UNITED STATES PATENT OFFICE.

ALEXANDRE DE LODYGUINE, OF PARIS, FRANCE, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, OF PITTSBURG, PENNSYLVANIA.

FILAMENT FOR INCANDESCENT LAMPS.

SPECIFICATION forming part of Letters Patent No. 494,151, dated March 28, 1893.

Application filed September 14, 1888. Serial No. 285,435. (No specimens.)

To all whom it may concern:

Be it known that I, ALEXANDRE DE LODYGUINE, a citizen of Russia, residing at Paris, France, have invented a certain new and useful Improvement in Incandescents for Electric Lamps, (Case No. 223,) of which the following is a specification.

The invention relates particularly to the manufacture of incandescents or filaments of incandescent electric lamps. I make use of any suitable organic substance such as silk, bamboo, thread, piassava, or other organic material capable of receiving the treatment hereinafter mentioned. In practice I have obtained especially good results from the use of silk. The material selected is reduced to the required shape and size in any of the usual ways employed in making the blanks from which such incandescents are generally formed. These blanks, having the required dimensions, are treated in the following manner. The material is first carbonized in any usual, well-known way, and it is then placed in a chamber from which the air is afterward exhausted. A current of electricity is then sent through the filament while *in vacuo*, and this is of such strength as to drive off the occluded gases contained therein. The vacuum pump employed for exhausting the air from the chamber may be kept in operation during this step of the process, if desired. After the filament has been thoroughly freed from the occluded gases, a current is passed through it of sufficient strength to change its character from the original carbonized filament, into the form of coke. This step is carried on *in vacuo*, and in practice it is found that it may be conveniently accomplished in about eight seconds. The strength of current used is as great as the filament will practically bear without breaking. In some instances the two steps may be combined. It is found that by thus coking the filament, its permanent or cold resistance is caused to change, being gradually reduced until it has become approximately the same as the hot resistance of the filament before it was coked. The coking may be stopped at this point, or before it has been reached, if desired, and for certain purposes it is found advantageous to arrest the operation at an intermediate point. When the resistance has reached its lowest point, it is found that it tends to again rise, if this step of the treatment is continued. The filament, after it has been thus electrically coked, may be placed in the bulb and the lamp finished and made ready for use in the usual way; or the coked filament may be further treated by the deposition of carbon upon its surface. This may be accomplished by placing it in a closed vessel charged with a hydrocarbon or other carbonaceous gas, and passing a current of electricity through it sufficient to heat it to such a temperature that the gas will be decomposed and carbon deposited upon the coked core.

On account of the great uniformity of its texture or fiber, silk is found to be especially suited to the purposes of this invention and to the treatment described.

In the manufacture of organic substances as heretofore practiced, it has been customary to carbonize the substance in a closed chamber by the external application of heat, and to then render the resistance uniform by the deposition of carbon by passing an electric current through the incandescent in the presence of a carbonaceous liquid or gas, and finally to drive off the occluded gases by the passage of an electric current through the incandescent after it has been placed in the bulb and while the air is being exhausted therefrom. Such incandescents are found to deteriorate when put in use, such deterioration being evidenced by the gradual diminishing of the candle-power, and the short life of the filament. This reduction of candle-power is due in part to a molecular change which takes place in the filament. It is difficult to determine exactly what change occurs in the structure of the filament, and whether or not it gradually becomes coked by the current employed in actual use; but it is found that its resistance becomes greater after long continued use, and therefore less current passes through it and the efficiency is diminished. The more or less amorphous condition of the filament renders it subject to

more rapid disintegration and destruction, as its particles are more rapidly detached. By changing the filament into a hard carbon or coke, in which form the resistance has been reduced to approximately its lowest point, the molecules become more fixed and permanent and less change in structure and resistance takes place during the use of the lamp. The increased durability of the filament thus obtained may be availed of either by giving it a greater length of life without increasing the efficiency, or by increasing the efficiency without increasing the life, or both the efficiency and the life may be increased. An incidental result of the coking operation is that the occluded gases are driven off thereby. If the filament thus made is subsequently covered by a deposit of carbon as described, the previous driving off of the occluded gases is an advantage because the hard shell of deposited carbon has a tendency to prevent the escape of occluded gases. Moreover the coking of the filament renders the core more homogeneous with the hard deposited shell, and the change in the density and hardness of the carbon renders the filament less liable to occlude gases in subsequent manipulations in the manufacture of the lamp.

I do not limit myself to a filament having an outer shell of deposited carbon, because, while for some reasons such a filament may be preferred, yet my improved filament is of great merit and is a complete and useful article without such outer shell of deposited carbon.

In another application of even date herewith (Case No. 222) I have claimed the method of making incandescents set forth in this specification.

I claim as my invention—

1. As a new article of manufacture, an incandescent for electric lamps composed of electrically-coked organic carbon.

2. As a new article of manufacture, an incandescent for electric lamps composed of a core or body of electrically coked organic carbon, and an external shell of deposited carbon.

3. As a new article of manufacture, an incandescent for electric lamps composed of a core or body of electrically-coked silk carbon, and an external shell of deposited carbon.

In testimony whereof I have hereunto subscribed my name this 9th day of August, A. D. 1888.

ALEXANDRE DE LODYGUINE.

Witnesses:

W. D. UPTEGRAFF,

CHARLES A. TERRY.