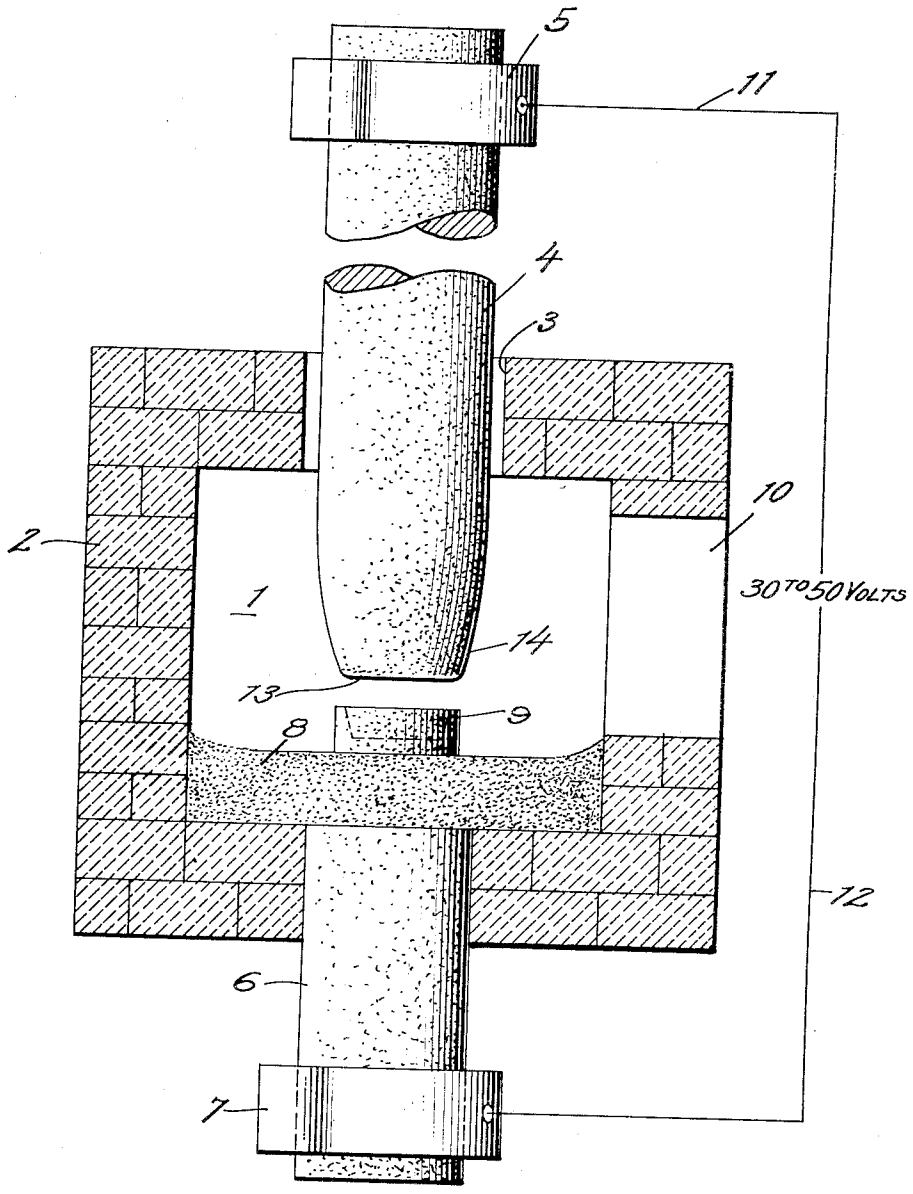
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PROCESS OF MANUFACTURING TUNGSTEN CARBIDE

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PROCESS OF MANUFACTURING TUNGSTEN CARBIDE

Application filed January 21, 1930. Serial No. 422,314.

My present invention relates to the production of tungsten carbide.

This application is a continuation in part of my copending application, Serial No. 371,540, entitled Electric arc furnace electrode holder, and filed June 17, 1929, now Patent 1,775,437, issued September 9, 1930.

Tungsten carbide is now commonly used as diamond substitutes for drill bits. When manufactured under proper conditions, it is substantially pure and of a fine silky grain structure having a hardness comparable with that of a diamond.

