

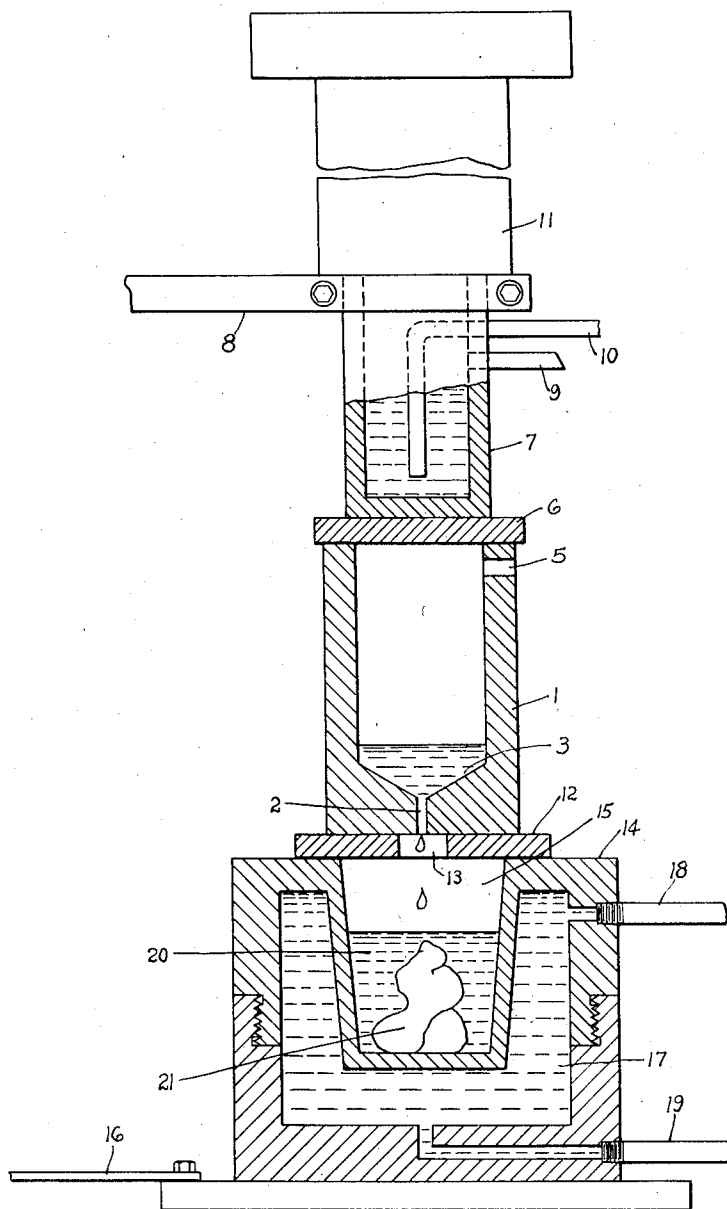
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METHOD OF FORMING TUNGSTEN CARBIDE

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METHOD OF FORMING TUNGSTEN CARBIDE

Application filed November 7, 1929. Serial No. 405,391.

Our invention relates to a method of forming tungsten carbide and the like, and pertains to the proper melting and cooling of the charge so as to produce the best quality of tungsten carbide for the purpose to which the carbide is to be applied.

Tungsten carbide is now commonly applied to tools where a hard surface is desired to resist abrasion. For this purpose, the carbide should not be too brittle and should not contain too large a proportion of carbon.

It is an object of the invention to so treat the tungsten carbide that the molten charge will not take up an excess of carbon over the desired amount.

We also desire to cool the carbide quickly so as to obtain a proper grain and consistency to the finished product.

The invention lies in the process of treating the materials in the obtaining of the final product, and the salient features of the invention will be set out in the specification which follows.

In the drawing herewith is a front view largely in section of an apparatus which may be used to carry out the invention.

This application is a continuation, in part, from the co-pending application of Gorham W. Woods, Serial No. 333,501, filed January 18, 1929. It differs therefrom in the addition of more effective cooling means.

The ingredients consisting of the proper proportions of tungsten and carbon are placed in a crucible 1 of graphite or other heat resisting material. Said crucible may be of cylindrical form, open at its upper end and closed at its lower end, except for a small discharge opening 2. The walls of the crucible are thickened at the lower end, and the inner wall thereof is tapered or sloped downwardly at 3 to direct the molten charge to the outlet. By making the walls thicker the electrical resistance is decreased about the opening 2. The crucible has a vent opening 5 adjacent its upper end for 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, which forms part of an electrical circuit. 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. A weight 11 is employed to hold the electrode 7 in firm contact with the crucible.

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. The 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 made of copper, or other good electrical conductor, and is water cooled on the outside thereof by forming a liquid chamber 17 about the mold chamber. The liquid chamber is connected by pipes 18 and 19 to a source of supply of cooling liquid which may be circulated therethrough.

As a further provision for cooling, we contemplate the use of salt within the crucible into which the metal is discharged. Any preferred salt may be employed and common salt, or sodium chloride, may be used because of its cheapness, and because its melting point of 804° C. makes it adaptable for the purpose. Other salts such as magnesium chloride, sodium carbonate and the like may be substituted, depending upon the cooling effect desired. Such salt, indicated at 20 in the drawing will be melted under the heat of the carbide, which is about 2800° C., and will be vaporized to some extent, thus, also adding to the cooling effect of the salt bath.

In operation, the tungsten and carbon in powdered form are introduced into the crucible, and the crucible then heated by passing the electrical current through the walls of the crucible which are heated through the resistance of the graphite to the passage of the current. The contents of the crucible will be melted when the temperature of fusion is

- reached. The current will be regulated to allow the melting to occur gradually, while 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 opening 2 at the lower end of the crucible is closed by some unmelted tungsten carbide at the beginning of the operation, and as the material at the lower end of the crucible heats more slowly, due to the thicker walls, the plug of carbide in the opening will melt last and will release the charge, as soon as the said charge has been completely fused.
- The molten carbide is received within the mold chamber 15 which is cooled by the circulation of cooling fluid in the container 17. Also the salt 20 in the mold will melt, and thus serve to further cool the carbide. By the use of the salt, the rapidity of cooling of the charge is materially increased, thus adding to the hardness of the finished product.
- 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. We 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 the 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 we claim as new is:
1. A method of manufacturing tungsten carbide comprising pulverizing the ingredients, placing them in pulverized form into a crucible in the presence of carbon, melting the charge, discharging the same as soon as it is completely melted, and immersing the melted carbide in a liquid bath.
 2. A method of manufacturing tungsten carbide comprising mixing a charge of ingredients in the desired proportions, melting the charge, quickly discharging the molten material after it has been completely melted, immersing the charge in a bath of salts, and rapidly cooling said charge.
 3. A method of manufacturing tungsten carbide comprising mixing a charge of ingredients in the desired proportions, melting the charge, quickly discharging the molten
- material after it has been completely melted, and receiving said charge in a mold containing salts.
- In testimony whereof, we hereunto affix our signatures.
- GORHAM W. WOODS.
HENRY B. WOODS.