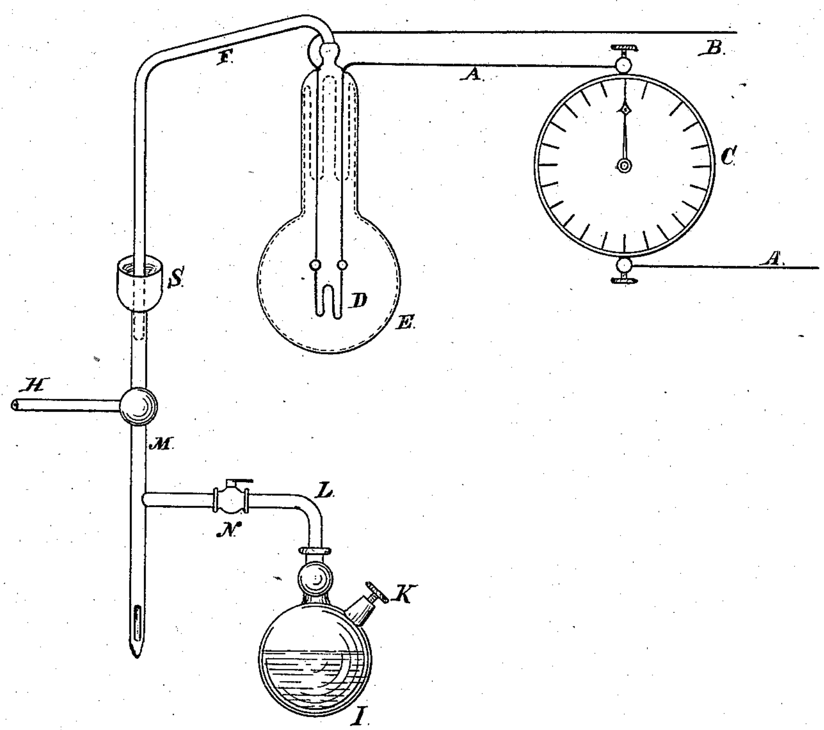
(No Model.)

H. S. MAXIM.

MODE OF MAKING ELECTRIC LAMPS AND CARBONS FOR THE SAME.

No. 261,741. Patented July 25, 1882.



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UNITED STATES PATENT OFFICE.

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MODE OF MAKING ELECTRIC LAMPS AND CARBONS FOR THE SAME.

SPECIFICATION forming part of Letters Patent No. 261,741, dated July 25, 1882.

Application filed February 14, 1881. (No model.)

To all whom it may concern:

Be it known that I, HIRAM S. MAXIM, of the city of Brooklyn, in the county of Kings and State of New York, have invented a new and useful Mode of Making Electric Lamps and Carbons for the Same, of which the following is a specification.

This invention relates primarily to electric lamps of the class commonly known as "incandescent," and particularly to those in which the light-giving conductor is of carbon.

The object of the invention, hereinafter fully explained, is to provide a mode of preparing the conductors, whereby they can be made more dense, homogeneous, and elastic than heretofore, with a resulting increase of durability and greater uniformity in their relative conductivity.

The carbon conductors heretofore used for electric lamps have been made in various ways. Sometimes they have been prepared by simply shaping pieces of carbon deposit taken from the interior of gas-retorts; sometimes, also, by comminuting such carbon and molding it under great pressure, both with and without other substances intermixed into the required form. Then, again, they have been made by shaping some fibrous material into the desired form and subsequently carbonizing it. The conductors made by these several modes are more or less imperfect. Those cut from the deposits of the gas-retort, while in the main hard, are not of uniform structure and are liable to develop flaws, while those produced artificially are not only far from being uniform in structure, but also are exceedingly porous. The existence of interstices between the fibers or particles of the carbons is a recognized element of weakness—among other reasons, because of the formation of minute voltaic arcs across such spaces, whereby the carbon is gradually eaten away or consumed. A further difficulty attending the manufacture of electric carbons by any of these methods is the impossibility practically of making them of a uniform standard resistance, which is a matter of great importance where it is desired to produce a large number of lamps of uniform illuminating capacity.

Another mode of preparing carbons for electric lamps has been to deposit carbon upon some solid conductor by electrically heating it while immersed in a gaseous or a liquid hydrocarbon at atmospheric pressure. The difficulty practically experienced in treating the conductors by this method is that if the temperature be carried high enough to produce a carbon deposit otherwise of good quality, the dissociation of the hydrocarbon goes on so very rapidly that the deposition of the carbon takes place almost entirely upon the exterior of the conductor and does not sufficiently penetrate the interstices of the interior, and the carbon thus deposited will be comparatively soft, irregular, and easily broken. On the other hand, if the carbon to be treated be subjected to an intense heat in the presence of a highly-attenuated carbonaceous gas so constituted as to deposit its carbon under high heat, the dissociation of such a medium will take place much more slowly than with a gas at full atmospheric pressure, and the deposition will begin and will proceed the most rapidly at the interior of the conductor, that portion being the soonest and the most highly heated. In this way the interstices will become filled with a fine deposit of carbon, which will firmly cement the fibers and particles of the original conductor into a much more dense, homogeneous, and elastic mass, the exterior of which, also, as the operation proceeds, will be materially evened up and rounded off. For the best results the occluded gases should be expelled from the conductor as completely as possible before the treatment with the carbonaceous gas begins.