In my former Patent No. 1,719,558, issued July 2, 1929, I describe an electric arc furnace, in which tungsten carbide of a high grade can be made in commercial quantities. My present invention relates to a method of manufacturing tungsten carbide, especially by the aid of such an electric arc furnace, although the process is not limited thereto.

It has been observed that tungsten will absorb carbon to form the tungsten carbides. In my former patent hereinabove referred to, I make it possible to control the absorption of carbon by bringing the mixture acted upon by the arc, rapidly to the melting point; and immediately casting it rapidly in cool molds, whereby the chemical union of tungsten and carbon is prevented, by the speed of cooling, from being reversed. My present invention relates to a variation of the manner of use of the furnace disclosed in that patent, although the same attributes thereof are essential; that is, a rapid, uniform heating of the mix.

In my former patent, I am enabled to secure this rapid, uniform heating by the use of a comparatively shallow crucible or work container placed beneath a vertical upper electrode made of carbon, the upper electrode being large enough at least to cover the work container completely; and the arc voltage being maintained at such a low value that the tip of the electrode is closely spaced from the work and serves to confine the heat to it. This tip has also been noticed as being maintained remarkably blunt during operation, it being maintained during operation at about the same area as the area of the work container below it.

These are now well understood phenomena. The arc being enclosed in a comparatively small chamber, it maintains the temperature of the work in the container without material losses by conduction, or through the walls, or by radiation.

In my present invention, I may utilize these same instrumentalities or others which have equivalent effects upon the work in the container. In making tungsten carbide, I have found that when the arc is placed upon a mass of finely divided tungsten, some carbon can be absorbed from the carbon atmosphere in the arc itself, but this absorption is not enough to yield a high grade alloy. In my former Patent, No. 1,721,966, issued July 23, 1929, I describe how this can be corrected by the use of scrap material. It is an object of my invention to make it possible to control the absorption of carbon in a simpler manner than disclosed in my prior patent.

It is another object of my invention in general to improve the product by proper manipulation of the arc furnace itself.

My invention possesses many other advantages, and has other objects which may be made more easily apparent from a consideration of one embodiment of my invention. For this purpose I have shown a form in the drawing accompanying and forming part of the present specification. I shall now proceed to describe this form in detail, which illustrates the general principles of my invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of my invention is best defined by the appended claims.

Referring to the drawing:

The single figure is a diagrammatic sketch of an arc furnace by the aid of which my invention can be practiced.

In this figure, I show a confined arc chamber 1, formed as by refractory walls 2. This arc chamber has an opening 3 at the top which rather closely encompasses a large upper electrode 4, which is movable vertically into the arc chamber 1 by any desired mecha-

nism. This electrode is made of carbon and is held in a clamp or electrode holder 5, preferably water cooled to maintain the temperature of the upper portion of the electrode below a dangerous arcing value. In this way, arcing to the sides of the aperture 3 from the electrode 4 is prevented.

The arc chamber 1 also has a lower electrode structure 6, water cooled as by a clamp 7. This electrode can be made from carbon and extends into the bottom of the chamber 1. Preferably there is a bed of loose carbon particles 8 in the bottom of the chamber 1. Disposed on this bed of carbon 8 and directly beneath the upper electrode 4 is a work container 9, in which the mix that I shall hereinafter describe, is disposed for treatment by the arc. A large opening 10 is also provided not only to view the operation of the arc, but also to make it possible to insert and withdraw the work container 9 as required in the operation of the process.

The current can be supplied to the arc from mains 11 and 12, connected to the clamps 5 and 7. The arc is formed between the blunt tip 13 of the upper electrode 4 and the material in the container 9. The space between this blunt tip and the top of the container 9 is maintained small in value, so that an arc of about 30 to 50 volts alternating current is produced; and also so that no great heat loss occurs by direct radiation from the arc to the walls of the furnace or up toward the roof. The sloping point 14 of the upper electrode 4 also serves by reflection or reverberation to return heat to the lower part of the chamber where it is needed, and to prevent too great a loss of heat by conduction from the work through the bed 8.

