W. D. COOLIDGE.

ELECTRIC RESISTANCE FURNACE.

APPLICATION FILED DEC. 16, 1916.

1,268,685.

Patented June 4, 1918.

Fig. 1.

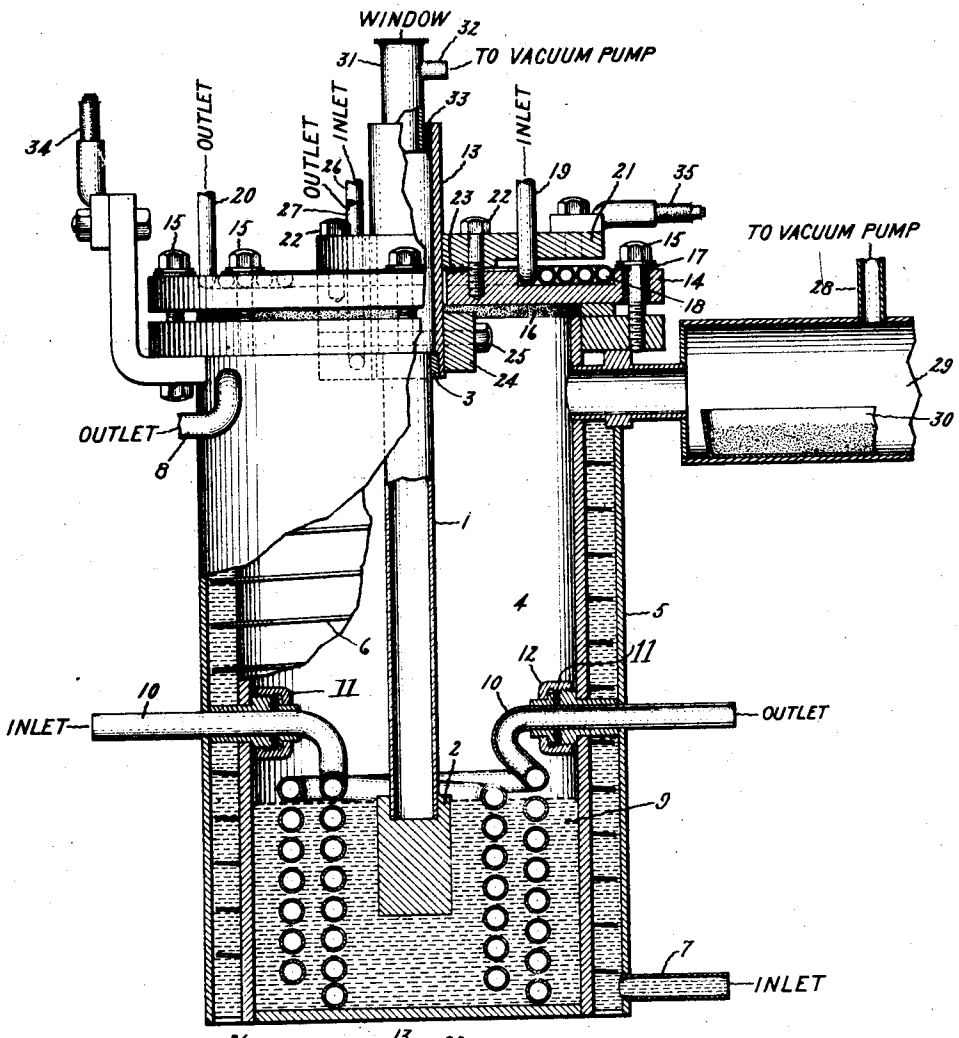
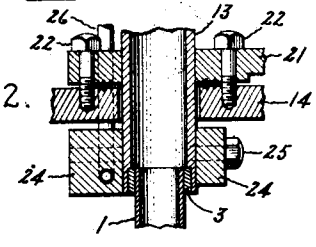


Fig. 2.



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UNITED STATES PATENT OFFICE.

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ELECTRIC-RESISTANCE FURNACE.

1,268,685. Specification of Letters Patent. Patented June 4, 1918.

Application filed December 16, 1916. Serial No. 137,354.

To all whom it may concern:

Be it known that I, WILLIAM D. COOLIDGE, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Electric-Resistance Furnaces, of which the following is a specification.

The present invention comprises a novel resistance furnace having a heater tube of refractory material, the object of the invention being to provide a simple, rugged furnace capable of operation at temperatures up to 2500° C., or more and adapted to maintain a high vacuum or inert atmosphere about the object to be heated.

The novel features of my invention will be pointed out with particularity in the appended claims and a detailed description of the invention will be given in connection with the accompanying drawings of which Figure 1 illustrates partly in perspective and partly in vertical section a furnace embodying my invention, and Fig. 2 shows in section details of a terminal adjacent to the cover plate.

As shown in the drawing, the furnace comprises a heater tube 1 of highly refractory material, preferably tungsten, at one end of which is joined a plug 2 of a metal of high electrical and heat conductivity, for example, copper, which closes the end of the tube. At the opposite end a ring 3 of like metal is joined. The copper is preferably first treated while fused with oxidizable boron material to remove dissolved gases and is then cast in a vacuum in contact with the tungsten, as described in my prior Patent, No. 1,162,341. In this way an intimate molecular adherence of the two metals is secured. Surrounding the heater tube and spaced away therefrom is an inclosing envelop or tank 4, which is provided with an outer jacket 5 affording a space through which a cooling fluid may be circulated. On the outer surface of the tank 4 spiral baffle plates 6 are located to cause a circulation about the tank of water or other cooling fluid, admitted through a tube 7 and exhausted through a tube 8.

