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DEVICE FOR MANUFACTURING TUNGSTEN CARBIDE

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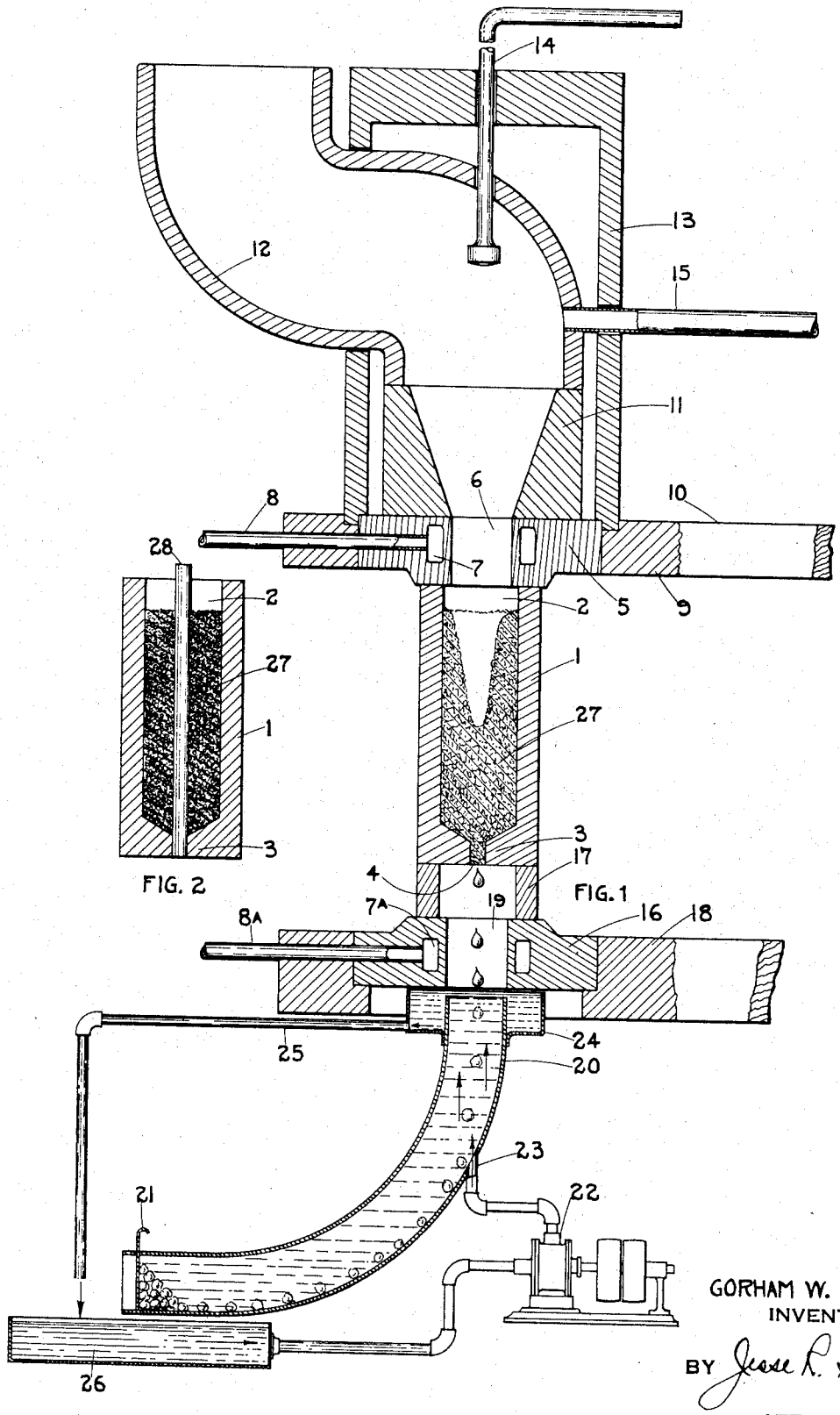


FIG. 2

FIG. 1

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DEVICE FOR MANUFACTURING TUNGSTEN CARBIDE

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7 Claims. (Cl. 13—22)

My invention relates to apparatus employed in the manufacture of tungsten carbide.

In the making of tungsten carbide it is known that the product has its most perfect structure, hardness and resistance to wear where the proportion of carbon to tungsten is about 3.5% to 4%, and the carbide must be quenched quickly. For, where it is cooled slowly, it will be coarse grained and specular instead of fine grained, as is desired, particularly if the proportional amount of carbon approaches the maximum allowed limit of 4%.

It is an object of the invention to provide an apparatus for the melting of the mixture of carbon and tungsten in which the proportions of the two ingredients may be maintained accurately and the product be quickly quenched.

I desire also to allow for the escape of gases during the fusion of the charge in the crucible to permit the charge to escape as soon as it melts and to collect the tungsten tending to be carried off by the escaping gas.

It is a further object to provide an electric furnace construction wherein the crucible may be used repeatedly and cleaned where necessary.

In the drawing herewith Fig. 1 is a central longitudinal section through an apparatus embodying my invention.

Fig. 2 is a similar section through the crucible showing my provision for permitting escape of gas from the charge.

