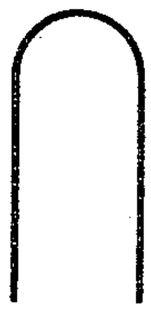
(No Model.)

L. K. BÖHM.

INCANDESCENT LAMP FILAMENT.

No. 464,719. Patented Dec. 8, 1891.

An incandescing lamp filament of Carbonizable material impregnated with carbonates of calcium or magnesium, and then carbonized.



Witnesses.
Jas. J. Maloney.
H. J. Livermore.

Inventor,
Ludwig K. Böhm
by Jos. P. Livermore
Att'y.

UNITED STATES PATENT OFFICE.

LUDWIG K. BÖHM, OF NEW YORK, N. Y.

INCANDESCENT-LAMP FILAMENT.

SPECIFICATION forming part of Letters Patent No. 464,719, dated December 8, 1891.

Application filed January 2, 1890. Serial No. 335,652. (No model.)

To all whom it may concern:

Be it known that I, LUDWIG K. BÖHM, of New York, county of New York, State of New York, have invented an Improvement in Processes of Making Filaments for Electric Lamps, of which the following description, in connection with the accompanying drawing, is a specification.

The invention relates to a process of making filaments for incandescent or glow lamps of high or low resistance.

Heretofore the filaments used to emit light by incandescence, when heated by the passage of the current, have consisted of carbon, and it has always been the aim to produce carbon of the utmost purity for such filaments. It has also been proposed to make filaments by soaking carbonaceous materials in solutions of metal salts, such as chlorides and nitrates, and then carbonizing the same; but such process is defective owing to the fact that in certain phases of the process strong mineral acids—as, for example, hydrochloric and nitric acid—are set at liberty, which are highly injurious to the filament and are likely to render the filament worthless for practical use in glow-lamps. By other proposed processes filaments have been made consisting of carbon and a metal—as, for example, aluminium and tungsten. In other processes a filament is first carbonized in the usual manner and is subsequently coated by the heating action of an electric current passing through it, in which case the coating is likely to peel off or break away from the filament when the current is passed through it after the filament has been removed from the liquid in which the coating is done.

The object of the present invention is to produce a filament of substantially different composition from those heretofore used, said filament consisting of carbon and an oxide of the earth, alkali metals, preferably calcium or magnesium oxide; and the invention consists in a filament having the composition stated and also in the process of making such filament, in which process no injurious decomposition products are formed, such as the strong mineral oxides above mentioned; but on the other hand the decomposition products are only such as are produced in the ordinary process of carbonizing the materials commonly used in making filaments wholly of carbon. The filament thus produced is a composition of carbon, a conductive material, and calcium oxide or magnesium oxide, which are substantially non-conducting and highly refractory materials, and when heated to incandescence by the passage of the current constitute a substantial part of the light-producing agent. The conducting and non-conducting refractory substances are thoroughly combined and united so as to form a compound having a sufficient conductivity to convey the current, but of far higher resistance than the conductive material of the compound alone, and also having far greater light-emitting capacity.

The property of calcium oxide and magnesium oxide to admit light when heated to incandescence is well known, this being the substance used in the well-known Drummond light, in which such substances are heated by the oxyhydrogen blow-pipe flame, and plaster-of-paris has been employed in a form of arc light typified by the well-known Jablochkoff candle, in which plaster-of-paris is employed as an insulator to electrically separate the carbon electrodes between which the arc is maintained and enhance the light by its incandescence produced by the heat of the current passing over it from one to the other carbon terminal of the candle. In such use of plaster-of-paris it operates as a substantial non-conductor or insulator and requires the establishment of an electric arc to afford passage of the current between the carbon conducting portions separated by it.

In the present invention, however, the conducting and non-conducting substances are combined in a substantially homogeneous compound which has sufficient conductivity, but is of higher resistance than the conductive material alone, and the proportions of the material in the compound may be varied so as to produce any desired conductivity in a filament or conductor of any required sectional area, so that high-resistance filaments may be made relatively short and thick instead of requiring long slender filaments to produce a high resistance to the current, as is the case when the filaments are composed

of substantially pure carbon or conductive material.

In order to produce a carbon filament in accordance with this invcation composed of conductive and non-conductive substances properly combined to afford an incandescent conductor of the required resistance, it is necessary to have the non-conducting refractory substance evenly distributed throughout the filament, and when the filament is made by carbonizing the conductive portion it is indispensable that the products of the decomposition arising during the process of carbonization should not injure the filament as is the case in processes in which the metal salts of strong mineral acids are used, in which processes the said acids are set at liberty, or by decomposition free chlorine is produced and the said acids or chlorine attack and injure the material of the filaments.

