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METHOD FOR THE PRODUCTION OF HARD-METAL ALLOYS

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The technical experience which has been gathered as a result of the manufacture of hard metal alloys containing sintered tungsten carbide and titanium carbide has indicated that the main difficulties in the production of high grade alloys having the most uniform constituency resides in the production and use of very pure titanium carbide.

In general, titanium carbide is obtained by the treatment of titanium oxide with carbon; in contrast to the oxides of the elements of the sixth group of the periodic system, a mixture of titanium oxide and carbon cannot be completely transformed into titanium carbide. It has been found that a titanium carbide obtained in this manner contains in addition to the theoretical total carbon content, a few per cent of oxygen and a portion of uncombined carbon corresponding to the oxygen content. When such titanium carbide is further processed with tungsten carbide, possibly with an addition of metals having a lower melting point, especially metals of the iron group (the auxiliary metal), there occur subsequent transformations between the residual oxygen and the free carbon, and these transformations have unfavorable chemical and physical effects on the properties of the hard metal alloys thus obtained, impairing the performance of tools made from the alloy as well as providing a lack of uniformity in the alloy and tools made therefrom.

According to the present invention, this difficulty in making sintered hard metal alloys that contain tungsten carbide and titanium carbide, as well as possibly an auxiliary metal, is avoided when one starts, not with a titanium carbide produced directly from titanium oxide and carbon, but when one produces titanium nitride by heating titanium oxide with carbon in a nitrogen stream, and when this titanium nitride, together with the tungsten carbide and with the addition of the quantity of carbon calculated for converting the titanium nitride into titanium carbide, are converted into a tungsten carbide-titanium carbide alloy. The technical advantages of this method lie, on the one hand, in the fact that titanium nitride can be produced with a much lower oxygen content than titanium carbide; on the other hand, when the titanium nitride and the carbon are converted, in the presence of tungsten carbide, possible oxygen residues may be further eliminated.

Instead of the tungsten carbide it is also possible to use tungsten metal, and then the required carbon addition is so calculated that the

tungsten metal can be transformed, during the process, into tungsten carbide.

The method may be carried out as follows: For instance, 100 parts of titanium oxide are heated, together with 50 parts of lampblack, for two hours, at a temperature of 1600° C. and in a nitrogen stream, and 15 parts of the titanium nitride thus obtained are heated with 85 parts of tungsten carbide, with an addition of 3 parts of lampblack, for two hours, also up to 1600° C. but this time in a hydrogen stream. Under these conditions, the titanium nitride is converted into titanium carbide, and nitrogen is released, while the tungsten carbide is absorbed by the titanium carbide produced, and that until saturation is attained, the solution being a solid solution. The tungsten carbide-titanium carbide alloy arrived at in this manner is then tritured, and if necessary is processed with the addition of auxiliary metals having a lower melting point, by pressing followed by sintering, or by simultaneous pressing and sintering, until hard metal molded bodies are obtained. If tungsten metal is employed instead of tungsten carbide, carbon must be added to the mixture, in quantities which will correspond to the composition of the desired tungsten carbide. To facilitate the transformations, it may be advisable sometimes to add to the mixtures to be heated, and that during the nitride production as well as during the transformation of the nitride into carbide, a part of the metals having a lower melting point, for instance 1 to 2 per cent cobalt. One may also subject the mixture of titanium nitride and carbon to a pre-heating process, and add the tungsten carbide subsequently.

The hard metal alloys obtained in this manner have a very high cutting capacity and are particularly uniform in their composition.

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

1. The method for producing a solid solution consisting of tungsten carbide and titanium carbide which comprises heating titanium oxide in an atmosphere of nitrogen and in the presence of carbon to thereby obtain titanium nitride, heating the titanium nitride thus obtained with tungsten carbide and carbon in a reducing atmosphere at a temperature sufficiently high to produce a solid solution of tungsten carbide and titanium carbide.

2. The method for producing a solid solution of tungsten carbide and titanium carbide which comprises heating about 100 parts of titanium oxide with about 50 parts of pulverized carbon

for about two hours at about 1600° C. in a nitrogen stream to thereby obtain titanium nitride, heating about 15 parts of the titanium nitride thus produced with about 85 parts of tungsten carbide and about 3 parts pulverized carbon for about two hours at 1600° C. in a hydrogen atmosphere.

3. The method for producing a solid solution of tungsten carbide and titanium carbide which

comprises heating about 15 parts of titanium nitride with about 85 parts tungsten carbide and about 3 parts pulverized carbon in an atmosphere of hydrogen and at a temperature of about 1600° C. and for a period of time long enough to form a solid solution of tungsten carbide and titanium carbide.

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