

UNITED STATES PATENT OFFICE

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The invention relates to hard alloys, more particularly intended for the manufacture of tools and implements.

As well-known, the carbides of metals of high melting point are extraordinarily hard, some of them, such as for instance tungsten carbide, approach very closely the hardness of the diamond. Carbides of this class therefore form the chief ingredient of the materials which as so-called hard metal or hard metal alloy are employed to a rising extent for the manufacture of tools and implements.

Now the invention resides in the perception that also an alloy consisting in a sintered or molten mixture of titanium carbide and titanium nitride gives an extraordinarily hard and simultaneously very solid product which is well suited for the manufacture of tools and implements of every kind, more particularly cutting tools. A special advantage of the new alloy consists in the feature that titanium compounds suited for the production of titanium carbide and titanium nitride are at disposal in large quantities from the operation of blast furnaces as constituents of the slag, so that the starting materials of the new alloy can be supplied very conveniently and at low costs.

Particularly satisfactory results are obtained by an alloy which consists of about 50% of titanium carbide and the same percentage of titanium nitride. Moreover, as stated, such an alloy possesses a melting point (about 3230° C.) which not only exceeds that of the titanium nitride (about 2950° C.) and of the titanium carbide (about 3140° C.), but is furthermore the highest melting point of all within the series of possible alloys of titanium carbide and titanium nitride. It is probably this feature which is the cause of the particularly great hardness of the alloy consisting of 50% of titanium carbide and 50% of titanium nitride.

The new alloy can be produced by melting as well as by pressing and subsequent sinter-

ing or by simultaneous pressing and sintering of the powdered starting materials. The toughness of the new alloy can be improved by adding one or more easily melting auxiliary of melting point above 1000° C., such as cobalt, iron, or nickel, in quantities up to 25%.

A suitable method for producing the new alloy, by way of example, is the following, on the basis of a powder mixture composed of 50% of titanium nitride and 50% of titanium carbide:

Pure titanium nitride can be produced by heating the commercial material a short time in the tubular carbon furnace at 2000° C. with scavenging by nitrogen, pure titanium carbide likewise by short heating of a mixture of titanitic acid and carbon in a hydrogen current at 2000° C. Thereupon pressed bodies are formed of the mixture of the fine powdered materials which bodies are sintered up on a carbon bed at 2400° C. while scavenged by nitrogen. By this operation the shapes acquire an extraordinarily great hardness.

By addition of an auxiliary metal, for instance of 7 to 10% cobalt, not only the toughness of the finished alloy can be improved but also the sintering temperature is reduced in known manner. Furthermore, the pressed bodies may be first sintered preliminarily and then shaped as they can easily be shaped when still in this presintered state, whereupon the great hardness is given to them by subsequent sintering up.

What we claim as our invention is:—

1. A hard alloy consisting of 99 to 75% of a mixture of titanium carbide and titanium nitride in substantially equal proportions, and 1 to 25% of at least one metal of the iron group.

2. A hard alloy consisting of 99 to 75% of a mixture of titanium carbide and titanium nitride in substantially equal proportions, and 1 to 25% of cobalt.

3. A hard alloy consisting of 99 to 75% of a fused mixture of titanium carbide and titanium nitride and 1 to 25% of at least one metal of the iron group.

- 5 4. A hard alloy consisting of 99 to 75% of a sintered mixture of titanium carbide and titanium nitride and 1 to 25% of at least one metal of the iron group.

The foregoing specification signed at Berlin, Germany, this 23rd day of March, 1931.

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