

UNITED STATES PATENT OFFICE.

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PROCESS OF MAKING FILAMENTS FOR ELECTRIC INCANDESCENT LAMPS.

936,403.

Specification of Letters Patent.

Patented Oct. 12, 1909.

No Drawing.

Application filed October 2, 1906. Serial No. 337,122.

To all whom it may concern:

Be it known that I, WERNER VON BOLTON, a subject of the Czar of Russia, and a resident of Charlottenburg, Berlin, Germany, have invented certain new and useful Improvements in Processes of Making Filaments for Electric Incandescent Lamps, of which the following is a specification.

My invention relates to electric incandescent lamps and is more especially concerned with the filaments for such lamps.

It has already been proposed to produce filaments of tungsten powder or mixtures of powdered tungsten and other metals, by pressing the powder under a high pressure in a form corresponding to the completed filament. It is impossible, however, to obtain filaments of satisfactory homogeneousness and stability by this method. On the other hand, however, filaments in suitable lengths having complete homogeneousness and high elasticity can be made from such metal powder by pressing the powder of the metal without adding any non-metallic binding means, into a tube composed of ductile metal, such as tantalum or iron, and then drawing out or rolling this ductile tube together with the metallic powder which it contains. After the drawing has been completed, the tube or shell of the other ductile metal can, if desired, be easily removed by chemical or mechanical treatment, or by simply melting it away. In order to remove the outer shell chemically the process would of course vary according to the material of which the outer shell is composed. However since tungsten is very difficult to dissolve in a great many chemical dissolving agents the number of dissolving agents which can be employed to remove the shell is almost unlimited. The proper dissolving agent can be easily selected by one skilled in the art. In case the outer shell is of iron, for instance, a weak solution of nitric acid, hydrochloric acid or sulfuric acid may be used without impairing the tungsten. If the outer shell is not too thick and the inner filament is of sufficient thickness the shell can generally be melted away or even evaporated by a strong heat. If for example the shell consists of nickel it will evaporate considerably below the melting point of tungsten even if it should have formed an alloy with the same. In some cases there is a certain tendency of the shell to split longi-

tudinally during the rolling process. If this tendency is aided, the filament may then be subsequently freed by simply pulling off the outer shell and the filament may then be used. In introducing the tungsten powder into the ductile metal tube, particular care must be observed in order that the pressing or stamping will be accomplished with the greatest possible uniformity and in such manner that all traces of air will be removed. If necessary, after the tube has been filled it may be heated in a vacuum to drive out the last trace of air. It is advantageous to seal the ends of the tube after the metal powder has been inserted in the above described manner. This is best done in a vacuum, by fusing the ends of the tube by an electrical heating. There is no particular difficulty connected with sealing the end of the tube in a vacuum. This may be done in a very simple manner by making the tube form an electrode in an electric vacuum furnace of the well known type and by approaching the other electrode to the end which is to be closed and thereby forming an arc which causes an immediate melting and sealing of the end of the tube. The same result may also be obtained by soldering, welding or any other well known method. The simplest way is to force a plug exactly fitting the end of the tube tightly into the opening, whereafter it may be soldered or screwed in.

By the above described process, it is easy to obtain a body from an original length of a few centimeters and a diameter of some five or ten millimeters, drawn out into a fine wire only a fraction of a millimeter in diameter. The process is also applicable to the production of thin plates or strips which have the qualities of excellent firmness and ductility.

It is old to purify tungsten and draw it into filaments without the use of an outer shell. The present process however differs from that in that metal powder can be used without the previous formation of a homogeneous fused mass. Furthermore by the present process the difficulties which are encountered in the drawing of tungsten by the old method are avoided.

Having thus described my invention, the following is what I claim as new therein and desire to secure by Letters Patent:

1. The hereindescribed process for pro-

ducing filaments which consists in inserting refractory metal powder into a tube of ductile metal and subsequently working the tube and the refractory metal powder into filamentary form.

5 2. The hereindescribed process for producing filaments which consists in inserting the refractory metal powder into a tube of ductile metal, exhausting the same of air,
10 sealing the ends of said tube and subsequently working the tube and refractory metal into filamentary form.

3. The hereindescribed process for producing filaments which consists in inserting refractory metal powder into a tube of 15 ductile metal, subsequently working the tube and the refractory metal powder into filamentary form and finally removing the tube from around the refractory metal.

WERNER VON BOLTON.

Witnesses:

HENRY HASPER,
WOLDEMAR HAUPT.