

UNITED STATES PATENT OFFICE.

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PROCESS OF FORMING ELECTRIC-INCANDESCENT-LAMP FILAMENTS.

No. 930,723.

Specification of Letters Patent.

Patented Aug. 10, 1909.

Application filed February 3, 1909. Serial No. 476,137.

To all whom it may concern:

Be it known that we, WERNER VON BOLTON and FELIX HARTMANN, subjects of the Czar of Russia and the German Emperor, respectively, and residing at Charlottenburg and Berlin, Germany, respectively, have invented certain new and useful Improvements in Processes of Forming Electric-Incandescent-Lamp Filaments, of which the following is a specification.

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

It has already been proposed in the United States patent application Serial No. 337,122 filed October 2, 1906 to press tungsten powder into a tube composed of ductile metal and to then draw out or roll this ductile tube together with the metallic powder which it contains into filamentary form.

Now in accordance with the present invention, before the tungsten powder is placed into the tube we place into the latter another tube which also consists of a very ductile metal, as, for example, copper, silver or nickel. The powdered tungsten is then inserted uniformly into this inner tube, the ends of the tube are sealed, for example by screwing or wedging copper plugs into them, and the tube is thereupon rolled or drawn out, or first rolled and then rolled out still further.

A steel tube is preferably employed as the outer tube. After the drawing operation the outer tube is removed, for example, when a steel tube is employed, by dissolving it in dilute hydrochloric acid or sulfuric acid. There then remains on the drawn wire a thin coating or shell consisting of the material of the inner tube. This considerably facilitates the manipulation of the core of tungsten, so that it can be brought more readily into the desired shapes and the remaining manipulations necessary for completing the manufacture of the lamp can be carried out more easily. Lastly, the thin coating of the tungsten filament can then be removed by heating it highly in a vacuum or in a rarefied atmosphere, for example in a rarefied atmosphere of hydrogen. For this purpose, after the body has been placed into a suitable receiver and the gas contained in the latter has been rarefied, an electric current is sent

through the filament. When the temperature has risen sufficiently, the metal forming the casing or shell begins to vaporize at one place. In a short time it will be found that the vaporizing process has extended along the entire length of the filament and the finished incandescent filament is obtained.

A drawn steel tube 50 mm. long, of 8 mm. exterior, and 4 mm. interior, diameter can be employed for example, a copper, silver or nickel tube of 4 mm. exterior diameter and having a wall 0.2 mm. thick being fitted exactly into it. Fine, sifted, powdered tungsten is now shaken loosely into the inner tube. It is preferable not to press this powder too firmly, but only to settle it uniformly in the tube which can be done by lightly tapping the tube on a hard surface. Particularly uniform results are then obtained, and simultaneously a certain degree of porosity is obtained which has advantages in many respects. The tube is now closed with plugs of copper or silver about 5 mm. long and is then rolled or drawn. Such a tube can be drawn out to the very finest wires and after the outer shell has been removed a very usable incandescent filament is obtained.

During the vaporization of the shell of copper, silver, and the like, which is directly on the tungsten filament an alloy of tungsten with the incasing metal can be formed under certain circumstances. Such an alloy can readily be obtained particularly when the temperature of the filament is driven very rapidly too close to the point at which the incasing metal vaporizes. These alloys have a more or less high degree of ductility, so that it is possible to subject the filaments alloyed in this manner to an additional rolling or drawing process. By heating the filament highly the additional metal can then be driven off later. The formation of such alloys is particularly facilitated by the tungsten being pressed not too firmly into the tube in which it is to be drawn. In exactly the same manner as is here described with reference to tungsten, other highly refractory metals, which are difficult to draw otherwise, can also be subjected to a drawing process.

What we claim as our invention and desire to secure by Letters Patent is:

1. The hereindescribed process for produc-

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ing filaments which consists in inserting into
a tube of ductile metal a tube of another
ductile metal, inserting refractory metal
powder into the inner tube, and subsequently
5 working the tubes and the refractory metal
powder into filamentary form.

2. The hereindescribed process for produc-
ing filaments which consists in fitting into a
tube of ductile metal a tube of a different,
10 very ductile metal, inserting tungsten pow-
der into the latter tube, subsequently work-
ing the tubes and the tungsten powder into

filamentary form, removing the outer tube,
and subsequently removing the inner tube
from around the tungsten metal.

In testimony whereof we have signed our
names to this specification in the presence of
two witnesses.

WERNER VON BOLTON.
FELIX HARTMANN.

Witnesses:

HENRY HASPER,
WOLDEMAR HAUPT.