UNITED STATES PATENT OFFICE.

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MANUFACTURE OF METALLIC FILAMENTS FOR ELECTRIC INCANDESCENT LAMPS.

1,104,557. Specification of Letters Patent. Patented July 21, 1914.

No Drawing. Application filed March 14, 1913. Serial No. 754,346.

To all whom it may concern:

Be it known that I, JAMES ALEXANDER SCOULAR, a subject of the King of England, residing in Hammersmith, London, England, have invented certain new and useful Improvements in the Manufacture of Metallic Filaments for Electric Incandescent Lamps, of which the following is a specification.

This invention relates to improvements in the manufacture of tungsten filaments for incandescent electric lamps and has particular reference to that type of process in which tungsten metal in the form of a fine powder is mixed with a binding agent and brought into filament form by squirting the mass through a die.

Many different types of binding agents have been employed, and most of the difficulties in manufacture and the disadvantages of finished metallic filaments have arisen from the binding agent.

The raw material which we employ is tungsten in the form of a very fine powder, which may be obtained for example by the reduction of the oxid at a high temperature with hydrogen or with zinc. The finely powdered metal which we employ is preferably as pure as possible, and it is especially desirable to avoid the presence therein of any considerable percentage of oxid or hydroxid, since the presence of these or other impurities may prevent the production of good filaments. Satisfactory results have, however, been obtained with tungsten powder having an "oxygen absorption" of 24.8 to 25.3 per cent., and a simple test suffices to show whether any given sample can be successfully used in the process. According to this invention the tungsten powder is mixed with a small proportion of sodium silicate solution in the thick gelatinous or viscous form, the mixing being carried out in such a way as to effect a uniform incorporation of the powder with the binding agent. The resulting mass or paste is squirted through dies in any well-known manner so as to form raw filaments. These filaments are then subjected to heat so as to render them conductive and to cause them to sinter into finished metallic filaments. During this process the silicate is substantially eliminated. For example, the squirted filaments may be dried, then baked by the application of external heat, and finally sintered by passing a current through them in an inert atmosphere so as to raise them to an intense white heat.

Instead of baking and sintering the filaments separately, the raw squirted filaments may be subjected to heat in a suitable inert atmosphere so as both to render them conductive and to sinter them in one operation. The best proportion of sodium silicate solution to employ varies to some extent with the physical and chemical qualities of the tungsten powder, the thickness of filament required, and other circumstances; but it should in any case be small, and an excess should be avoided. In most cases I have found the best results to be obtained on using the proportion stated in the following example which is one method of producing tungsten filaments according to this invention with separate baking and sintering operations:—

One hundred and twenty (120) grams of tungsten powder of the kind hereinbefore described, 24 grams of sodium silicate solution of 140° Twaddell (containing about 36.35% of silica, 18.85% of soda, and 44.8% of water), and 4 grams of distilled water, are first mixed by hand in a porcelain mortar, the metallic powder being added little by little, and the mixture may also be rubbed around in the hand, the object being to effect uniform mixing. The mixed mass is then calendered in small quantities (say 30 grams) at a time and during the calendering operation a few drops of water are added if necessary. Thereafter the mass is squirted through a die, the filament on issuing from the press being passed through a hot atmosphere, and collected on cards or trays. The filaments are next dried and then introduced in suitable receptacles (say trays of iron) into a baking furnace. The baking furnace may conveniently be a silica tube furnace and is gradually heated during the baking operation by electricity or otherwise to a temperature of about 900° C., which temperature is maintained for about 20 minutes. During this stage the baking furnace is filled with inert gas, preferably an atmosphere of dry hydrogen at a few millimeters absolute pressure. The filaments after baking are conductive. They are then subjected to a sintering operation, that is to say, an electric current is passed through them in order to raise them to an intense

white heat in an inert atmosphere, preferably an atmosphere of pure dry hydrogen at a reduced pressure. Thus each filament may be sintered first for about three seconds in an atmosphere of hydrogen at about 610 mm. pressure and again for about one second in an atmosphere of hydrogen at about 110 mm. pressure. Some filaments may require a longer treatment with electric current. After sintering the filaments are ready for mounting in lamps.

In the case in which the filaments are rendered conductive and sintered in one operation, the process may be the same as above described up to the drying stage. The dried filaments are then introduced into an electric resistance furnace which conveniently consists of a vertical carbon tube through which a very heavy electric current is passed. This tube is filled with an atmosphere of hydrogen for example by leading hydrogen downward through it. The filaments are suspended in the vertical tube and are raised to the temperature necessary to sinter them.

It is to be understood that the method of forming and finishing the filaments may be varied without departing from this invention. For example the filament as it is squirted may be passed directly into an apparatus in which it is subjected to the subsequent operations. Further, the filaments may be cut into hairpin form or other suitable form at any stage of the manufacture or they may be kept in continuous form.

What I claim as my invention and desire to secure by Letters Patent is:—

1. The herein described process for the manufacture of tungsten filaments for incandescent electric lamps which consists in intimately mixing tungsten powder with a small proportion of sodium silicate solution in the viscous form so as to produce a paste, squirting the said paste to form raw filaments and subjecting the raw filaments to heat so as to render them conductive and to cause them to sinter into finished metallic tungsten filaments.

2. The herein described process for the manufacture of tungsten filaments for incandescent electric lamps which consists in intimately mixing tungsten powder with a small proportion of sodium silicate solution in the viscous form so as to produce a paste, calendering the mixture, squirting the said paste to form raw filaments, and subjecting the raw filaments to heat so as to render them conductive and to cause them to sinter into finished metallic tungsten filaments.

3. The herein described process for the manufacture of tungsten filaments for incandescent electric lamps which consists in intimately mixing tungsten powder with a small proportion of sodium silicate solution in the viscous form so as to produce a paste, calendering the mixture, squirting the said paste to form raw filaments, drying the raw filaments and rendering the same conductive by baking, and thereafter subjecting the baked filaments to a high temperature in an inert atmosphere so as to sinter them into finished metallic tungsten filaments.

4. The herein described process for the manufacture of tungsten filaments for incandescent electric lamps, which consists in intimately mixing tungsten powder with a small proportion of sodium silicate solution in the viscous form so as to produce a paste, calendering the mixture, squirting the said paste to form raw filaments, drying the raw filaments, and subjecting them to heat in a suitable inert atmosphere in an electric furnace so as both to render the filaments conductive and to sinter them in one operation.

5. The herein described step in the process for the manufacture of tungsten filaments for incandescent electric lamps by the squirting process which consists in producing a squirtable paste by intimately mixing tungsten powder with a small proportion of a viscous solution of sodium silicate.

6. The herein described composition of matter for use in the manufacture of tungsten filaments by the squirting process which consists of a paste composed of tungsten powder, and a small proportion of a viscous solution of sodium silicate.

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

JAMES ALEXANDER SCOULAR.

Witnesses:
E. J. WATT,
JOHN EDWARD BLACKWELL.