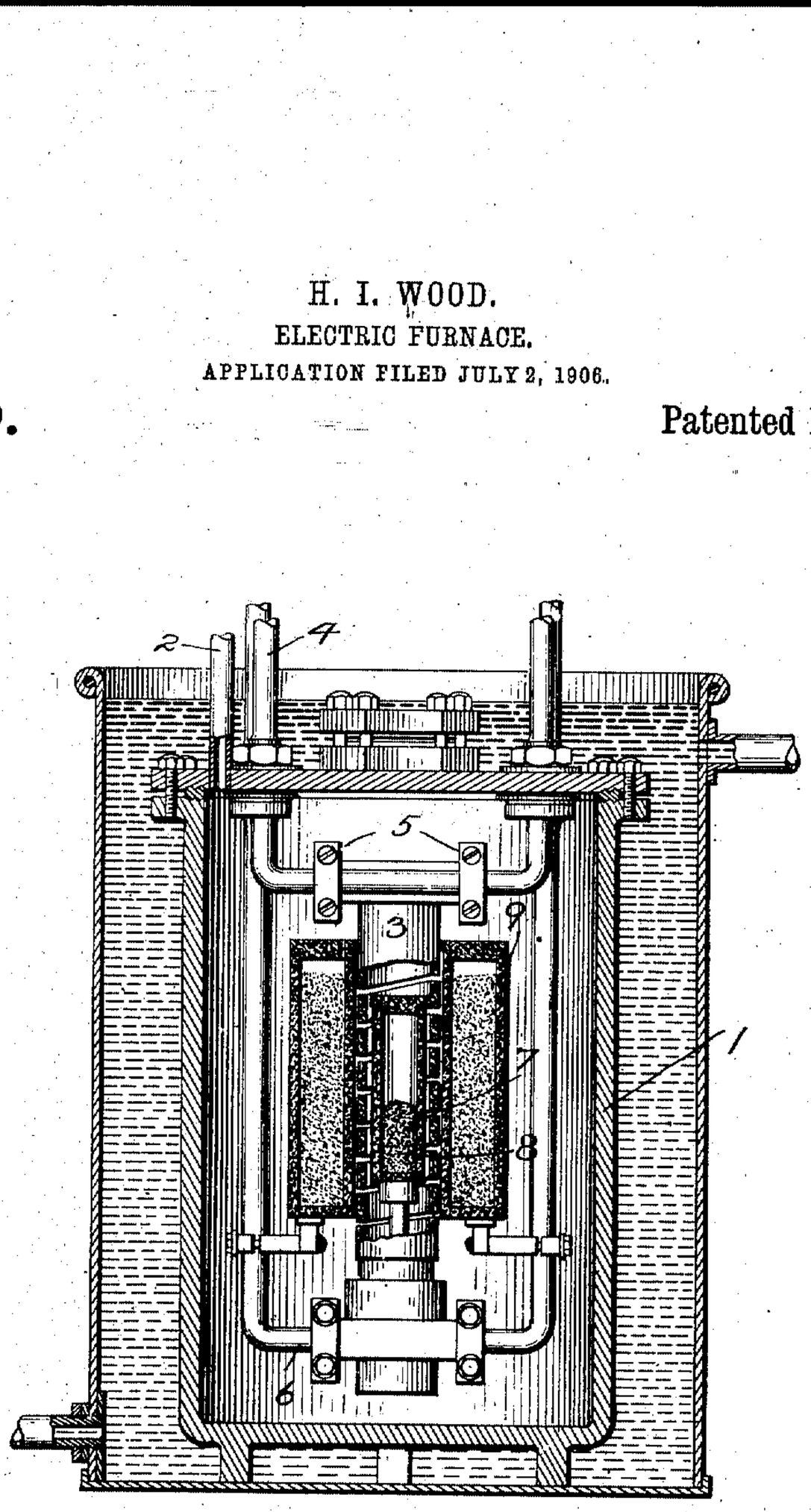
H. I. WOOD.

ELECTRIC FURNACE.

APPLICATION FILED JULY 2, 1906.

984,119. **Patented Feb. 14, 1911.**



WITNESSES

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UNITED STATES PATENT OFFICE.

HOWARD I. WOOD, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRIC FURNACE.

984,119. Specification of Letters Patent. Patented Feb. 14, 1911.

Application filed July 2, 1906. Serial No. 324,388.

To all whom it may concern:

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

Several of the refractory metals are known to have a fusing temperature higher than that at which carbon or graphite appears to vaporize and disintegrate *in vacuo*, and various reducible compounds of these metals require for reduction a temperature higher than can be produced by a resistance conductor of graphite without danger that the product will be contaminated by carbon given off by the heating member.

