C. T. FULLER.

ELECTRIC FURNACE.

APPLICATION FILED DEC. 30, 1908.

1,023,371. Patented Apr. 16, 1912.

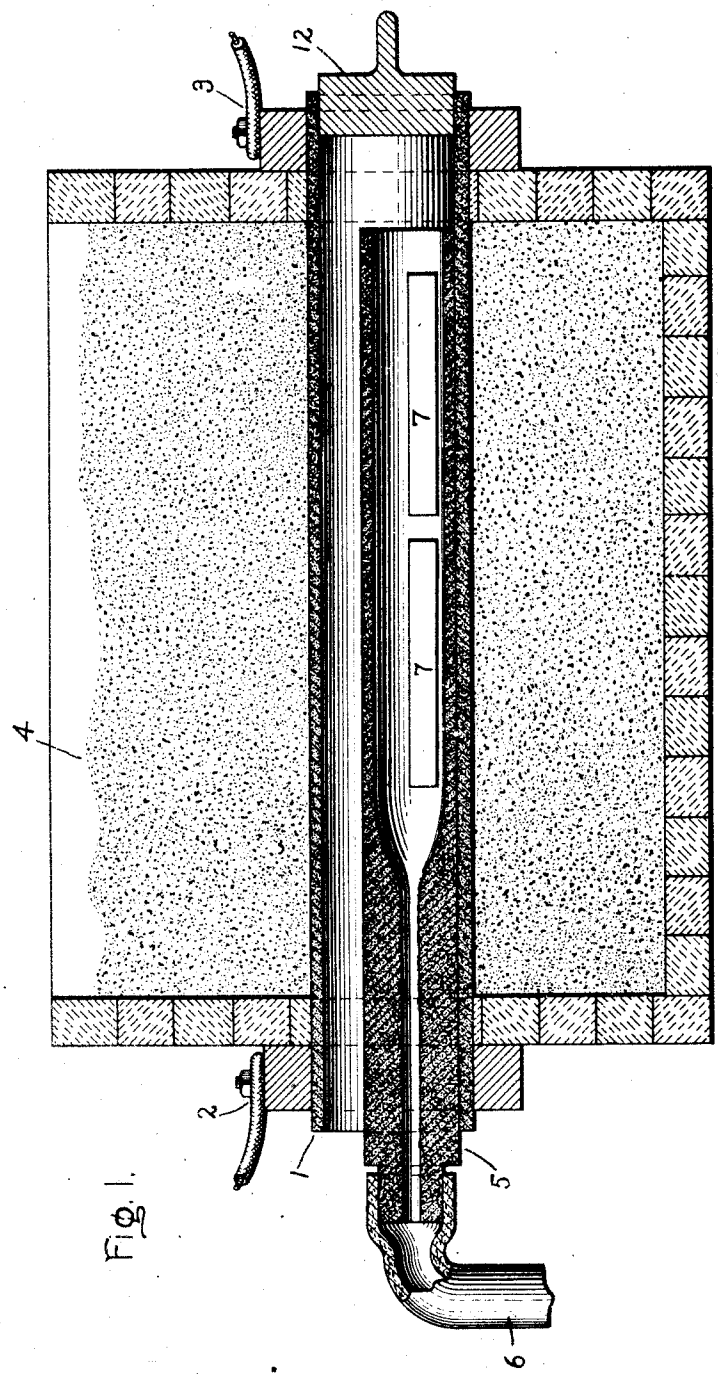

Fig. 1.

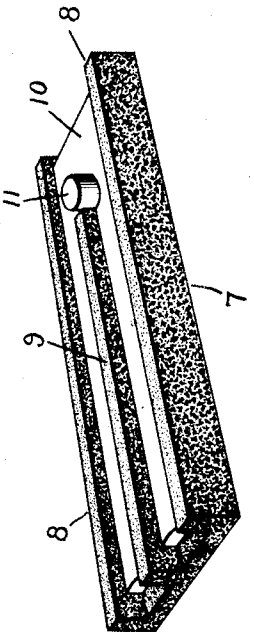

Fig. 2.

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UNITED STATES PATENT OFFICE.

CARL T. FULLER, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRIC FURNACE.

1,023,371. Specification of Letters Patent. Patented Apr. 16, 1912.

Original application filed August 24, 1907, Serial No. 390,048. Divided and this application filed December 30, 1908. Serial No. 470,022.

To all whom it may concern:

Be it known that I, CARL T. FULLER, a citizen of the United States, residing at East Orange, county of Essex, State of New Jersey, have invented certain new and useful Improvements in Electric Furnaces, of which the following is a specification.

My present invention comprises an apparatus suitable for use in the production of refractory electrical conductors, such as incandescent lamp filaments, furnace heaters, and the like.

My improved apparatus comprises a tubular heater through which hydrogen or other reducing gas may be passed and in which filament containing boats may be placed, these boats being of such nature and so constructed that the hydrogen is free to act on the filaments without danger that the latter will become contaminated by carbon or other material vaporized in the furnace.

