UNITED STATES PATENT OFFICE

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MANUFACTURE OF METALLIC FILAMENTS FOR INCANDESCENCE LIGHTING.

1,016,804. Specification of Letters Patent. Patented Feb. 6, 1912.

No Drawing. Application filed April 20, 1910. Serial No. 556,598.

To all whom it may concern:

Be it known that I, CHRISTOPH HEINRICH WEBER, chemist, a citizen of the German Empire, residing at 15/16 Kurfürstenstrasse, Berlin, Germany, have invented a certain new and useful Improved Manufacture of Metallic Filaments for Incandescence Lighting, of which the following is a specification.

This invention relates to the manufacture of metallic filaments for incandescent lighting, and has for its particular object the production of a filament which is durable, and which on account of its reduced brittleness will stand considerably more shock and jar of transportation than can be withstood by metallic filaments made according to the processes at present used.

According to this invention it is possible to reduce the brittleness of metal filaments made from metals of high melting points, for instance from tungsten. The process is based on the addition to the metals of high melting points, of a metalloid in the form of tellurium. Tellurium is an exceedingly brittle body which can be easily reduced to powder, and vaporizes at 1400° C. It is therefore specially remarkable that such a brittle body, when alloyed in the proper manner with metallic tungsten, should give an exceedingly tough alloy which can be advantageously used in the incandescent lamp filament industry. Three methods of manufacturing such filaments, which will be sufficient for purposes of illustration, may be given briefly as follows:

1. A mixture is made of 11.7 grams of fine tungsten powder and 0.3 of a gram of purest pulverized tellurium. The mixture is mixed with 2 grams of an organic substance, such as concentrated solution of sugar, and formed in the usual way into filaments and preliminarily heated in a vacuum. This operation is effected by placing the filaments in a porcelain tube which is well evacuated, and the tube is then heated slowly up to 800° C. Thereupon the tube is allowed to cool and the preliminary glowing operation is completed. This preliminary glowing effects the decomposition of the organic binding agent added to the paste and renders the filament conductive. Then follows the forming operation which differs materially from the forming process of ordinary tungsten filaments. The forming is effected by the threads being introduced into a receptacle filled with an inert gas, such as hydrogen, nitrogen, or the like. Then an electric current is caused to pass through the filament, whereby the latter is caused to glow; this heating of the filament is continued up to brightest incandescence. During this operation the filament sinters and the single particles are fused together, whereby the filament receives a metallic surface. It is however absolutely necessary to form the filament by the dull red glowing operation for a considerable time, in order that the tellurium contained in the mixture of the metals should be carefully melted, and should cement together the single metal particles, a tungsten-tellurium alloy being formed at the same time. The temperature of the filament is thereupon slowly raised to bright red heat, nearly the whole quantity of the tellurium contained being vaporized from the filament, and only a very small quantity of tellurium, which can be proved only by qualitative analysis, remaining in the filament, probably about 0.05 per cent. It must be pointed out that in order to make the filaments more elastic, only traces of tellurium are required, since greater quantities of tellurium make the filaments still more brittle than pure tungsten filaments.

2. A mixture of fine powder of metallic tungsten and about 2% of purest pulverized tellurium dioxid is made, and the process carried out for obtaining the filament as stated above. These filaments are then heated at first at dark red heat in an atmosphere consisting of a mixture of a neutral gas, for instance hydrogen, and sulfur dioxid (SO_2). The temperature is gradually raised to bright red heat, a reduction of the tellurium dioxid by the hydrogen and the sulfur dioxid taking place in accordance with the following equation:

$$TeO_2+SO_2+H_2=Te+H_2SO_4.$$

The pure tellurium is accordingly separated on the filament, slight vapors of sulfuric acid being formed, which however do not affect the quality of the filament. This second method is to be preferred to the first one, as tellurium which is obtained during the same in the nascent state forms the desired tungsten alloy in a much easier and more energetic manner, and the fila-

ments produced are in fact still more elastic than those produced when proceeding according to the first described method.

3. Such filaments can also be obtained by pure tungsten filaments being heated in an atmosphere of tellurid of hydrogen (TeH_2) and a neutral gas, for instance hydrogen. This method has, however, the drawback that for forming the filament in question, a considerably longer time is required to get favorable results. When treating pure tungsten metal filaments in the said gas mixture, tellurium is first separated on the surface of the metal filaments and penetrates only very slowly into the interior of the filament. Special care must be taken that the initial temperature of the filament should not be too high, not higher than 500° C. in order that the tellurium separated should not again vaporize at once on the surface, but that there should be sufficient time for a portion of the tellurium to penetrate into the filament.

It must again be pointed out expressly that the quantities of tellurium to be used are only very small, as otherwise the opposite result will be obtained. The limits within which the addition should be kept are at least 0.02% and at most 1%. The experiments I have made show that those filaments have the best properties in which at the end of the heating operation no quantitative quantity of tellurium could be discovered.

As regards the durability of the filaments and blackening produced by them, it has been found that the results are at least as good as those obtained with pure tungsten filaments, although it would seem at first sight that tellurium which vaporizes at 1400° C. ought to be finally separated out of the filament. That, however, does not take place, but the required very slight traces of the metalloid adhere so firmly to the tungsten metal that no subsequent separation is produced by calcining in a vacuum. It must be further pointed out that the proportion of carbon in the metallic filaments is also smaller than in the case of ordinary tungsten metal filaments (produced by the Pasteve process), as it appears as if, in the vaporization of tellurium the carbon bound to these metalloids, disappears with them.

What I claim is:

1. A metallic filament for incandescent lighting comprising a metal of high melting point and containing tellurium within the limits of 0.02% and 1.%, substantially as described.

2. A metallic filament for incandescent lighting consisting of tungsten with tellurium, the latter within the limits of 0.2% and 1%, substantially as described.

3. The process of manufacturing metallic filaments for incandescent lighting which consists in mixing a finely divided metal of high fusing point with pulverized tellurium dioxid and a suitable binder, forming a filament from the mixture, and heating the filament in an atmosphere consisting of a neutral gas and sulfur dioxid.

4. The process of manufacturing metallic filaments for incandescent lighting which consists in mixing finely divided tungsten with pulverized tellurium dioxid and a suitable binder, forming a filament from the mixture, and heating the filament in an atmosphere consisting of a neutral gas and sulfur dioxid.

In testimony whereof, I affix my signature in presence of two witnesses.

CHRISTOPH HEINRICH WEBER.

Witnesses:
ELISE SOHNOKERT,
GEORG FALKERVITZ.

Correction in Letters Patent No. 1,016,804.

It is hereby certified that in Letters Patent No. 1,016,804, granted February 6, 1912, upon the application of Christoph Heinrich Weber, of Berlin, Germany, for an improvement in the "Manufacture of Metallic Filaments for Incandescence Lighting," an error appears in the printed specification requiring correction as follows: Page 2, line 62, percentage, for "0.2" read *0.02;* and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 2d day of July, A. D., 1912.

[SEAL.]

C. C. BILLINGS,

Acting Commissioner of Patents.