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ETCHING TUNGSTEN COILS

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This invention relates to the reduction of the diameter of tungsten electric lamp coils and more particularly to a chemical etching process to effect said reduction.

An object of this invention is to provide a process for producing tungsten wire which is finer than that which can be drawn commercially by mechanical means.

Another object of this invention is to provide a process for treating electric lamp tungsten coils which will make it possible to decrease the wattage thereof.

A further object of this invention is to provide a process for reducing the diameter of tungsten wire without embrittling it.

In attempting to provide tungsten wire of smaller diameter than that which can be drawn commercially, it has been the practice to etch the wire to reduce the diameter thereof to the desired size. However, we have found that the etching process weakens the wire considerably. The embrittled wire is very difficult to handle in the formation of electric lamp coils therefrom and, as a result, excessively high losses are suffered. To overcome this, we have developed a process for reducing the diameter of drawn tungsten wire after it has been formed into coils for electric lamps.

In the process of our invention tungsten coils are treated in an alkaline oxidizing solution under controlled conditions of temperature and concentration for a definite time interval. Initially, the coils are wound with more turns per inch than is normally done and the etching process produces the desired final spacing as the diameter of the wire decreases.

In carrying out the process of our invention, a plurality of electric lamp coils of tungsten wire are disposed in a bath of an alkaline oxidizing solution. For our purposes we have found that alkaline potassium ferricyanide gives very desirable results. However, other alkaline oxidizing solutions may be used without departing from the spirit of our invention. For example, satisfactory results may be obtained with potassium permanganate and ceric salts.

The concentration of the bath may be varied depending on the speed with which it is desired to complete the etching process and the wire diameter reduction desired. For example, in reducing coils formed from tungsten wire of the order of .3 mg. per 200 m. m. to about .18 mg. we have used a bath comprising about 10 grams of $K_3Fe(CN)_6$, about 40 grams of NaOH and about 350 ml. of H_2O.

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We have found it desirable to maintain the temperature of the bath at about 20° C. The temperature of the bath should be carefully controlled because an increase in the temperature of the bath speeds the etching process. If one permits the process to develop too rapidly, it is quite difficult to accurately control the reduction of the wire diameter. However, we have found that it is desirable to etch the coils faster than tungsten wire is normally etched because it reduces the formation of fissures which tend to form in slow etching along crystal boundaries.

For example, we have found that about a 50% reduction may be effected in about six minutes when coils of the size mentioned above are treated in a bath of the above-mentioned concentration.

After the coils have been disposed in the solution, the bath is agitated until all the coils are off the bottom of the container and swirling with the etching solution. This condition is maintained for the desired time, i. e., until the coils have been reduced in diameter to the extent desired.

After the etching has been completed, the bath agitating means is disconnected, the coils are permitted to settle in the bottom of the container and the etching solution is decanted. Distilled water is then poured over the coils and they are washed thoroughly, preferably twice. After the second washing, the coils are poured, with the aid of more water, into a Gooch crucible. The crucible is then placed in a bath of NH_4OH for about five minutes to remove oxide from the coils. The crucible is then dipped twice into baths of hot distilled water and finally rinsed thoroughly in acetone. The coils are then dried in an oven at about 115° C. for about 15 minutes.

We have found that the process of our invention enables us to wind coils to more turns per inch than normal coils. By winding about 2000 to about 2200 T. P. I. it is possible to etch coils without tangling or intermeshing. The etching process reduces the diameter of the wire so that the finished product has the proper spacing between coil turns.

In order to insure uniform etching of the coils, care should be taken to adjust the speed of the bath agitating means so that the coils do not touch each other or the sides of the container. We have found that, due to the speed with which the process of our invention is accomplished, this point is quite important. The process of our invention can be satisfactorily employed only when

the coils are uniformly in contact with the solution.

Precise control of the etching process is desirable because variation of the component concentrations of sodium hydroxide and potassium ferricyanide causes considerable variation in the etching power of the solutions. For example, an increase in the concentration of potassium ferricyanide increases the etching power.

What we claim is:

1. The process of reducing the diameter of coiled tungsten wire which comprises bathing the coiled tungsten wire in an agitated solution of alkaline potassium ferricyanide.

2. The process of reducing the diameter of coiled tungsten wire which comprises bathing the coiled tungsten wire in an agitated solution of alkaline potassium ferricyanide until the diameter of the wire has been reduced to the desired size, decanting said solution, washing the wire in distilled water, bathing the wire in a solution of NH_4OH, bathing the wire in hot distilled water, rinsing the wire in acetone, and drying the coils.

3. The process of manufacturing filaments for electric lamps from tungsten wire which includes the steps of coiling the tungsten wire, bathing the coiled wire in an agitated solution of alkaline potassium ferricyanide, and washing the coiled wire to free it from substantially all contaminants.

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