My invention comprises means for the protection of the material under treatment from any substantial contamination by carbon, even though the material under treatment may be heated in the presence of graphite to a temperature considerably higher than that at which graphite begins to disintegrate.

The drawing is a sectional elevation of one type of furnace to which my invention may be applied.

The furnace consists of a water cooled metal envelop 1 having air-tight joints and an outlet 2 for connection with a vacuum pump. The pump is used for exhausting the chamber and for insuring a low pressure at all stages of the heat treatment. The resistance conductor of the furnace consists of a helix 3 of graphite, clamped at the top to a U-shaped tube 4, which passes through the top of the chamber and serves as a means for delivering current to the refractory helix. The tube may be supplied with a cooling liquid to insure a good contact at the end of the helix and to prevent vaporization of the metal clamps 5 by means of which the helix is clamped to the tube. A similar U-shaped tube 6 is clamped to the lower end of the helix and serves as a support therefor and as means for connecting to a source of power. The material 7 to be treated is inclosed in a covered crucible 8 within the refractory helix but out of contact therewith. To insure a concentration of heat on the crucible and its contents, the helix is surrounded by a refractory shield 9 consisting of an annular box filled with graphite powder.

When the furnace is to be used for the reduction of tantalum oxid, the charge is introduced into the crucible 8, and after the chamber formed by envelop 1 has been evacuated, current is passed through the refractory helix 3 and the charge is heated up to the desired temperature. If the desired temperature is higher than that at which carbon disintegrates, there is danger that the material of the helix or of the surrounding shield will pass into the charge and change the chemical composition thereof. I find, however, that by making the crucible of suitable material I can protect the charge from the carbon, even at exceedingly high temperatures. If the charge is of tantalum oxid, I may make the crucible of tantalum oxid or of tantalum carbid, as these materials will absorb the vaporized carbon and prevent its action on the charge within the crucible. If the charge is metallic tantalum which is to be melted or fused, I may make the crucible of tantalum carbid.

I have referred to tantalum and its oxid as material suitable for treatment in this furnace but I desire it to be understood that I may treat other refractory metals or their compounds to fuse the materials or to reduce or otherwise modify the compounds. All this may be done at a temperature higher than that at which carbon disintegrates, by surrounding the material under treatment with a crucible or other envelop consisting of material which does not react on the charge and which has sufficient power of absorbing carbon vapors to prevent any substantial contamination of the charge by carbon given off by the heating members of the furnace.

Although I may treat other materials than tantalum and use other protective material than tantalum oxid, I consider that these are typical of the general class of materials to which my invention applies and will serve to disclose my invention to persons skilled in the art.

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

1. The combination of an evacuated chamber, a tubular resistance heater of carbonaceous material, within said chamber, means

for supporting a charge in proximity to said heater, and a closed envelop within said heater but out of contact therewith, said envelop consisting of a refractory compound of a refractory metal.

2. In a furnace, the combination of an evacuated chamber, a graphite resistance heater within said envelop subject to disintegration when in normal operation, and a closed envelop inclosing the furnace charge and separated from said heater by an evacuated space, said charge-inclosing envelop consisting of material capable of chemically uniting with such carbon vapor as crosses said space.

3. In a furnace, the combination of an evacuated chamber, a tubular resistance heater within said chamber subject to disintegration by heat at normal operating temperature of the furnace, and a charge protecting envelop within said heater and separated therefrom by an annular gap, said envelop consisting of material capable of uniting with material liberated by said heater.

4. The combination of an evacuated chamber, a heater of carbonaceous material therein, and a closed charge-protecting envelop therein but out of contact therewith, said envelop consisting of a refractory compound of a refractory metal, said compound having high affinity for carbon.

5. The combination of an evacuated chamber, a resistance heater therein consisting of carbonaceous material, and a closed charge-inclosing envelop in proximity therewith having a marked affinity for carbon and yielding a reduction product stable at the temperature at which carbon begins to disintegrate.

6. The combination of a resistance heater, and a charge protecting envelop proximity thereto but out of contact therewith having high affinity for the material of said heater and yielding a stable product when associated with vaporized material from said heater.

7. The combination of an evacuated envelop, a hollow resistance heater therein of carbonaceous material, and a closed charge-protecting envelop in proximity thereto but out of contact therewith, having a high affinity for carbon.

In witness whereof, I have hereunto set my hand this 30th day of June, 1906.

HOWARD I. WOOD.

Witnesses:
EDWARD WILLIAMS, JR.,
ARBA B. MARVIN, JR.