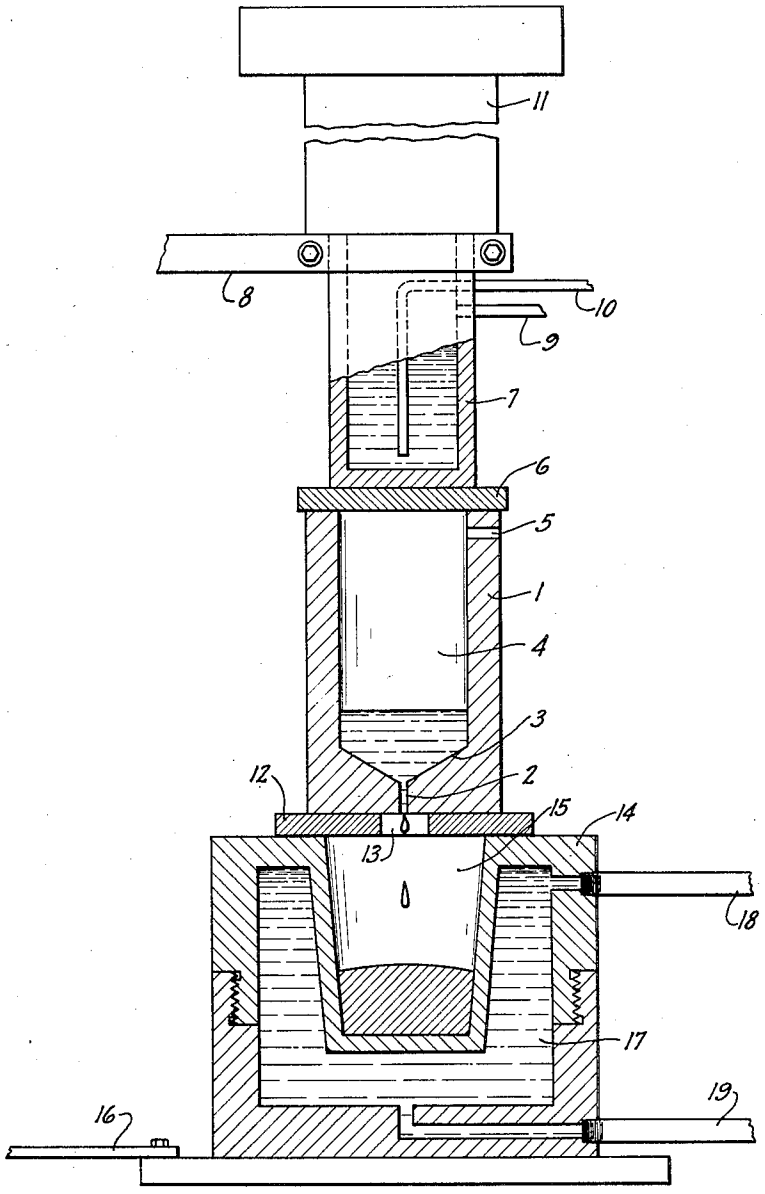
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ELECTRICAL FURNACE

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UNITED STATES PATENT OFFICE

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ELECTRICAL FURNACE

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My invention relates to furnaces for fusing materials of relatively high melting point, and pertains particularly to electrical furnaces of either the resistance or the induction type.

I shall illustrate the operation of my invention as applied to the forming of tungsten carbide, but I wish it understood that it may be used for general application to other metals. In forming tungsten carbide, it is best to employ a container of graphite, and for proper results the molten carbide should be removed from the crucible and quickly cooled before too great a proportion of carbon has been absorbed from the crucible.

It is believed that tungsten carbide of good quality and hardness consists of a solution of W_2C in tungsten containing crystals of WC. WC is the hardest, but also the most brittle of the carbides of tungsten, and the quality of the product depends upon the size of the WC crystals. The size of the WC crystals may be decreased by rapid cooling from the molten condition. If allowed to cool slowly, the WC will decompose to form a lower carbide of tungsten and graphite. A solid fine grained tungsten has a melting point of 2800° C. and a hardness of 9.4 to 9.8.

It is an object of my invention to provide a furnace in which the proper proportions of the constituents of the resulting compound may be accurately maintained, and in which the cooling of the same thereafter may be quickly accomplished.

