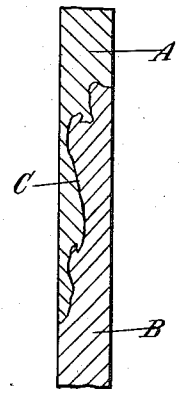
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FILAMENT FOR INCANDESCENT ELECTRIC LAMPS AND THE LIKE.

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1,436,717. Patented Nov. 28, 1922.



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FILAMENT FOR INCANDESCENT ELECTRIC LAMPS AND THE LIKE.

Application filed November 25, 1921. Serial No. 517,679.

To all whom it may concern:

Be it known that I, FREDERICK SHAND GOUCHER, Ph. D., of Research Laboratories of The General Electric Company Limited, Brook Green, Hammersmith, London, W. 6, England, a British subject, have invented certain new and useful Improvements in Filaments for Incandescent Electric Lamps and the like, for which I filed an application for a patent in Great Britain on October 28, 1920, Serial No. 30,552 of 1920, and of which the following is a specification.

This invention relates to filaments, for use in incandescent electric lamps and the like, which can be deformed and subjected to prolonged high temperatures without becoming brittle.

The wire of such filaments will hereinafter be referred to as "stable wire".

It is well known that the crystal grains of metal become elongated during drawing into wire. When the wire is used as the filament of an incandescent electric lamp, the crystal grains tend to re-arrange themselves; sometimes an intercrystalline boundary develops which extends across the greater part or the whole of the cross-section of the wire, and may become a source of mechanical weakness. It is also known that filaments formed from squirted threads composed of fine crystal grains, when heated for a sufficient time to a sufficiently high temperature, tend to develop a structure of much larger grains of uneven size.

In the specification of British Patent No. 16620 of 1914, a method of preventing such re-crystallization with its attendant mechanical weakness is described. The method proposed consists in passing the filament through a short zone of very high temperature at a speed equal to or less than the speed of crystal growth. It is stated therein that by the treatment the wire is converted into a single crystal or several such crystals arranged in juxtaposition or in the form of a bundle. Wire in which such structural change has been effected is stable wire in the sense referred to above. It has now been found, however, that wire which has not necessarily the single-crystal structure may be stable under certain conditions. Thus, wire may be rendered stable by the process according to this invention without assuming the single-crystal form and, furthermore, it is found that wire may be rendered stable if its crystalline structure is made such that the crystal boundaries are interlocked to a sufficient extent.

The present invention consists in a process for rendering a wire stable by first annealing the wire, then subjecting it to a treatment which sets up a suitable strain in the metal, and subsequently heating the wire to a temperature sufficiently high for crystal growth to take place rapidly, the heating being carried out so that the region in which there is a suitable temperature gradient travels along the wire at a relative speed equal to or less than the speed of crystal growth. One method of producing the necessary strain in the metal is to pass the wire through a die or series of dies at the temperature usually employed in wire-drawing the metal. Other methods of treatment which produce a compression in the wire will also serve the purpose, but the invention is not limited to any particular method of producing the necessary strain. Furthermore, according to the invention a stable wire is produced which owes its properties to the fact that the boundaries of the crystals are such that the crystals effectively interlock, as has been determined by microscopic examination of such wire.

A longitudinal section of a short portion of one specimen of such wire, on a greatly enlarged scale, is shown in the accompanying drawing. In this view the parts marked A and B are contiguous portions of two adjacent but separate crystals; whilst the boundary between them, shown by the irregular line C., has such a form that the crystals are effectively interlocked and can form part of a stable wire.

In order that the invention may be clearly understood and readily carried into effect, an example of the improved process applied to drawn tungsten wire of a particular diameter will now be more fully described.

A tungsten wire of 0.043 mm. diameter and containing about 0.6 per cent of thoria is subjected to an annealing treatment in a known manner for the purpose of modifying the fibrous structure of the wire resulting from the normal drawing operations in reducing the diameter to the required size. The annealing treatment of this wire consists in heating it in a reducing atmosphere to about 1600° C. for about one second.

The annealing treatment may, however, be

varied as to temperature and time of treatment according to the size, composition, and extent of the previous mechanical treatment of the wire.

The diameter is thereafter reduced from 0.043 mm. to 0.04 mm., by drawing through a die of the usual kind, the temperature of the wire being maintained during the drawing at about 300° C. In this manner, a suitable strain is introduced in the wire.

The wire is next subjected to a heated zone treatment in a known manner whereby each portion of the wire is successively passed through a zone of very high temperature, the zone having a very steep temperature gradient substantially as described in the Schaller U. S. Patent No. 1,256,929. This heat treatment is arranged as a continuous process, the high temperature being produced by passing an electric current through the wire; the wire is automatically fed at an even speed of between one and two metres per hour through the zone arranged between two contacts in a reducing atmosphere hydrogen or the like, thereafter emerging in a cooled condition and being wound on to a reel. The heated zone may be about one centimetre long. No special precautions are required in cooling the wire and no further mechanical treatment such as drawing is necessary.

The process described in the above-mentioned specification of British Patent No. 16620 of 1914 is stated to be applicable to filaments formed either of squirted threads or of drawn wire. It has now been found, however, that in the case of drawn tungsten wire the said process does not always convert the wire into a single crystal or into stable wire. While the process of the present invention is applicable to filaments of squirted threads and of all kinds of drawn wire, it is particularly useful for producing stable wire from drawn wire in cases where the above-mentioned single-crystal process is not effective. It may also be applied to produce a stable wire which consists of a single crystal or several such crystals arranged in juxtaposition or in the form of a bundle and does not owe its stability to the fact that the crystals are effectively interlocked. The invention is useful in producing stable wire from drawn or otherwise mechanically worked tungsten wire with or without added materials such as thoria, alumina or silica.

I claim:—

In the manufacture of tungsten filaments, the improved process which comprises annealing a wire, applying a suitable strain to the wire, and then passing the wire through a zone of steep temperature gradient.

FREDERICK SHAND GOUCHER.