The crucible 1 which I prefer, is a cylindrical pot of heat resisting material such as graphite. It has an interior chamber 2 to receive the charge and while the upper end is open, the lower end is provided with thickened interior walls 3 thus forming a discharge orifice 4 of comparatively small diameter.

The upper end of the crucible is partially closed by a water cooled top 5 of copper in the form of a heavy plate with an opening 6 above the crucible. It has a water circulating chamber 7 about the opening to which water may be conducted through a pipe 8 in the usual manner. This top plate 5, forms part of the upper electrode or bus bar 9 connected with a conductor 10 for electric current.

Above the plate and electrode and supported thereon is a two part brass funnel 11 including a downwardly converging hopper leading to the opening 6, and a curved extension 12 on the funnel. Said extension provides a feeding opening and tends to prevent the escape of the powdered charge with the gas from the melting carbide. The funnel is partly enclosed by a housing 13.

Through the housing and funnel a cleaning plunger 14 is extended downwardly axially of the opening 6 so that the opening may be cleaned when desired. Also a lateral pipe 15 is extended into the funnel to carry a supply of reducing gas such as hydrogen or methane to the crucible.

The crucible rests upon a lower copper, water-cooled, bottom 16 from which it is spaced by a short cylindrical bottom ring 17 of graphite. The plate 16 is constructed like the plate 5. It is water-cooled through a chamber 7a and a pipe 8a and is supported on the electric terminal 18 forming the other electrode in the electric circuit in which the furnace is connected.

The plate 16 has a central opening 19 through which the molten carbide is discharged to a mold 20. This mold may be of any preferred form adapted to cool the charge quickly. I have shown a tubular container curved on an arc of a circle, the lower end of which is closed by a hand-operated valve 21. This mold may be filled with oil or other preferred quenching fluid. I circulate this oil through a pump 22 having the discharge end connected with the mold at 23 thus circulating the oil over the top of the mold into a shallow pan 24 from which it flows by gravity through the pipe 25 to a pan 26, connected with the intake end of the pump.

When the charge 27 of tungsten and carbon in powdered form is placed in the crucible 1, I place a tube 28 of combustible material such as paper axially of the crucible and filling the opening 4 at the lower end thereof. The powdered charge is preferably mixed with a material causing it to cake when heated such as heavy lubricant.

Thus when the current is turned on and the charge heats up, the ingredients will cake and the paper tube will burn up leaving a central opening through the charge to allow escape of gas from the melting materials. It is found that the escaping gas ordinarily carries with it parts of the powdered tungsten which are wasted. By forming the funnel over the crucible, a collector of this powder is provided which collects the powder and delivers it back to the crucible. With the central opening provided by the tube 28, the explosions of gas are greatly lessened and I am thus able to save materials previously wasted and also have a more smoothly operating apparatus.

When the charge begins to melt, it becomes fluid and flows out gradually through the opening 4 into the mold 20. It is here cooled quickly and drops in small pieces to the bottom of the mold. Thus the carbide is not overheated in

melting, and when melted, is quickly cooled to form a small pebble of tungsten carbide of the desired quality.

The crucible may be cleaned after its first use and may be again employed repeatedly without removing from the apparatus. As the crucibles are frequently broken when moved, I am thus enabled to economize on the repeated use of the same crucible without breaking. By employing a reducing gas in the furnace, the tungsten is not burned when melted in this manner.

What I claim as new is:

1. An electric furnace for the purpose described, including upper and lower electrically conducting plates, means to cool said plates, a crucible between said plates, said upper plate having an opening above said crucible to receive the material to be fused and a laterally curved funnel above said opening through which said material may be fed thereto by gravity.

2. An electric furnace for the purpose described, including upper and lower electrically conducting plates, means to cool said plates, a crucible between said plates, said upper plate having an opening above said crucible through which a charge may travel by gravity and a laterally curved funnel above said opening, and a laterally curved mold below said crucible adapted to cool the carbide quickly.

3. In an electric furnace including upper and lower electrodes, plates on said electrodes with openings therein, a graphite crucible between the openings in said plates, said upper plate partly closing the upper end of said crucible, a laterally curved funnel above said upper electrode and means to clean said upper opening.

4. In an electric furnace upper and lower electrodes, water cooled plates having openings therein on said electrodes, a crucible between said plates, means above said crucible to receive the burning gases from said crucible and to collect portions of the contents, a mold below said crucible and means to cool said mold.

5. In an electric furnace including upper and lower electrodes, a crucible between them, said crucible having its upper end open and a discharge orifice in its lower end, combustible means closing said orifice and adapted to extend upwardly through the charge in said crucible and means below said orifice to receive and cool the charge.

6. An electric furnace including upper and lower electrodes, a crucible between them, said crucible having its upper end open and a discharge orifice in its lower end, a liquid filled mold below said orifice to receive the drops of melting material from said crucible and direct it away from said orifice and means to circulate said liquid toward said molten material.

7. An electric furnace for the purpose described including upper and lower plates forming electrodes, both said plates having openings therethrough, a crucible between said plates and connected with said openings, means to cool said plates about said openings, a funnel above the opening in said upper plate, means to clean said upper opening, and a mold beneath the opening in said lower plate to receive the molten charge from said crucible.

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