I desire to heat the ingredients quickly and to discharge the same automatically when they have been fused and before sufficient time has elapsed to permit the absorption of too great an amount of carbon.

The device includes a mold into which the contents of the crucible are discharged, said mold being maintained comparatively cool to cause immediate hardening of the material.

In the drawing is shown, partly in vertical section, a preferred design of furnace by means of which my invention may be carried out.

I have formed a crucible 1 of graphite or other heat resisting substance. The crucible may be cylindrical in form, open at its upper end and closed at its lower end, except for a small discharge opening 2. The inner walls of the chamber 4 thus formed in the crucible slope downwardly to the opening 2 as indicated at 3. The wall of the crucible has a small vent opening 5 at its upper end to allow for escape of gas.

The top of the crucible may be closed by a plate 6 also of graphite. The plate contacts with an electrical conductor 7 arranged to be cooled by the circulation of a cooling liquid therethrough. Said conductor forms an electrode of hollow construction, the upper end of which is connected to a heavy conductor 8 of copper. The electrode 7 may also be of copper and adapted to be filled with the cooling liquid circulated therethrough from pipes 9 and 10 leading to some source of liquid under pressure, or to a circulating pump, not shown.

The electrode 7 is held in firm contact with the crucible by weights 11 thereon.

The crucible is supported upon a plate 12 of graphite resting upon a mold 14. Said plate 12 has a central opening 13 below the opening 2 in the crucible to allow the discharge of the molten tungsten carbide to the mold. A mold chamber 15 receives the metal, and as this mold also forms an electrode its lower end is connected to an electrical conductor 16.

The mold is preferably of copper, and is water cooled by forming a liquid chamber 17 about the mold chamber. The liquid chamber is connected with pipes 18 and 19 through which cooling liquid may be circulated to the mold.

In the operation of the device the carbon and tungsten in powdered form are introduced into the crucible. The crucible is then heated by passing the electrical current through the walls of the crucible, which are immediately heated through the resistance of the same to the passage of the current. The copper electrodes 7 and 14 are good conductors, and are cooled by the liquid circulation as described. The contents of the crucible will soon begin to melt slowly, and the current will

be regulated to allow the melting to occur gradually, while the gaseous impurities in the tungsten escape through the vent 5. After the flow of gas from the vent subsides, the current will be turned on more fully and the heat is rapidly increased. The molten carbide gives up the residue of gas therein, and begins to run through the small opening 2 into the mold. The molten carbide is immediately cooled in the mold, and a uniform quality of carbide is obtained with fine grained tungsten crystals therein.

There is usually a small amount of tungsten carbide remaining in the opening 2 after the charge has passed to the mold, and this melts with the next charge to allow the contents to be discharged. I contemplate filling the opening 2 each time with tungsten carbide or some material of the same or slightly higher melting point, so that the charge will be automatically released as soon as it is completely melted, and before it is allowed to combine with carbon gas from the crucible. If the molten material remains too long in the crucible the product will show graphite flakes due to carbon included from the crucible and to decomposition of the carbide which has formed.

The advantage of my invention lies in the convenient operation of the device whereby the charge is quickly and uniformly melted, and automatically discharged before it has remained too long in a molten state in the crucible. The rapid cooling of the charge also results in the best quality of product.

What I claim as new is:

1. An electric furnace including a crucible of graphite, electrodes at each end thereof, said crucible having a discharge opening at the lower end thereof, said opening being normally closed by material of the same melting point as the charge in the crucible, the lower electrode forming a cooling mold.

2. An electrical furnace, including a crucible of graphite, electrodes at each end thereof, said crucible having a discharge opening at the lower end thereof, said opening being normally closed by a plug of the same material as the charge in the crucible, the lower end of the crucible being formed to melt the plug at the same time that the charge becomes completely molten.

3. In combination, a crucible of electrical resisting material having a small discharge opening therein at its lower end, the walls of said crucible being thickest about said opening, means to close said opening adapted to be melted at a temperature approximately the same as the melting point of the charge in the crucible, and electrical resistance means to heat said crucible, whereby the whole charge is released as soon as it becomes fused.

In testimony whereof, I hereunto affix my signature, this the 11th day of January, A. D. 1929.

GORHAM W. WOODS.