The best way yet ascertained of carrying out this invention is to place the carbon to be treated in an exhausted receiver provided with proper electrical connections. Then pass through it a current of electricity to expel the occluded air and gases, which, when released, are to be pumped from the receiver, after which admit a pure hydrocarbon vapor or other carbonaceous gas, which will deposit its carbon at a high temperature of a pressure equal to about one inch of mercury, more or less, and increase the current on the conductor, carrying the temperature up to a very high point, the time of the exposure being dependent mainly on the thickness of the conductor and the strength of the current. By arresting the operation at the proper point it will be found that the density of the carbon conductor has been greatly increased, with also a large increase in its strength and elasticity, and, if desired, without material change in volume. Its conductivity, although somewhat increased, still remains at a low point and its resistance correspondingly high.

By the use of a galvanometer introduced into the circuit leading to the receiver the resistance of the carbon conductor is indicated at all stages of the process, falling gradually as the deposition of the carbon proceeds. The current is to be shut off when the needle of the galvanometer reaches the point that corresponds to the standard resistance. By "galvanometer" in this connection is meant any instrument for indicating the resistance of the circuit. This feature in the process is deemed of much importance, since by such use of the galvanometer any desired number of carbons can be made of substantially uniform resistance. Of course it is to be understood that the carbons to be thus treated are preferably made, in the first instance, as nearly uniform in the matter of size as practicable by the usual methods, and are of higher resistance than the standard required, the galvanometer method of treatment being intended primarily for the correction of such inequalities as are incident to conductors made in the usual way. In conductors of the same size equality of resistance insures equality of illuminating power. The current used should be of a constant "potential."

When the deposition of the carbon has been arrested, if the receiver is to form the globe of the finished lamp, the excess of gas is to be pumped out of the receiver, which is then to be sealed up, and the lamp will be ready for use. Conductors thus prepared may also be transferred from the receiver and afterward placed each in its own globe inclosing a very high vacuum, or, preferably, a very highly-attenuated atmosphere of some carbonaceous vapor.

It will readily be understood that in working the foregoing process the higher the attenuation of the gas used in the receiver the greater will be the temperature required to effect the deposition of the carbon, and it is believed that the fineness of the deposit, and thus the excellence of the product, varies in a measure as the heat to which the conductor is subjected.

The most available gases for the purpose are the vapors of gasoline, marsh-gas, olefiant gas, or ordinary coal-gas. A gas composed of nitrogen and carbon also may be used with advantage, such as cyanogen, as derived from cyanide of mercury or other sources. A preparation of sulphur and carbon also may be used, such as carbon bisulphide.

A good form of apparatus for working the foregoing process is shown in the accompanying drawing, being, with the exception of the galvanometer, substantially what is shown in Letters Patent No. 230,954, granted to Hiram S. Maxim, assignor to S. D. Schuyler, August 10, 1880.

In this drawing, A and B are the wires leading to the carbon D, inclosed in the gas-receiver E, and C is a galvanometer, of any ordinary construction, through which one of these wires passes. I is a vessel containing a volatile hydrocarbon, and H is a pipe connecting with the air-pump. (Not shown.) The interior of the receiver E is connected with the air-pump through the pipes F and H, and by operating the cock M communication may be made between the vessel I and the receiver E through the pipes L, M, and F.

From the preceding general description of the process it will readily be understood how this apparatus is to be used. After exhausting the air and occluded gases from the receiver as completely as possible, an attenuated atmosphere of carbonaceous vapor is admitted, after which the electric current is passed through the carbon conductor D. The deposition upon this conductor of carbon derived from the dissociation of the gas in the receiver gradually reduces its resistance with a corresponding change in its illuminating power. The current remaining of a constant potential the needle of the galvanometer will indicate when the resistance has been brought to the proper point to produce the standard illuminating power. When this point is reached the operation is to be arrested.

As above indicated, the heating of the conductors is effected by the use of the electric current, and for the purpose of securing the thorough deposition of the carbon on the interior parts of the conductor, as well as securing uniformity of results, this is undoubtedly the best mode. Where, however, uniformity of results is not deemed essential any other available mode of heating may be used. An intense heat may be obtained by a properly-directed beam of heat condensed by a suitable lens or reflector.

The foregoing process, while designed primarily for the manufacture of continuous carbons for incandescent lamps, may also be used with advantage in preparing the carbon electrodes to be used in voltaic-arc lights, as also in the preparation of carbons to be used otherwise for electrical purposes.

The invention, again, is not necessarily limited to the treatment, in manner above described, of conductors of carbon, as conductors of other material may be greatly improved by being subjected to the same process.

I do not here claim equalizing the illuminating power of the carbonized conductors of incandescent lamps by electrically heating said conductors in the presence of a hydrocarbon or equivalent vapor until their electrical resistance and illuminating power for a definite intensity of current have been brought to a predetermined standard. This feature forms the subject-matter of another application in my name for Letters Patent now pending in the United States Patent Office.

What is claimed as new is—

1. The above-described process of preparing carbons for electric lamps, which consists of, first, removing the occluded gases by means of heat and the air-pump, then subjecting the conductors to a high heat in an attenuated atmosphere of hydrocarbon vapor or other equivalent carbonaceous gas, and afterward exhausting the surplus gases, substantially as set forth.

2. In the preparation of electric carbons, the cementing and consolidation of the conductors by the deposition of pure carbon from an attenuated atmosphere of hydrocarbon vapor or other equivalent carbonaceous gas, substantially as and for the purpose set forth.

3. The above-described process of regulating the resistance of electric carbons, which consists in heating them in a hydrocarbon or equivalent gas by means of an electric current until their resistance is brought to the required standard, as indicated by a galvanometer acted on by the same current.

4. The hereinbefore-described method of making carbon conductors for electric lamps of a standard resistance, which consists in preparing such conductors of an approximately-uniform size and of a higher than the standard resistance and then subjecting them to the action of an electric current in a hydrocarbon or equivalent gas until the resistance is reduced to the required point, substantially as set forth.

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