UNITED STATES PATENT OFFICE.

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LAMP-FILAMENT.

963,872. Specification of Letters Patent. Patented July 12, 1910.

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To all whom it may concern:

Be it known that I, WILLIAM D. COOLIDGE, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Lamp-Filaments, of which the following is a specification.

This invention relates to the art of making incandescing conductors, such as are used in electric lamps, furnaces, and other apparatus.

According to my invention a refractory material is incorporated in a colloidal solution to produce a pasty mass, and this mass is squirted or otherwise shaped to form threads, filaments, rods, or other desired shapes, and these bodies are then treated to remove all easily vaporizable components and yield a conductor of refractory material suitable for use in incandescent lamps and other apparatus. As a basis for my refractory conductor, I may use various metals or elements, such as tungsten, molybdenum, boron, zirconium, titanium, thorium, etc., and although I will explain the process as applied to tungsten it should be understood that my process is a general one and is applicable to other refractory metals, elements, and compounds.

Colloidal solutions suitable for use as binding agents are easily produced by well known chemical methods, such as the Carey Lea method, or may be produced by various methods which yield a pasty and sticky mass though preferably the colloid should be one which can be changed to the metallic state without any special difficulty. Colloidal silver is very easily made and is entirely satisfactory in accordance with my invention, though colloidal gold, prepared by Dr. Blake's method, is also suitable, as are also colloidal copper and many other metals of relatively high melting point.

The finely divided refractory material may be incorporated in the colloid by simply stirring it in and mixing thoroughly. If silver colloid is used as the binding means and tungsten as the refractory element, I prefer to have the tungsten in a finely divided condition. This state is easily obtained with tungsten, and in fact with most of the elements above enumerated, for the reason that they are ordinarily obtained as fine powder which may be ground, sifted, or precipitated to separate out the coarse grains and leave a homogeneous residue of exceeding fineness. In adding the tungsten to the silver colloid I prefer to put in as much tungsten as the colloid will take and still retain the sticky qualities necessary to an easy manipulation of the product. I think it probable that the colloid does not chemically unite with the tungsten, but acts more as a suspending medium to take up the exceedingly fine particles of tungsten and to hold them in position by capillary or other forces.

After obtaining threads or filaments of the desired size and shape, and then drying to drive out any excess moisture, I treat the threads to convert the colloidal metal into the metallic state. This may be conveniently done by chemical methods, as by subjecting the colloid to the action of electrolytes or to the precipitating action of acid fumes. For instance, I may blow traces of HCl vapor over the threads of tungsten and silver colloid and thereby instantly convert the silver into the metallic state in which condition it acts as a firm binding agent for the tungsten particles. The wires or conductors produced as above described have sufficient ductility to permit ready manipulation and mounting on lead-wires. I may use some of the impregnated colloid as a paste for securing the threads to the lead-wires. The ductile metal, as for instance, silver, gives the wire strength, while the refractory powder with which the silver is impregnated is in sufficient quantity to insure a continuous wire after the silver is removed. I next proceed by driving the ductile or low melting metal out of the wire and the pasted joint, and consolidating the refractory powder into a coherent conductor suitable for operation at high temperatures. This may be conveniently done by passing current through the threads or filaments in a vacuum or in an inert atmosphere and thereby vaporizing the silver and sintering the tungsten particles together. I find that the silver comes out entirely and that the particles of tungsten draw together and consolidate into a strong wire. Capillary forces are very strong with metals which melt at high temperatures, and I consider that this phenomenon assists in producing a coherent product.

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

1. The process which consists in introducing a refractory powder into colloid of less

refractory metal, producing threads from the product so obtained, and subsequently treating said threads to remove all components except said more refractory material.

2. The process which consists in incorporating refractory metal in colloid of less refractory metal, treating the mixture so formed to convert the colloid into the metallic state, and subsequently driving out said less refractory metal to produce a coherent refractory conductor.

3. The process which consists in incorporating refractory metal powder in colloid of less refractory metal, chemically treating said colloid to convert it into the metallic state, and then heating by current to drive out all the easily vaporizable materials.

4. The process which consists in incorporating a refractory powder in colloid of ductile metal, making filament shaped threads from the mixture so produced, and treating said threads to drive out the elements of the colloid and produce a coherent filament of pure refractory metal.

5. The process which consists in mixing a refractory metal powder with colloid of less refractory metal, squirting threads from the mixture so produced, treating the threads to convert the colloid into the metallic state, and treating by current passing therethrough to vaporize the metal of the colloid and sinter the refractory material into a coherent conductor.

6. A composition of matter for the production of incandescent lamp filaments consisting of colloid of relatively low melting metal, with which is incorporated a refractory powder.

7. A squirtable mixture for the production of incandescent lamp filaments consisting of colloid of relatively low melting metal, with which is incorporated finely divided refractory material.

8. The process which consists in incorporating tungsten powder in colloid of ductile metal which has a vaporizing temperature approaching that of silver, making filament shaped threads from the mixture so produced, and heating said threads to drive out all said vaporizable metal and produce a coherent filament of tungsten.

9. A squirtable mixture for the production of incandescent lamp filaments, consisting of colloid of relatively low melting metal with which is incorporated finely divided tungsten.

10. A squirtable mixture for the production of incandescent lamp filaments, consisting essentially of colloidal copper associated with finely divided tungsten.

11. A squirtable mixture for the production of incandescent lamp filaments comprising colloid of metal vaporizable about as silver or copper, with which is associated finely divided refractory metal.

12. The process which consists in producing a mixture of tungsten and colloidal copper, producing threads from said mixture, and subsequently treating said threads to remove the copper and to sinter the refractory residue.

In witness whereof I have hereunto set my hand this 30th day of July, 1906.

WILLIAM D. COOLIDGE.

Witnesses:
BENJAMIN B. HULL,
GRACE M. HANIGAN.