In operation, the work container or crucible 9, which is also made of carbon, is first filled with the mixture; and then it is disposed beneath the electrode 4. The arc is then struck by lowering the upper electrode 4 onto the container 9, the current then flowing through container 9, and the carbon bed 8 to the lower electrode structure 6. As soon as the arc is struck, the upper electrode 4 is moved upwardly a short distance. The arc is permitted to play on the work until all of the work is melted, and sometimes for a time in excess of that period, as determined by experience. With a container 9 of about 2½ inches in diameter and about 1¼ inches or 1½ inches deep, the time required for melting the work is in the neighborhood of one minute. The upper electrode 4 is made 4 or 5 inches in diameter. It is thus seen that it is considerably larger in diameter in the present instance than the work container 9, so as to cover, and indeed to overlap the work container 9. After the work has been fully treated, the container 9 is quickly removed as by a pair of pincers, and the contents thereof are poured into comparatively cool molds. In this process, about a pound of material is melted at a time, and the resulting material has a fine silky structure of extreme hardness.

In making tungsten carbide, it would appear that finely divided tungsten, such as tungsten powder, would be all that would be needed to make a good product. I find, however, that with an electric arc, there is an insufficient amount of carbon absorption that is possible in the short interval of operation. This, of course, could be corrected by proper manipulation, but in order to ensure a quick absorption of carbon and thereby speed up the production, I mix with the tungsten powder, some grains of tungsten carbide. The proportions are about twenty-four parts by weight of the tungsten carbide, to about six parts by weight of the tungsten powder. Preferably the tungsten carbide is in the form of crushed material, small enough to pass an 8 mesh screen. A small portion of this tungsten carbide can be still finer, say of sufficient fineness to pass a 30 mesh screen. In one form of mix which I find advantageous, I use twenty pounds of crushed tungsten carbide fine enough to pass an 8 mesh screen, and three pounds of crushed tungsten carbide fine enough to pass a 30 mesh screen. To this is added six pounds of commercially pure tungsten powder.

Indeed, I find that a sufficiently good product can be made when the tungsten powder forms but one percent of the total mixture. On the other hand, the mixture may have as much as fifty percent of tungsten powder.

There is a sufficient amount of scrap material resulting from the normal operation of the furnace to provide the granular tungsten carbide so that the process is a continuous one; some of the tungsten carbide being continually remelted in succeeding mixes.

This mixture, I believe, is useful for the production of a good grade of tungsten carbide, because the tungsten carbide in the mix serves to provide a sufficiently large amount of carbon during the chemical combination, fully to carburize the tungsten powder in the mix, and especially when this mix is subjected to a carbon vapor, as in a carbon electric arc. Thus the deficiency of the carbon absorbed by the tungsten powder from the carbon vapor is compensated for by the addition of the tungsten carbide, since this carbide also absorbs carbon.

The manipulation of the furnace to maintain the blunt surface 13 hovering over the container 9 serves to maintain this blunt surface of substantially the same area as the container 9. It serves thereby to define the conical annular surface 14 which shields the upper part of the furnace from the action of destructive heat rays.

I claim:

1. The process of manufacturing tungsten carbide, which comprises placing tungsten

material from which the carbide is to be made in an open shallow work container, covering substantially all the exposed area of the material with the arcing end of a carbon electrode, and maintaining a short arc between the electrode and the material.

2. The process of manufacturing tungsten carbide which comprises placing a mixture of divided tungsten and divided tungsten carbide in an open shallow work container and maintaining a short arc between the exposed material and a carbon electrode that has an arcing surface substantially covering the whole exposed area of the material.

3. The process of manufacturing tungsten carbide which comprises placing a mixture of divided tungsten and divided tungsten carbide in an open shallow work container and maintaining a short arc between the exposed material and a carbon electrode in such manner that the arc acts upon substantially the whole exposed area of the material uniformly.

4. The process of manufacturing tungsten carbide which comprises placing tungsten material from which the carbide is to be made, in a shallow open work container, and maintaining a short arc between the exposed material and a carbon electrode in such manner that the arc acts upon substantially the whole exposed area of the material uniformly.

In testimony whereof I have hereunto set my hand.

OSCAR L. MILLS.