Patented Mar. 10, 1936 2,033,513

UNITED STATES PATENT OFFICE

2,033,513

HARD CEMENTED CARBIDE MATERIAL

Gregory J. Comstock, Fairfield, Conn., assignor to Firth-Sterling Steel Company, McKeesport, Pa., a corporation of Pennsylvania

No Drawing. Application June 12, 1935, Serial No. 26,249

6 Claims. (Cl. 75—1)

This invention relates to hard cemented carbide material useful in the production of cutting tools, wire drawing dies and the like. The present application is a continuation-in-part of my copending application Ser. No. 646,874, filed December 12, 1932.

Cemented or sintered compositions for making products of the general type to which the present invention relates are now made by sintering or cementing a hard metal carbide such as tungsten carbide and an auxiliary metal such as cobalt, nickel or iron. The present invention relates to a particular combination of hard metal carbides, together with one or more of the above-mentioned auxiliary metals and, in addition, an oxide of titanium or zirconium, or both, all in the proportions hereinafter set forth.

In accordance with the present invention, the composition contains tantalum carbide and one or more of the carbides of tungsten or molybdenum, and an auxiliary metal or metals such as cobalt, nickel or iron, and, in addition, one or more of the oxides of titanium or zirconium. The tungsten carbide or molybdenum carbide, or mixture thereof, may vary between about 55 and 75% by weight of the composition, preferably between 60 and 65%. In a preferred composition, the tungsten carbide or molybdenum carbide, or mixture thereof, constitutes about 64%. The tantalum carbide may vary between 15 and 35%, preferably between 20 and 30%, and in a preferred composition it constitutes about 27%. The auxiliary metal or metals cobalt, nickel or iron constitute from .5 to 25%, preferably 3 to 15%. In a preferred composition, it or they constitute about 8%. The titanium oxide or zirconium oxide or mixtures thereof may vary between .10 and 10%, preferably between .25 and 3%. In a preferred composition, it or they are about 1%.

It has been found that an exceptionally good steel cutting material can be made by mixing powdered tungsten carbide, tantalum carbide, cobalt and titanium oxide within the ranges herein set forth and sintering the mixture. It is believed that in the sintering operation an alloy binder is formed containing cobalt, tungsten, tantalum and titanium and that this alloy binder is responsible for the exceptional properties exhibited by the composition when used as a tool for cutting steel. The cemented composition produced in this manner has a fine grain and is very hard and exhibits a greatly superior ability to cut steel as compared with a similar composition but containing no titanium oxide. The titanium oxide increases the fluidity of the bonding alloy formed during the sintering operation probably by reducing the melting point of the alloy, and this increased fluidity results in a better bonding of the hard metal carbides by the binding alloy than if the titanium oxide were omitted.

As a specific example of the manner in which my process may be carried out, about 64.4% by weight of tungsten carbide, about 27.6% tantalum carbide, about 8% of cobalt, and, in addition, about .10 to 10% and preferably about .25% to 3% of titanium oxide are ground in a ball mill in order to thoroughly mix them, and the mixed powders are then sintered either by first compacting them and then sintering the compacted billet, or by simultaneously applying heat and pressure to the powder to sinter it. In the preferred practice, the mixture of powders is milled for from 24 to 48 hours in a ball mill and the mixed powder so obtained is then placed in a graphite mold, which is heated electrically, and heat and pressure are applied simultaneously to the powder. The powder is heated to a temperature of about 3200° F. and is maintained at this temperature for about 5 min. while subjected to a pressure of about 1400 pounds per square inch. The powder may, however, be first compacted into a billet and then sintered in a hydrogen furnace, preferably using both a preliminary sinter and a final sinter in accordance with common practice for making cemented carbide compositions.

The proportions of the tungsten or molybdenum carbide, the tantalum carbide, the auxiliary metals, and the oxides of titanium and zirconium may be varied from the percentages given in the preferred example, within the ranges hereinabove pointed out and still produce satisfactory results. As between the tungsten carbide and molybdenum carbide where only one of these carbides is employed, it is preferred to use tungsten carbide. The preferred auxiliary metal is cobalt. As between titanium oxide and zirconium oxide, it is preferred to use titanium oxide.

I have described by way of example a present preferred composition and a present preferred manner of making the composition. It is to be understood, however, that the invention may be otherwise embodied within the scope of the following claims.

I claim:

1. A hard cemented carbide material consisting substantially of about 55 to 75% of a carbide of the group consisting of tungsten carbide and molybdenum carbide, about 15 to 35% tantalum carbide, about .5 to 25% of an auxiliary metal of the group consisting of cobalt, nickel and iron,

and in addition about .10 to 10% of an oxide of the group consisting of titanium oxide and zirconium oxide.

2. A hard cemented carbide material consisting substantially of about 60 to 65% of a carbide of the group consisting of tungsten carbide and molybdenum carbide, about 20 to 30% tantalum carbide, about 3 to 15% of an auxiliary metal of the group consisting of cobalt, nickel and iron, and in addition about .10 to 10% of an oxide of the group consisting of titanium oxide and zirconium oxide.

3. A hard cemented carbide material consisting substantially of about 64% of a carbide of the group consisting of tungsten carbide and molybdenum carbide, about 27% tantalum carbide, about 8% of an auxiliary metal of the group consisting of cobalt, nickel and iron, and about 1% of an oxide of the group consisting of titanium oxide and zirconium oxide.

4. A hard cemented carbide material consisting substantially of about 55 to 75% tungsten carbide, about 15 to 35% tantalum carbide, about .5 to 25% of an auxiliary metal of the group consisting of cobalt, nickel and iron, and in addition about .10 to 10% titanium oxide.

5. A hard cemented carbide material consisting substantially of about 60 to 65% tungsten carbide, about 20 to 30% tantalum carbide, about 3 to 15% cobalt, and in addition about .10 to 10% titanium oxide.

6. A hard cemented carbide material consisting substantially of about 64% tungsten carbide, about 27% tantalum carbide, about 8% cobalt, and about 1% titanium oxide.

GREGORY J. COMSTOCK.