

UNITED STATES PATENT OFFICE

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CEMENTED CARBIDE

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The present invention relates to cemented carbides but more particularly to a sintered composition consisting mainly of tantalum carbide and columbium carbide in combination with a binder material having a lower melting point than either of the carbides.

In my prior application Serial No. 478,557, filed August 28, 1930, I have disclosed and claimed a combination of tantalum carbide with a binder material and in my prior application Serial No. 496,826, filed November 19, 1930, I have disclosed and claimed a plurality of carbides, for example tantalum carbide and tungsten carbide in combination with a binder material. The tantalum carbide employed in the compositions disclosed in my prior application is manufactured from substantially pure tantalum. The latter, however, is quite expensive to produce due to the fact that it is very difficult to remove columbium which is an impurity occurring in varying quantities in tantalum ore.

It is one of the objects of the present invention to provide an improved cemented carbide composition containing not only tantalum carbide but columbium carbide as the main ingredients thereof.

While the present invention will be illustrated in connection with a composition consisting of about 13% binder material and about 87% of a mixture of tantalum carbide and columbium carbide, the invention is not restricted to these specific proportions of materials. If desired, I may employ from about 3% to about 25% binder material in the composition.

According to the present invention, tantalum carbide and columbium carbide in suitable proportions are ground in a ball mill for about four hours or until the powdered material is capable of passing through a 325 mesh screen. The mixed carbides are then ball milled with an appreciable quantity of cementing material for example powdered iron and molybdenum which have also been ground to a suitable degree of fineness. The mixed powdered materials are then ground in the ball mill for about four hours or until they are capable of passing through a 325 mesh screen. The powdered mixture thus obtained is pressed to a desired shape in a hydraulic press, the pressure employed being about 30 to 40 tons per square inch. The pressed material, which may be handled easily, is fired in a closed graphite tube in a hydrogen furnace at a temperature of about 1400° C. to 1600° C. for about 1½ hours. At this temperature the pressed material is sintered into a hard metallic composi-

tion which, although somewhat brittle, may be employed with satisfactory results as a tool bit for cutting steel or like materials. If desired, the powdered material after it is pressed may be fired in a closed graphite tube for about one half-hour at a temperature of about 800° C. to 1100° C., then shaped or cut to the desired size and then fired as usual in the closed graphite tube at a temperature of about 1400° C. to 1600° C.

When employed as a tool bit the cemented carbide is usually copper brazed to a steel shank. I have found it desirable to employ a flux, such as borax, in the brazing operation in order to secure a good joint between the shank and the bit.

With a composition consisting of about 13% cementing material and the remainder tantalum carbide and columbium carbide, various proportions of the carbides may be employed. For example, I have employed about 5% to 40% columbium carbide with 82% to 47% tantalum carbide, the smaller percentages of columbium carbide being associated with the higher percentages of tantalum carbide and vice versa, the total carbide content of the composition in any case amounting to about 87%.

The modulus of rupture of a tool bit employing 13% of a cementing medium consisting of about 37% molybdenum and about 63% iron and having the lowest content of columbium carbide specified above (5%) and the highest content of tantalum carbide (82%) is about 71,000 pounds per square inch and the Rockwell A hardness about 88.2. A tool bit employing the same percentage of the same cementing medium and containing the highest content of columbium carbide (40%) and the lowest content of tantalum carbide (47%) has a modulus of rupture of about 80,000 pounds per square inch and a Rockwell hardness of about 87.8.

With tool bits of the same weight, it will be found that the volume of the tool bits increases towards the columbium carbide rich end of the above series, i. e. a tool bit containing 40% columbium carbide and 47% tantalum carbide has more than twice the volume of a tool bit containing 5% columbium carbide and 82% tantalum carbide.

The present invention is not limited to the use of any particular cementing material. Metals of the iron group taken alone or metals of that group in combination with metals of the 6th group of Mendelejeff's periodic table of elements may be employed as the binder material. I have found that the binder material consisting of about 37% molybdenum and about 63 parts iron

is a very satisfactory one for a mixture of tantalum and columbium carbides. Although I have obtained unusually good results with this binder, good results have also been obtained with binders

5 consisting of about:

- 30% tungsten and 70% cobalt
- 40% tungsten and 60% nickel or 60% iron
- 40% molybdenum and 60% nickel
- 50% molybdenum and 50% cobalt
- 10 25% tungsten carbide and 75% cobalt.

A tool bit $\frac{1}{8}$ " by $\frac{1}{8}$ " by $1\frac{1}{8}$ " consisting of about 77% tantalum carbide, 10% columbium carbide and 13% of a cementing material consisting of 37% molybdenum and 63% iron when
 15 mounted on a steel shank $\frac{3}{4}$ " by $1\frac{1}{2}$ " in cross section and tested on a $3\frac{1}{2}$ % nickel steel log having a Brinnell hardness of 219 ran for 29 minutes with a feed of 25/1000 of an inch, a depth of cut of $\frac{1}{16}$ of an inch and a speed of 180 feet per minute.
 20 The tool produced an unusually smooth finish on the steel log. Without regrinding and with the same feed and cut, the speed was increased to 200 feet per minute. The tool was operated under these conditions for eleven minutes without any sign of breakdown of the tool. It
 25 showed no signs of wear, retained its sharp cutting edge and was in excellent condition at the end of the test.

Ordinarily, with the particular kind of work
 30 specified above and with the feed and cut indicated, it would be extremely difficult, if not impossible, for a motor to turn a lathe at a speed of 200 feet per minute. However, with the cemented carbide tool described above the motor easily operated the work at a speed of 200 feet per minute
 35 probably due to the unusually sharp cutting

edge on the tool and also to the low coefficient of friction between the tool and the work.

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

1. A sintered composition containing about 3% 80 to about 25% of a cementing medium, the remainder of said composition consisting substantially of tantalum carbide and columbium carbide, the columbium carbide comprising not appreciably more than 45% of said composition, 85 said cementing medium containing an appreciable quantity but not more than 50% of a metal of the 6th group of Mendelejeff's periodic table of elements, the remainder of said cementing medium consisting substantially of metal of the iron 90 group.

2. A sintered composition containing about 3% to about 25% of a cementing medium, the remainder of said composition consisting substantially of tantalum carbide and columbium carbide, the columbium carbide varying from a few per cent up to about 45% of said composition, 95 said cementing medium containing an appreciable quantity but not more than 50% of a metal of the 6th group, the remainder of said cementing medium consisting of metal of the iron group. 100

3. A sintered composition containing about 3% to about 25% of a cementing medium, the remainder of said composition consisting substantially of tantalum carbide and columbium carbide, the columbium carbide varying from a few per cent up to about 45% of said composition, 105 said cementing medium consisting mainly of a metal of the iron group.

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