(No Model.)

T. A. EDISON.

INCANDESCING ELECTRIC LAMP.

No. 389,369. Patented Sept. 11, 1888.

Fig. 1.

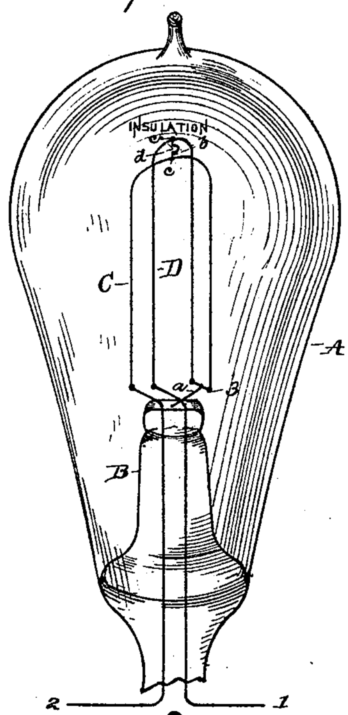
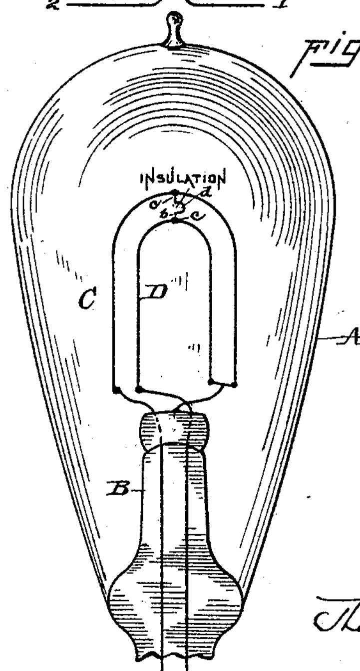


Fig. 2.



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THOMAS A. EDISON, OF LLEWELLYN PARK, NEW JERSEY.

INCANDESCING ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 389,369, dated September 11, 1888.

Application filed February 6, 1888. Serial No. 263,136. (No model.)

To all whom it may concern:

Be it known I, THOMAS A. EDISON, a citizen of the United States, residing at Llewellyn Park, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Incandescing Electric Lamps, (Case No. 759,) of which the following is a specification.

In an application for a patent filed by me February 5, 1880, (Serial No. 202,180,) is described an incandescing electric lamp having two or more carbon filaments connected in series, whereby a lamp of exceedingly-high resistance is obtained, necessitating the employment of a high electro-motive force, and consequently enabling a great saving to be made in the cost of conductors for carrying the current in a multiple-arc system of electric lighting. As described in the application referred to, I am able by the use of two or more filaments of proportionately smaller cross-section to maintain the same radiating-surface as in lamps having but one filament, and yet to increase largely the resistance, while the normal candle-power of the lamp remains the same. To do this requires that the filament should be exceedingly fine or small in cross-section. Such fine filaments have great flexibility and are more readily deflected or distorted than filaments of greater cross-section.

It is now well-known that there is a very considerable attraction between the electrified surfaces of the glass globe and the filament, such parts being, of course, charged statically in the opposite way. On the other hand, when two filaments are placed in the same globe, the mutual repulsion and attraction of the currents traversing the filaments tends also to displace the filaments. The result of these disturbing influences upon exceedingly-fine filaments may cause them to touch the walls of the globe or each other, and thus to destroy the lamp.

The object I have in view is to produce a multiple-carbon lamp such as is described in my application referred to which will have the advantage of an exceedingly-high resistance at the same time that the filaments will be maintained in their proper relation to each other and to the walls of the inclosing-globe.

In carrying out my invention I connect the fine carbon filaments at one or more points between their ends by a sustaining-bridge of insulating material. This bridge, in order that it may cast the minimum shadow, I prefer to make of a thread or filament of a proper insulating material. For this purpose I may use a filament of pure silica melted by the oxyhydrogen blow-pipe, or I may use the most infusible Bohemian glass. The filament of insulating material is connected at its ends with the carbon filaments by means of a carbon paste, which, by enlarging the radiating-surfaces at the points of connection, reduces the temperature of the carbon filaments at those points and prevents the fusion of the bridge. This glass filamentary bridge I prefer to place midway between the ends of the carbon filaments. In order that the filaments may be free to contact and expand, the bridge of insulating material is also made elastic, which may be accomplished by bending the insulating-filament into a small loop, or by coiling, or by otherwise forming it so that it can yield lengthwise.

