bracket, H, and is there put in electrical connection by means of a wire, G′, with the circuit-wire E. From the bracket H the wire passes down and round the ebonite roller I, and thence alternately up and down consecutively over the ebonite rollers I′ I^2 I^3 I^4, then over the roller F on the lever C, and thence consecutively down and up over the ebonite rollers I^5 I^6 I^7 I^8 I^9 to the small barrel J in electrical connection with the casing D, to which barrel the other end of the wire is attached, and which can be rotated by the tangent-screw J′, so as to wind up the end of the wire G more or less round it. The rollers I to I^9 being carried in fixed bearings respectively at the upper and lower end of the casing D, it will be seen that the winding of the wire upon the barrel J will cause the end of the double lever C to be drawn more or less downward, thus adjusting the position of the tube B and carbon pole A relatively to the negative pole K, and also that any expansion or contraction of the wire, due to variations in its temperature, will cause the end of the levers carrying the roller F to move up or down, and consequently will move the pole A nearer to or farther from the pole K. The wire G is maintained in a stretched condition by the weight of the carbon rods A and holder B acting at the end of the levers C, and also by a helical spring, L, bearing against the fixed guide D^2 for the holder, and pressing the lower end of the latter downward, which spring acts as a damper to prevent any jerking motion of the holder B when being moved up or down by the action of the wire G.

The carbon rods A, which fit loosely in the tubular holder B, have a longitudinal groove, in which is fixed a thin strip of zinc or other fusible metal, M, which at the lower end bears against a stop in the corresponding longitudinal slot of the tubular holder. This stop is at such a height above the extreme end of the pole that the heat conducted from the electric arc through the carbon to such point will be just sufficient to fuse the end of the zinc strip, which, in being thus gradually consumed, will allow the carbon to descend gradually in proportion as it burns away. The upper end of the carbon rod is recessed, as shown at A′, and in such recess is a bead of gum or saccharine matter, so that when it, together with the correspondingly-formed end of the following carbon, A^2, which fits closely thereon, arrives near the luminous arc the heat will first fuse and then carbonize the gum, thus forming a carbonaceous junction between the two rods, and insuring an uninterrupted feed thereof.

The lower end of the tubular holder B is provided with a shield, B′, with porcelain or other refractory coating, for protecting the spring L and zinc strip M from the radiated heat of the electric arc. The negative pole K consists in this case of an iron rod which passes up through the hollow tubular copper holder N, through which water is made to circulate from the tubular casing D, constituting a reservoir, the cold water passing from the bottom of the casing through the hollow arm D^3 to the lower end of N, and the heated water ascending from the upper end of the latter through the tube D^4 to the upper end of the casing D. The latter has a considerable capacity compared with the holder N, and offers very extended surface for radiating the heat taken up by the water, so that by the circulation a constant supply of sufficiently-cooled water is made to flow into the holder. The iron rod passes freely through the holder to the upper end, where the opening of the latter is slightly restricted by a platinum collar, so that, as before stated, the upper end of the rod, softened by the intense heat of the electric arc, can just squeeze itself upward through the holder as its extreme end is consumed away, the upward motion being afforded by a coiled spring, O, carried by the arm D^3, acting by means of a wire and hook, O′, on the lower end of the rod K.

The action of the lamp is as follows: The electric current passes from the circuit-wire E through lever C and holder B to the carbon pole A, thence forming the electric arc to the metal pole K, and through the tubular holder N, pipes D^3 D^4, and casing D to the other terminal, P. So long as the distance of the carbon pole from the metal pole is such as to give the requisite difference of electric potential between the two nearly the whole of the current will pass in the direction indicated, a small quantity, however, passing through the wire G′ and thin stretched wire G of high resistance to the casing D and terminal P without passing through the lamp. By such pas-

