Sept. 10, 1935. E. HEDIGER 2,013,755

ELECTRIC FURNACE

Filed May 7, 1934

Fig. 1.

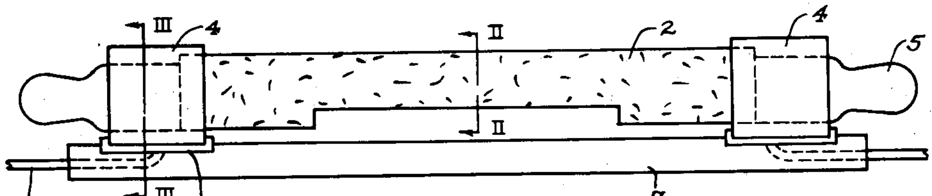


Fig. 2.

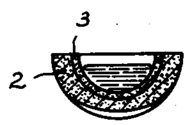


Fig. 3.

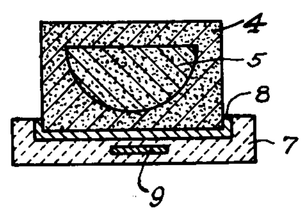


Fig. 4

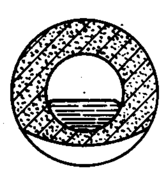
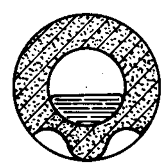


Fig. 5.



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ELECTRIC FURNACE

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Application May 7, 1934, Serial No. 724,268

3 Claims. (Cl. 13—22)

This invention relates to electric furnaces which are used in the preparation of small amounts of metal alloys which it is desired to prepare in a high state of purity. Such alloys are needed for example in dental work where they are used as substitutes for gold. The high cost of gold and its strong color contrast to the tooth to be filled have created a demand for metal substitutes and a need for careful research on the physical and chemical properties of such substitutes. Small amounts of metal are also required for bearings under various lubricating conditions. The selection of the alloy desired for a given purpose requires the preparation of a great number of samples for the various physical and chemical tests which are to be made in the course of such researches.

My invention comprises in a concrete embodiment a combined heater and crucible which is provided with a highly refractory protective coating over the surfaces which come in contact with molten metal.

A specific embodiment of my invention is illustrated by the accompanying drawing in which:

Figure 1 shows a side elevation of my improved heater and crucible;

Figure 2 is a section on the line II—II of Figure 1;

Figure 3 is a section on the line III—III of Figure 1; and

Figures 4 and 5 are transverse sections of modified forms of the combined heater and crucible.

Referring to the drawing in detail, the semi-cylindrical heating element 2 is composed principally of silicon carbide. Refractory bodies formed of bonded silicon carbide usually have a very high electrical resistance especially when cold and have a negative temperature coefficient of resistance in the range in which they are operated. In my United States Patent No. 1,906,853, patented May 2, 1933, I have described a method of making a silicon carbide resistor which has a low specific resistance and a positive temperature coefficient of resistance in the principal operating range, e. g. 550° C. to 1400° C. The raw mix for such a mixture is made from a mixture of silicon carbide of different grit sizes to which about 2 per cent of finely divided carbon is added. For example one fifth of the silicon carbide granules may range in size from 14 to 36 mesh (per linear inch), one fifth from 50 to 70 mesh, while the remainder are smaller than 80 mesh. The mix is moistened with sodium silicate solution as a temporary agglutinant and made in the form of long tubes. These tubes are dried and given a preliminary baking at about 600° C. Before the final curing operation the tubes are given a protecting coating produced by dipping them in a slip or slurry composed of finely divided sand and carbon suspended in water. The tubes are then placed in series in a bed composed of finely divided carbon and silica which surrounds the tubes. The curing operation is effected by passing a current through the tubes, using at first a high voltage to start the current and reducing the applied voltage as the specific conductivity of the tubes increases. The baked slurry may be removed by brushing the tubes after the curing process. The ends of the tubes are then trimmed to remove the terminal portions. The trimmed tubes are then cut in transverse and axial planes to yield semi-cylindrical elements of the desired length. The cutting of the tube can be performed by means of a silicon carbide or fused alumina cut-off wheel of small thickness (axially measured) e. g. $\frac{1}{16}$ inch thick. The central portion of any element can then be reduced in cross-sectional area to give the form indicated in Figures 1 and 2. This can be done by grinding or lapping the convex outer surface by means of a silicon carbide or fused alumina wheel or by means of a wheel made of softer material to which finely divided abrasive is supplied at the point of contact. To make the heating surface more chemically inert, the inside surface of the semi-cylindrical element is painted with a slurry containing a large percentage of alumina. This coating may consist for example of 95 per cent of alumina and 5 per cent of bentonite clay. This coating is hardened on the heating element by passing an electric current through the element. The coating is indicated by the reference character 3 in the drawing. It helps to prevent contamination of the molten metal by the silicon carbide element. The ends of the heating element rest in terminal blocks 4 which are composed of carbon or graphite. These blocks are provided with openings extending therethrough but normally closed by aluminous plugs 5. The molten metal contacts therefore with the aluminous coating of the heating element and with the aluminous plugs in the terminal blocks, the plugs being of such dimensions that they extend over the terminal areas of the semi-cylindrical trough. The molten metal may be poured from the trough by removing one of the plugs. To facilitate the pouring, the heating element and terminal blocks are mounted on a base 7. The carbon blocks 4 rest on metal plates 8 set in recesses in the insulating base. The outer convex surfaces of the terminal portions of the element