The carbon filaments I prefer to make of an arched or looped form and straight, as distinguished from being coiled. I prefer to employ two carbon filaments in each lamp, and in order to neutralize as far as possible the attraction and repulsion between the currents I prefer to arrange such carbon filaments at right angles, although they may be placed side by side, or one over the other and in the same plane. In placing the filaments at right angles one filament is made somewhat longer than the other, so that the loop formed by it will be longer. Where one filament is placed over the other in the same plane, the outside filament will necessarily, also, be longer than the inside one. It is essential of course, whether the carbon filaments are of the same or of different lengths, that they should have the same resistance per unit of radiating-surface, so that with a definite current the same degree of incandescence will be produced at every point throughout the length of both filaments. This is accomplished by making the filaments of the same material, having a uniform density throughout, and by making them of the same shape and of the same cross-sectional area, so that the filaments will have the same resistance per unit of length, although the total resistance of the longer filament (if one filament is longer than the other) will be greater than the total resistance of the shorter filament.

The use of straight or simple filaments as distinguished from coiled filaments has an advantage, since when the filament is coiled it is unequally heated by radiation from one spiral to another, and, in addition, the straight filaments can be more readily and more perfectly carbonized than the coiled filaments.

In the accompanying drawings, forming a part hereof, Figure 1 is a perspective view of a lamp having the preferred arrangement and embodying my invention, and Fig. 2 is an elevation of a lamp with a modified arrangement of the carbons.

A is the glass globe of the lamp, and B is the glass support or inside part. As will be well understood, the glass support B, after having the carbons mounted thereon, is inserted in the globe A and is fused thereto, and the globe is then exhausted and sealed, forming a vacuum-chamber entirely of glass.

C D are the carbon filaments, the filament C being slightly longer than the filament D. These filaments are straight or simple filaments, as distinguished from coiled filaments, and are made in the form of loops. The leading-in wires 1 2 of the lamp pass through and are sealed into the glass support B. One end of the filament D is connected to the wire 1, and one end of the carbon filament C is connected to the wire 2. The other ends of the carbon filaments are connected by a short bridge-wire, 3, from which a supporting-wire, *a*, runs down to the part B of the lamp, and is stuck to it by softening the glass. The course of the current through the lamp is then by wire 1 to the carbon D, through this carbon to the bridge-wire 3, to carbon C, through carbon C to the wire 2, and out of the lamp. Thus the carbons are connected in series, and the advantage is obtained of the high resistance due to the bringing of the total length of the two carbons into series.

At the center of the carbon loops C D is a bridge, *b*, of insulating material. This is preferably a filament or thread of glass or other form of silica, which is connected to the carbon filaments at its ends by small quantities of carbon paste, *c*, the effect of which is to reduce the temperature at these points and prevent the fusion of the filamentary bridge of insulating material. The filamentary bridge *b* is bent into a loop, *d*, at its center, so as to be capable of yielding lengthwise.

By the preferred arrangement shown in Fig. 1 the carbon loops are placed at right angles to each other, although other arrangements may be employed—such, for instance, as that shown in Fig. 2, in which the carbon filaments are located in the same plane, one being outside the other.

What I claim as my invention is—

1. In an incandescing electric lamp, the combination of two carbon filaments located, within the same lamp-globe and having circuit-connections at their ends, with a bridge of insulating material connecting such filaments at a point between their ends, substantially as set forth.

2. In an incandescing electric lamp, the combination of two carbon filaments connected in series and located within the same globe, with a bridge of insulating material connecting such carbon filaments at a point between their ends, substantially as set forth.

3. In an incandescing electric lamp, the combination of two uncoiled or straight carbon filaments located within the same globe and having circuit-connections at their ends, with a bridge of insulating material connecting such filaments at a point between their ends, substantially as set forth.

4. In an incandescing electric lamp, the combination of two loop shaped carbon filaments arranged at right angles to each other and having circuit-connections at their ends, with a bridge of insulating material connecting such carbon filaments at a point between their ends, substantially as set forth.

5. In an incandescing electric lamp, the combination of two carbon filaments, each connected at one end with a leading-in wire of the lamp, a conducting-connection between the other ends of the carbon filaments, a support from this conducting-connection to the glass-work of the lamp, and a bridge of insulating material connecting such filaments at a point between their ends, substantially as set forth.

6. In an incandescing electric lamp, the combination, with two carbon filaments, of a filamentary bridge of insulating material connecting such filaments at a point between their ends, substantially as set forth.

7. In an incandescing electric lamp, the combination, with two carbon filaments, of a yielding bridge of insulating material connecting such filaments at a point between their ends, substantially as set forth.

8. In an incandescing electric lamp, the combination, with two carbon filaments, of a bridge of insulating material connecting such filaments at a point between their ends, the mass of carbon being enlarged at the ends of such bridge to reduce the temperature of the filaments at those points, substantially as set forth.

9. In an incandescing electric lamp, the combination, with two carbon filaments, of a bridge of insulating material connecting such filaments at a point between their ends and secured to the filaments by carbon paste, substantially as set forth.

10. In an incandescing electric lamp, the combination, with two carbon filaments, of a filamentary bridge of glass secured to such filaments at a point between their ends by means of carbon paste and bent so as to be capable of yielding to permit the expansion and contraction of the carbon filaments, substantially as set forth.

This specification signed and witnessed this 2d day of February, 1888.

THOS. A. EDISON.

Witnesses:

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E. C. ROWLAND.