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FILAMENT FOR INCANDESCENT LAMPS

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The present invention relates to improvements in a tungsten filament for incandescent lamps and a method of manufacturing or producing the same, its object being to prevent especially the sagging and twisting of the known filament of this kind. In the known method of manufacturing a so-called non-sagging and non-offsetting filament, tungsten particles are mixed with non-metallic substances, for example, silica. In such a method, it is unknown whether said non-metallic substances really serve to prevent the over-production of the nuclei of crystals and consequently produce a filament of large crystal size or reversely these impure matters hinder the growth of the crystals themselves to produce a filament of small crystal size, but it may at least be supposed that such impure matters somewhat cause the lack of homogeneity in the arrangement of the molecules of the tungsten in the slug. Therefore, although the growth of the crystals may be expected by the stress produced by the lack of the homogeneity due to said impure matters, on the other hand it may also be expected that such stress will effect a change during recrystallization. That is to say, according to an experiment the non-sagging filaments produced by such an operation almost without exception produce so-called twist. This phenomenon is especially remarkable in a filament for low wattage lamps, bringing about the pitch-short of the coil and sometimes making it unfit for its purpose all the more because of its being non-sagging. It is considered that this is due to the fact that the stress is too great for the size of the filament and that it would be impossible to regulate the stress properly.

The filament which does not sag must necessarily have a large crystal structure and it is well known that for this purpose the production of the nuclei of crystals must be limited. Accordingly, in the manufacture of a tungsten slug it is very important to give it a comparatively coarse grain structure and although crystals of uniform grains may be obtained by adding tungsten metal particles of various sizes, a slug of crystals of coarse grains cannot be obtained in this manner.

Now, according to the present invention the above-mentioned disadvantages are removed by the manufacture of a slug having a coarse grain structure on an industrial scale and thus produce a filament which does not sag. This invention in brief is characterized by mixing one or more kinds of pure tungsten metal particles of different sizes with one or more kinds of seasoned tungsten particles.

The seasoned tungsten particles are the pure tungsten particles left alone at a certain temperature for a certain time in a closed vessel with suitable humidity and are clearly different from the common pure tungsten metal particles in the property, some being coated with a lower oxide film or having merely absorbed moisture or water. For example, they have their so-called cubic weight increased by about 10% and are reduced to pure tungsten metal particles by hydrogen at approximately 1,200° C., when some increase in the size of the particles is usually recognized. Moreover, the operation of forming them into a slug by compression is not only easy, but also they perform a noteworthy action as follows. That is to say, if purse tungsten metal particles and seasoned tungsten particles are mixed together in any desired proportion, formed into a slug by compression, and heated at sintering temperature, the seasoned tungsten particles are not only reduced at the above temperature (1,200° C.) which is a low temperature during the operation, to pure tungsten metal particles of much greater size than the above pure tungsten metal particles, but also when the reduced seasoned tungsten particles reach the recrystallization temperature, they will act as the nuclei of crystals and annex the adjacent small particles of pure tungsten metal thereto to form a slug of crystals of coarse grain.

It is known that if a tungsten slug of coarse grain is drawn to a wire by hammering and drawing, it is possible to obtain a filament which does not sag, whereas the filament drawn to a wire from pure tungsten slug according to the present method has the advantage of hardly producing twist, probably because the absence of impure matters tends to create a homogeneous arrangement of the molecules of tungsten in the slug. Generally, a slug having a coarse grain structure is somewhat difficult to be drawn to a wire, but the inventors have succeeded in removing such a disadvantage by performing some additional operations in carrying out this invention into practice.

According to the inventors' experiment, suitable seasoned tungsten particles are obtained by leaving alone pure tungsten metal particles at atmospheric temperature for 240 hours in a closed vessel having a humidity of about 80–90% and the quantity of said seasoned particles to be mixed with pure tungsten metal particles is ½ to ¼ of the latter and may be regulated according to the requirement regarding the size of crystal grains for the thickness of the finished filament, etc.

For the purpose of comparing the deformations caused by the heating of a filament (A) made by mixing different batches of tungsten metal particles, a filament (B) manufactured by the present method and a filament (C) made especially with the object of preventing offset, each of these filaments was wound into a coil and was suspended perpendicularly with one end free and then was electrically charged at various voltages and heated, when it was found that under the same condition the sag is the greatest in (C), about half as great in (A) and the least in (B).

Having thus described our invention, we claim:—

1. The method of producing a substantially non-sagging and non-twisting filament for incandescent lamps which consists in mixing pure tungsten metal particles with tungsten particles coated with lower tungsten oxide film, sintering the mixture into an ingot and simultaneously reducing said oxide-coated particles to large pure tungsten metal particles, and then working the pure tungsten ingot into the form of a filament.

2. The method of producing a substantially non-sagging and non-twisting filament for incandescent lamps which consists in mixing pure tungsten metal particles of different sizes with tungsten particles coated with lower tungsten oxide film, the ratio of the mixture being two to four parts by weight of pure tungsten to one part of oxide-coated tungsten, sintering the mixture into an ingot and simultaneously reducing said oxide-coated tungsten particles to pure tungsten metal particles, and working the pure tungsten ingot into the form of a filament.

3. The method of producing a substantially non-sagging and non-twisting filament for incandescent lamps which consists in mixing pure tungsten metal particles of different sizes with tungsten particles coated with lower tungsten oxide film, sintering the mixture into an ingot and simultaneously reducing said oxide-coated tungsten particles to pure tungsten metal particles of enlarged size, subjecting the ingot to a recrystallization temperature to form the reduced oxide-coated tungsten particles as the nuclei of crystals annexing adjacent small particles of pure tungsten to form an ingot of coarse grain, and subsequently hammering and drawing the tungsten ingot thereby to work the same into the form of a filament.

4. The method of producing a substantially non-sagging and non-twisting filament for incandescent lamps which consists in subjecting particles of tungsten to humidity in a closed vessel thereby to coat said particles with lower tungsten oxide film, mixing said oxide-coated particles of tungsten with particles of pure tungsten, compressing the mixture into a slug, sintering the slug into an ingot and simultaneously reducing the oxide-coated tungsten particle content to large pure tungsten particles, and then working said ingot into the form of a filament.

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