The requirements for making a compound filament without injurious chemical action in the process of chemical action are fulfilled by the process forming the subject of this invention, in which the products of decomposition that arise during the process are entirely harmless, being the same as produced in carbonizing the fiber forming the basis of the filament in the usual process of making carbon filaments.

The compound filaments forming the subject of this invention are produced in the following manner: Freshly precipitated calcium carbonate ($CaCO_3$) immediately after precipitation is dissolved by the passage of a strong current of carbonic-acid gas (CO_2) through it and produces soluble bicarbonate of calcium $(CO_3H)2Ca$.

$$CaCO_3+CO_2+H_2O=(CO_3H)2Ca.$$

Then the thread that is to form the conducting portion of the filament, and which may be of silk, linen, cotton, or other suitable material capable of carbonization, linen being the best known to me for this purpose, is soaked in the solution of bicarbonate of calcium and dried, the soaking and drying operation being repeated, if need be. In drying the bicarbonate of calcium is decomposed carbonic-acid gas (CO_2) and escaping into the air, and the calcium carbonate ($CaCO_3$) is left as fine powder uniformly distributed throughout the thread.

$$(CO_3H)2Ca=CO_2+H_2O+CaCO_3.$$

The thread is then carbonized in any usual manner, and the heat employed in this operation should be high enough to decompose the calcium carbonate, throwing off carbonic-acid gas (CO_2) and leaving in the filament calcium oxide, (CaO,) the chemical reaction being indicated by the following formula: $CO_3Ca=CO_2+CaO$, and owing to the presence of a large excess of carbon the carbon dioxide is decomposed, attacking the excessive carbon and forming carbon oxide $-CO_2+C=2CO$. As a result of this decomposition the calcium oxide remains in the filament and constitutes the non-conducting refractory portion of the filament, which constitutes the main light-emitting agent when the filament is heated to incandescence by the passage of the current through it. Thus a compound but homogeneous filament is produced by the carbonizing process, which is substantially different from a filament containing the same materials, but made from first forming the filament of carbon and subsequently applying to the carbonized filament other materials to render it more refractory, such processes resulting in a non-homogeneous filament which is likely to break or separate into its component parts in its subsequent operation in the lamp. If the heat of the carbonizing-furnace is not sufficient to fully decompose the calcium carbonate, as above described, this will be effected by the heat of the electric current while the lamp is in the process of manufacture. When desired, a larger portion of the refractory material may be embodied in the filament than can be introduced therein by soaking in soluble bicarbonate of calcium. This can be done by adding to the solution of bicarbonate of calcium some of the freshly-precipitated calcium carbonate which is kept in suspension in the solution by adding gum-arabic to the solution and by passing a constant current of carbonic-acid gas through the solution. It is especially desirable to do this in the manufacture of filaments for series lamps, which are of comparatively low resistance and are shorter and thicker than high-resistance filaments. Gum-arabic used as thus stated dries when the thread is dried, and serves to retain the calcium carbonate in the thread while being handled in the process of manufacture. The products given off in the decomposition of the bicarbonate and carbonate — namely, vapor of water and carbonic oxide and carbonic-acid gas oxide—obviously produce no injurious effect upon the material of the filament, since they are substantially the same as the products given off in the ordinary process of carbonizing filaments.

The herein-described materials may be compounded in various proportions, it being possible to make a homogeneous compound of carbon with a very large or very small proportion of calcium or magnesium oxide, and the proper proportions for any given filament may be determined by experiment, it being understood that other things being equal the resistance is greater the larger proportion of calcium or magnesium oxide incorporated in the compound. The drawing represents a filament composed of the conducting and non-conducting materials, and made by the process hereinbefore described, embodying the invention.

I claim—

1. The process of making filaments for incandescent lamps, consisting of impregnating carbonizable material with carbonates of cal-

cium or magnesium and carbonizing the same, whereby a filament is produced composed of carbon and oxide of calcium or magnesium, substantially as described.

2. The herein-described improvement in the art or method of making filaments for incandescent lamps, which consists in soaking carbonizable material in a solution of bicarbonate of calcium or magnesium and subsequently carbonizing the same, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

LUDWIG K. BÖHM.

Witnesses:
JOS. P. LIVERMORE,
M. E. HILL.