Between the plug 2 at the lower closed end of the heater tube and the tank 4 is provided a yielding or floating electrical connection, preferably a body 9 of liquid metal, such as mercury which permits expansion and contraction of the heater while preserving good electrical connection. A cooling coil 10, immersed in the mercury maintains a desired temperature during the operation of the furnace. Suitable gas-tight packed couplings 11, 12 are provided for the inlet and outlet tube of the cooling coil.

The contact ring 3 is mechanically fitted within the end of a metal tube 13 which passes through the cover plate 14 of the tank 4. The cover plate is maintained firmly pressed against the tank 4 by bolts 15, suitable insulating gaskets 16, 17 of fiber, rubber or the like, being provided to insulate the cover from the tank and the bolts 15. The cover is cooled by means of a coil 18, having an inlet tube 19 and an outlet tube 20. A contact plate 21 joined to the tube 13 is fastened to the cover plate 14 by bolts 22, suitable washers 23 of lead or the like being provided to make a gas-tight joint. A split clamping ring 24 best shown in Fig. 2 surrounds the tube 13 at its junction with the ring 3 on the open end of the heater. It is drawn tightly against the junction by a bolt 25. This clamping ring 24 is also water-cooled, the inlet pipe 26 and the outlet pipe 27 being shown in Fig. 1 adjacent the tube 13.

The space between the resistor tube 1 and the tank may be evacuated or charged with gas through a tube 28, and is shown as communicating with a vacuum pump through a chamber 29 containing a drying agent 30 such as phosphorous pentoxid. The space within the heater tube may be separately evacuated, or charged with gas. As indicated the end of the charging tube 13 is closed with a cylindrical stopper 31 communicating with a tube 32, and provided if desired with a window for observing the interior of the heater tube. A gasket 33 of rubber secures a vacuum-tight joint.

A heating current for the heater tube is supplied by conductors 34, 35, connected respectively to the tank 4 and the contact 21. A furnace constructed as above described with artificially-cooled electrical terminals in intimate contact with the heater and located within the inclosing tank, may be heated up with great rapidity with a

sufficiently heavy current without weakening or increasing the electrical resistance of the contacts.

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

1. An electric furnace comprising a heater tube consisting of refractory material, a plug of metal of good heat and electrical conductivity molecularly joined to and closing one end of said tube, an inclosing metal tank spaced apart from said heater tube, a yielding electrical connection between said inclosed end of the heater tube and the tank, an insulating seal between the opposite end of the heater tube and said tank, and electrical connections respectively for said tank, and for the end of the heater tube opposite the end in electrical contact with said tank.

2. An electric furnace comprising a heater tube of tungsten, a plug of copper joined to and closing one end of said tube, a copper contact ring joined to the opposite open end of said tube, a metal tank inclosing said tube, a yielding electrical connection between said plug and said tank, a metal cover for said tank electrically in contact with said heater tube, an insulating seal between said cover and said tank, and electrical connections respectively for said tank and said cover.

3. An electric furnace comprising a substantially gas-tight heater tube of refractory material, means for removing or introducing gas to said tube, means for conducting a heating current thereto, and a sealed inclosing envelop spaced apart from said heater tube and adapted to be separately evacuated or filled with gas.

4. A vacuum furnace comprising a heater tube of refractory material, a metallic casing for said tube spaced apart therefrom, a quantity of mercury in said casing, means for cooling said mercury, a plug of good conducting material joined to one end of said heater tube and contacting with said mercury, and electrical connections respectively for the opposite end of said tube and for the metallic casing.

5. A furnace comprising a heater tube of refractory material, a metal casing spaced apart therefrom, an insulating seal between one end of said heater tube and said casing, a conducting liquid between the opposite end of said tube and said casing, and electrical connections respectively for said casing and for the end of said heater tube insulated from said casing.

6. An electric furnace comprising a resistor of refractory material inclosing a heating zone, a metal casing spaced away from said resistor comprising a tank and a cover for said tank, an insulating seal between said casing and said cover, a yielding electrical connection between one of the members of said tank and one end of said resistor, and an electrical connection for the opposite end of said resistor.

7. An electric furnace comprising a resistor tube of refractory material, bodies of metal of good heat conductivity molecularly adhering to opposite ends of said resistor, an inclosing tank, electrical contacts joined to said adhering bodies of metal within said tank, means for artificially cooling said contacts, a tube for introducing a charge to be heated into said resistor tube communicating with said resistor tube and projecting outside of said tank, and electrical connections for said contacts.

8. An electric furnace comprising a tungsten tube closed at one end, a gas-tight casing surrounding said tube and spaced apart therefrom, a quantity of liquid metal in contact with the closed end of said tube, a charge-receiving tube electrically connected to the open end of said tungsten tube and projecting through said casing, means for evacuating or filling with gas the space between said tungsten tube and said casing independently of the space within said tube, and electrical connections for the respective ends of said tungsten tube whereby a current for heating the tube may be conveyed.

9. An electric furnace comprising a gas-impervious refractory conducting tube sealed at one end, means for introducing and withdrawing a charge into the opposite end thereof, a gas-tight casing surrounding said tube and spaced away therefrom, a yielding electrical connection between the closed end of said tube and said casing, an electrical connection to the opposite end of said tube and means for evacuating the space between said tube and said casing independently of the space within said tube.

In witness whereof, I have hereunto set my hand this 14th day of Dec., 1916.

WILLIAM D. COOLIDGE.