sage of the current the wire G becomes heated, and consequently expanded to a certain extent, and its length is so regulated by the barrel J and screw J′ that with such normal degree of expansion it will hold the lever C and carbon pole in the normal position required. On a decrease of difference of potential between the two poles occurring, owing to a too near approach of the carbon pole, more of the current will pass through them and less through the resistance-wire or by-pass G, and this, in contracting, will move the lever C and holder B, so as to separate the carbon pole from the metal pole to such an extent as to restore the normal difference of potential. If, on the other hand, the carbon pole be removed too far from the metal pole, so as to increase the difference of potential above the normal degree, less of the current will pass through the poles and more through the by-pass G, and the wire becoming heated, and consequently expanded beyond the normal degree, will allow the lever C and carbon pole to descend, so as to restore the normal difference of potential. If the electric arc should be blown out or cease from any cause, then the by-pass wire, being the only channel for the current, will become rapidly heated and expanded to such an extent as to allow the carbon pole to descend until it touches the metal pole. The electric arc will instantly be re-established, and the electric potential having now become a minimum, owing to the proximity of the poles, the by-pass wire will cool and contract until the normal length of arc has been re-established.

The wire G is made of considerable length, as shown, so that even a slight increase of temperature will give an appreciable elongation for the purposes of regulation, as above described, the motion being further multiplied by the difference in length of the two ends of the levers C. The by-pass wire or metal strip is contained within the hollow lamp-casing D, maintained at a practically uniform temperature by the circulating water, so that the wire is not affected by sudden changes of temperature of the surrounding atmosphere. The casing is supplied with water from time to time through the small side compartment, D^5.

Having thus described the nature of my invention and in what manner the same is to be performed, I wish it to be understood that I do not claim the combination of two coils, one of low resistance in the lamp-circuit and one of high resistance, external to such circuit, operating jointly for the regulation of the distance of the poles of the lamp, as described in the specification of English patents granted to me as communications from F. v. Hefner Alteneck on the 4th December, 1878, No. 4,949, and 1st July, 1879, No. 2,652.

I am also aware that the extreme ends of the carbon poles of an electric lamp have been brought in contact with a fixed point—such as a block of lime—and have been automatically fed forward as such extreme ends were consumed, and I do not claim such an arrangement as my invention; but

I claim—

1. A carbon rod constituting the pole of an electric lamp provided at its rear end with a bead of gum or saccharine matter, which becomes carbonized by the heat of the electric arc, so as to form a carbonaceous joint between the end of the rod and the contiguous end of the next one.

2. An iron or steel rod constituting the negative pole of an electric lamp, in combination with a holder containing a cooling-liquid and a spring combined, as described, with said rod for the purpose of feeding it forward, as and for the purposes described.

3. In an electric lamp, the combination of the carbon pole A, holder B, lever C, thin metal strip or wire G, stretched over insulating-rollers F I, one end of the said wire or metal strip being in electrical connection with the one circuit-terminal, E, and the other end in connection with the other circuit-terminal, P, of the lamp, substantially as herein described with reference to the accompanying drawings.

4. In an electric lamp, the combination of the iron or steel negative pole K, tubular holder N, containing a cooling-liquid, tubular arms D^3 D^4, and lamp-casing D, constituting a water-reservoir, with extended heat-radiating surfaces, operating substantially as herein described.

5. In an electric lamp, the combination of the tubular water-reservoir containing within it the stretched thin metal strip or wire G, constituting a by-pass for the electric current, so that such metal strip or wire is protected from sudden changes of temperature of the surrounding atmosphere.

6. A reciprocating carbon-holder open at the upper end to permit the insertion of additional carbons to follow up the preceding one, in combination with a carbon rod provided at its rear end with matter which becomes carbonized by the heat of the electric arc, whereby the carbon is rendered continuous without interrupting the light.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 8th day of August, 1879.

C. WILLIAM SIEMENS.

Witnesses:

J. D. LACY,

Clerk to Ridgway & Sons, 2 Waterloo Place, Pall Mall, S. W.

CHARLES E. P. WILSON,

Notary's Clerk, 2 Waterloo Place, Pall Mall, London, S. W.