UNITED STATES PATENT OFFICE.

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METHOD OF MANUFACTURING FILAMENTS FOR INCANDESCENT LAMPS.

955,461.

No Drawing.

Specification of Letters Patent. Patented Apr. 19, 1910.

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To all whom it may concern:

Be it known that I, JOHN W. HOWELL, a citizen of the United States, residing at Newark, county of Essex, State of New Jersey, have invented certain new and useful Improvements in Methods of Manufacturing Filaments for Incandescent Lamps, of which the following is a specification.

When ordinary treated carbon filaments, sometimes known as "flashed" filaments, are heated or fired for a moderate length of time in a carbon tube or other suitable electric furnace at an extremely high temperature, remarkable changes appear in the filaments thus fired. These changes, among other things, are manifested by alterations in the resistance characteristics of the filaments. Generally speaking, the specific resistance of the filament is very greatly reduced by the firing while its change of resistance with temperature approaches that of a metal and under certain conditions of firing closely approximates that of metal. In other words, the filament may have a positive temperature-resistance coefficient. Generally speaking, the higher the temperature at which the firing is carried out the higher the resistance of the filament when hot as compared with its cold resistance. In any case however, the hot resistance is never as low as fifty per cent. of the cold resistance, and, when the firing is carried on at extreme temperatures, is much higher than the cold resistance.

In firing filaments as above described, bubbles or blisters have been observed on the surface of the completed filament especially when the temperatures reached in the firing have been the most extreme. To obviate this trouble the untreated base filament has first been fired in the electric furnace, and then after treating by heating the filament in the usual manner in a hydro-carbon vapor, has again been subjected to firing in the electric furnace. This process results in the production of filaments with smooth surfaces. The surface, however, is rather dull in appearance instead of shiny as in the case of the blister filaments. The shiny surface is an element which assists in the very high efficiency observed in filaments of the character described and is therefore a very desirable feature. I have found that this shiny surface may be secured in the filaments subjected to the double firing in the furnace by carrying out the following procedure. The base filaments, before coating (or flashing) in the hydro-carbon vapor, are fired in the electric furnace, as before mentioned, but at a temperature below that to which the filaments are subjected in the final firing. It may be that this treatment at reduced temperature drives off a part of the volatile ash to which the bubbles or roughness are due, but leaves a residue which has some action in producing the final shiny surface of the filament. After the base filament has been thus fired it is treated by heating in the usual manner in a hydro-carbon vapor, and is then again fired in the furnace but at a temperature higher than before. This results in a filament having a shiny surface and free from blisters or roughness.

The exact temperature, expressed in degrees, in the furnace in which the firing of the filaments is carried out is not known with certainty. The final treatment, however, is at such a temperature that the interior of the furnace appears to be of a bluish or greenish color. The temperature is above that at which platinum and silica volatilize, and probably between 2300° C. and 3000° C. This temperature limit has been attained by observing an incandescent filament in the line of vision with the furnace interior and equalizing its luminosity with that of the furnace interior. After making this adjustment it is found that this filament is then running at about double its normal voltage. The temperature was calculated from the law of Lummer that at high temperatures the ratio of luminosities of the filament equals the twelfth power of the ratio of the absolute temperatures. The preliminary firing of the base filament is at a temperature lower than this. Assume that 30 amperes is the current used in the primary of the transformer for supplying the furnace when the final firing of the filament takes place, then the proper current for the preliminary treatment would be in the neighborhood of 20 amperes. These figures are, of course, very variable and the specific instances here given are only by way of illustration.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. The method of producing filaments which consists in firing an untreated filament at a high temperature sufficient to

drive off some of the volatile ash in the base, then treating the filament, and then firing the treated filament at a still higher temperature.

2. The method of producing filaments which consists in firing an untreated base filament of carbon to a high temperature, then depositing thereon a coating formed of a reduced hydrocarbon, and then again firing the coated filament but at a very high temperature and higher than that of the previous firing.

3. The method of producing filaments which consists in expelling from an ordinary untreated carbon filament some of the ash present in the carbon after carbonization of the material from which the untreated filament is made, then treating the filament, and then firing the treated filament at an excessively high temperature.

In witness whereof I have hereunto set my hand this 12 day of August, 1904.

JOHN W. HOWELL.

Witnesses:

BENJAMIN B. HULL,

HELEN ORFORD.