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PROCESS OF MAKING HARD ALLOYS

Robert Pinta, Paris, France, assignor to General Electric Company, a corporation of New York

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The present invention relates to a process for the manufacture of hard sintered alloys having at least two different hard components and a metal, either alloy, or solid solution acting as a binding agent.

There are a great number of hard sintered alloys in which two or several hard constituents, usually carbides, are associated in a certain proportion. The composition of tungsten carbides WC and W_2C have already been described. Similar compositions based on either or both of these two carbides associated with either titanium carbide, or tantalum carbide, etc. have also been described. Usually these sintered alloys are obtained by mixing the totality of the hard components with the totality of the auxiliary components which are most often metals or alloys from the iron group, as, for instance, cobalt, nickel, etc. The pulverized components are often thoroughly ground in an enclosed machine, for instance a ball-mill; the resulting material is then compressed and sintered by means of high temperature, the sintering process being executed either after the compression or simultaneously with the compression.

Practically this general process, which offers the advantage of being simple, is not always satisfactory. It may happen that the hard components have an unequal adsorbing power with respect to the binding metal or the binding alloy. The most active hard component will strongly fix the binding alloy to the detriment of the less active hard component; consequently the tenacity of the final alloy will be dangerously affected.

I have discovered new and important means for avoiding these inconveniences. Accordingly, I fix separately one or several auxiliary metals on each of the hard components until the auxiliary metal is adsorbed by the corresponding component. When this operation is realized, the products obtained are mixed together and the sintering is terminated exactly as in the already known processes.

The choice of the auxiliary metals is not an indifferent one. If may happen that only one auxiliary metal will prove suitable. In this case, it suffices to distribute the totality of the auxiliary metal between each of the hard components according to experimental laws. Most usually, a given auxiliary metal is not fixed equally by the various hard components. In such case, I find it advantageous to fix on each hard component a particular metal or alloy. On the other hand, during the final sintering, each one of the various metals or alloys can react on the other auxiliary metals or alloys.

According to my invention, the auxiliary components are so selected that when associated together, they will give a solid solution. The advantage of such process is that when the atoms of a determined metal have been adsorbed by hard components, they will remain adsorbed in spite of the diffusion of the auxiliary metals in each other, which is necessary to give a solid solution. Consequently the tenacity of the final product is advantageously increased.

For instance I will indicate hereunder a particular process which will enable all readers to understand thoroughly my process.

I shall suppose that I must sinter tungsten carbide WC with titanium carbine TiC and with an auxiliary solid solution. Experience shows that tungsten carbide strongly fixes cobalt whilst titanium carbide will fix nickel better. The various components, having previously been thoroughly pulverized, are mixed together, on the one hand, the totality of the tungsten carbide with the quantity of cobalt necessary for the final alloy, on the other hand, the total quantity of titanium carbide with the minimum quantity of nickel necessary for its separate agglomeration. I have obtained good results by mixing from 75% to 97% (by weight) of tungsten carbide with 25% to 3% (by weight) of cobalt.

In a similar way I have associated from 75% to 92% (by weight) of titanium carbide with 25% to 8% (by weight) of nickel. Each one of these binary mixtures is subjected to an energetic attrition, for instance by long grinding in an hermetically enclosed ball-mill, either by a dry process or with the use of a liquid agent free from any chemical action on the components. This attrition process has permitted the fixing of the nickel on the titanium carbide and of the cobalt on the tungsten carbide. The two powders thus obtained by the above process are then mixed together. This operation is relatively easy to make because the friction coefficient of nickel on cobalt is nearly the same as the friction coefficients of nickel on nickel and cobalt on cobalt. When complete homogeneousness has been realized, I compress the mixture under pressure of several thousand kilograms per square centimeter, for instance four to six thousand kilograms and I harden the mixture by firing in a neutral or reducing atmosphere, for instance at temperatures between about 1250 and about 1500° C. The lower the temperature, the longer

is the duration of firing. It is useful that this firing be made under such conditions, that the cobalt and nickel will be able mutually to diffuse into each other, so that they may realize a solid solution nearly homogeneous, but this condition is not absolutely necessary. Experience has shown that the tenacity of the product remains satisfactory even when the solid solution is not perfectly realized and even when this solid solution has just begun to appear.

For instance, I obtained a tenacious alloy constituted by 90 to 95% (by weight) of tungsten carbide mixed with cobalt and 10 to 15% (by weight) of titanium carbide mixed with nickel. I have also convinced myself that for this particular mixture, there is interest in seeing that when the tungsten carbide is mixed with cobalt, there will be not more than between 8 to 6% of cobalt, whilst when titanium carbide is mixed with nickel, it is better to have between 12 to 18% of nickel.

I can also accomplish the sintering in two or several stages so that the alloy will not receive its final tenacity at first so that it will be easier to shape this alloy before making the final sintering at the highest temperature.

I can also accomplish this sintering by simultaneously submitting the products both to pressure and sintering, for instance under a pressure of between about 50 to about 100 kilograms per square centimeter, and a temperature of between about 1200° and about 1500° C. In such case the total duration of the sintering process does not exceed a few minutes.

Of course, the same process can be followed for more complex alloys. For instance, if there are three hard components I can, at will, fix them with one, two or three binding metals or binding alloys according to the nature of the hard components. I have been able to use the same process to agglomerate mixtures of both of the tungsten carbides with tantalum carbide or with titanium carbide and also for mixtures of tungsten carbide WC, of tantalum carbide TaC and niobium carbide NbC, etc.

Experience has shown that by the rational use of my process the bending strength of small plates obtained is increased by 30% to 70%, but the chief advantage of my process is the better resistance to shocks of tools and working implements manufactured according to my process.

I claim:—

1. Manufacturing process of hard sintered metallic compositions containing tungsten carbide and titanium carbide agglomerated with nickel and cobalt, in which the adsorption of the nickel powder is obtained with a titanium carbide, the cobalt powder being separately adsorbed by powdered tungsten carbide, the two mixtures thus prepared being brought to homogeneousness, and the final mixture being sintered according to already known processes.

2. Manufacturing process of hard sintered metallic compositions according to claim No. 1, in which the alloys have from 90 to 95% by weight of tungsten carbide and cobalt and from 10 to 5% by weight of titanium carbide and nickel, these binary mixtures having from 6 to 8% of cobalt for the first one and from 12 to 18% of nickel for the second one,—these last percentages by weight being calculated on 100 parts of the binary mixtures.

3. The process for manufacturing hard alloys containing at least two hard carbides and metal binders therefor which comprises mixing separately each of said hard carbides with a metal binder, the products thus obtained being mixed together and then sintered.

4. The process for manufacturing hard alloys containing at least two hard carbides and a lower melting binder for each of said carbides which comprises mixing separately each carbide with its binder, the products thus obtained being mixed together and sintered, said binders forming a solid solution during sintering.

ROBERT PINTA.