2 are sprayed with a thin coating of conducting metal such as brass. This is conveniently performed by means of a Schoop gun.

In assembling the heating element 2 within the carbon blocks 4 a carbon paste can be used between each terminal portion of the element and the adjacent surface of the supporting block. This intermediate conducting material fills in gaps caused by imperfect fitting of the terminal portion of the heating element within the corresponding opening of the block 4. The carbon paste can be made of graphite or lampblack mixed with a small proportion of sodium silicate or a carbonaceous binder such as glutrin (a residue from the sulphite treatment of wood pulp). The carbon blocks 4 can be set in direct contact with the metal plates 8 or a carbon paste can be added if any block does not fit well in its recess in the metal plate. Lead wires 9 are indicated for the connection of the heating element with an outside source of power.

The heating elements 2 can be made of carbon instead of silicon carbide or may be made of finely divided carbon bonded with clay or other material which will increase the specific resistance of the element.

The inert coating can be made by using a slurry of zirconia mixed with a small percentage (e. g. 5 per cent) of bentonite.

Figure 4 shows a transverse section of a combined heating element and crucible which has a cylindrical base. The area of cross-section can be diminished by grinding or lapping the outer convex surface as indicated for the semi-cylindrical element in Figure 2 where the outer surface of the element is applied to the periphery of an abrasive wheel whose plane of rotation is perpendicular to the axis of the element.

The central portion of the tubular element may be fluted as indicated in Figure 5 by means of an abrasive wheel which is rotated in a plane parallel to the axis of the element.

My heater and crucible have many advantages for research on metal alloys where large numbers of small batches of metal are required for testing purposes. My apparatus is extremely compact. The heating elements can be made at small cost and are very easily renewed. The conditions are favorable to the production of alloys without contamination from other metals.

Many variations may be made in the form of my compact melting furnace and in the method of mounting it and connecting it to sources of power. The invention is defined within the compass of the following claims.

I claim:

1. A heating device for melting small quantities of metal comprising a semicylindrical trough composed mainly of silicon carbide which is bonded by passing an electric current longitudinally of the trough member, metal terminals sprayed on the outer convex surfaces of the ends of the trough element, said element having a relatively thin wall intermediate of its two ends to concentrate the heating of an electric current to a major extent in the intermediate portion of the trough element, an aluminous coating attached to the inner surface of the trough element, two carbonaceous blocks of comparatively large volume provided with grooves complementary to the semicylindrical metallized terminals, and a packing of finely divided carbon between the metallized terminals and the grooved surfaces of the blocks.

2. The method of making simultaneously a plurality of similar small crucibles which comprises molding finely divided silicon carbide into a long hollow cylindrical element, heating the element by passing an electrical current therethrough to bond the silicon carbide particles, baking an aluminous coating containing a small proportion of flux on the inside surface of the cylinder, cutting the hollow cylinder longitudinally in an axial plane and also in a plurality of transverse planes to obtain a plurality of semi-cylindrical trough-shaped heating elements, plugging the ends of each trough-shaped element with an inert refractory material to make a plurality of similar crucibles, and reducing the wall thickness of the intermediate portion of each trough-shaped element to concentrate a major portion of the heating in said intermediate portion when an electric potential is applied to the terminals.

3. The heating device described in claim 1 in which the crucible lining contains more than nenety per cent of alumina.

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