In the accompanying drawing Figure 1 is a sectional elevation of a furnace, partly diagrammatic, and Fig. 2 is a perspective view of the shuttle or boat in which the filaments or threads are inclosed during treatment.

The furnace illustrated in Fig. 1 comprises a graphite heater tube 1 supplied with current through suitable terminals 2 and 3, and inclosed in a protective coating 4 of coke or other refractory material. Within this tube, a second tube 5 may be inserted and withdrawn. This second tube is continuously supplied with hydrogen through a rubber tube 6 and serves as a receptacle for the boats or shuttles 7 containing the material to be treated. I prefer that tube 5 should have a small bore at the end connecting with the rubber tube 6 and should have an enlargement at the end containing the boat 7.

The refractory boat consists of a trough-shaped member having side walls 8 and a central web 9 and having a lining of refractory material 10 consisting of rutile or of other materials hereinafter mentioned. A post 11 of rutile is mounted at one end of the boat to serve as an anchoring device for the filaments under treatment.

My invention may be used and applied for many purposes. In Patent #929,578 granted to me July 27, 1909 on application filed August 24, 1907, Ser. No. 390,048, (of which application this application is a division) I have described in detail its use as applied to the production of tungsten conductors. In this mode of employment, the tube 5 is withdrawn from the furnace, the filamentary bodies or threads to be treated in the furnace are arranged in bundles on a rutile packing 10 of boat 7, the boats are introduced into the tube 5, and the tube 5 is returned to its position within the heater tube 1, a stream of hydrogen through tube 5 being maintained during this time. The filamentary bodies in the boats are converted into pure tungsten threads or wires in a comparatively short time, and are further fired at such a high temperature and for such a length of time as will completely sinter and shrink the tungsten threads or wires and render them suitable for mounting in lamps without further treatment. These baking and firing operations require not more than about eight minutes at a temperature of about 1475 to 1550 degrees centigrade.

The unfavorable influence of carbon from the heating members of the furnace during the firing or high heat treatment can be guarded against by the use of proper material for the boat or shuttle illustrated in Fig. 2 of the drawing. In general, I prefer that the boat shall consist of or comprise a material having a high affinity for carbon, or at least having as great a tendency to absorb carbon as do the filaments under treatment. Such a body acts as an absorbing shield to take up any carbon vapor given off by the furnace tube.

Of the various materials used by me in constructing the boats, I have obtained best results with a carbon boat having a packing of rutile TiO_2, the materials being arranged as shown in Fig. 2 of the drawing. I have also successfully used carbon boats lined with powdered tungsten. Either rutile or powdered tungsten serves, by virtue of its high affinity for carbon, to protect the filaments from whatever carbon vapor may be circulating through the tube. These materials also possess the very important requisite of not sticking to the filaments or combining therewith, in this respect being similar to powdered silica which I have successfully used, and being, in my opinion, far superior to oxids of the earth metals,

such as thorium, magnesium, cerium, etc. By the use of materials which do not become sticky, the filaments are free to move longitudinally in the boats and are free to undergo complete shrinkage. When treated as above described, they do undergo this shrinkage, and they attain an electrical resistance which remains substantially constant throughout their normal life as filaments in lamps. This resistance is directly comparable with the resistance of filaments shrunk or sintered individually with current in a treating bottle.

My furnace method of firing and shrinking has great commercial advantage in that it permits simultaneous treatment of dozens or even hundreds of filaments, and furthermore yields conductors, which, for any furnace run, are sure to be uniform in size, composition, and electrical properties, and therefore adapted for use in series without previous sorting and weighing or other calibration.

Although I have in my patent above referred to described my improved apparatus in connection with a process for the production of tungsten conductors by reducing an oxid with hydrogen and then effecting complete shrinkage and sintering of the refractory residue, it should be understood that my invention is applicable to the production of conductors of various other refractory metals and materials, such for instance as molybdenum, boron, zirconium, tantalum, titanium, graphite, or compounds or alloys of any of these or of other materials of the same general refractory nature.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. The combination of a carbonaceous resistance tube, means for supplying electrical energy thereto to heat the same, means for supplying hydrogen to said tube, and a charge protecting boat heated by said tube, said boat consisting in part of rutile.

2. The combination with a carbon tube resistance heater, of means for continuously supplying hydrogen thereto, and a charge protecting boat of carbon lined with rutile inclosed and heated by said tube and also protected by said hydrogen.

3. In an electric furnace, the combination of a carbonaceous tube, means for heating said tube, means for supplying hydrogen to one end of said tube, and a refractory boat, having marked affinity for carbon, mounted in said tube in the path of said hydrogen, said boat being open.

In witness whereof, I have hereunto set my hand this 28th day of December, 1908.

C. T. FULLER.

Witnesses:
J. H. Elkins,
S. W. Whitehead.