June 21, 1938. G. RITZAU 2,121,448

HARD METAL COMPOSITION

Filed Oct. 5, 1936

Fig. 1

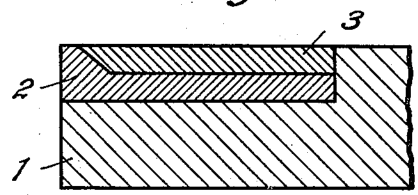


Fig. 2

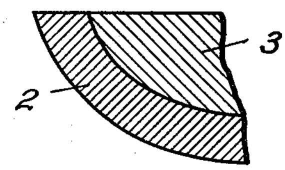
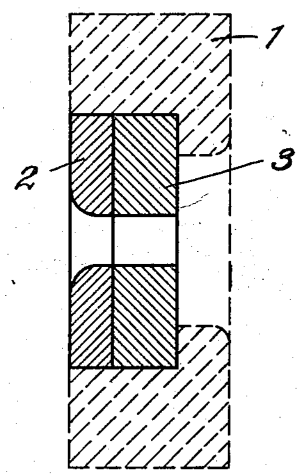


Fig. 3



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HARD METAL COMPOSITION

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7 Claims. (Cl. 75—136)

My invention relates to hard metal compositions, and more particularly to compositions and alloys comprising in preponderating amount one or more highly refractory carbides and which are manufactured by pressing and sintering a pulverized mixture. Such alloys contain in addition thereto, as a rule, one or more metals, the melting point of which is lower than that of the hard carbide employed.

An object of my invention consists in providing such a sintered composition or alloy which surpasses the hitherto known alloys in hardness while retaining at the same time a relatively high tenacity.

Another object of my invention consists in increasing the resistance to wear caused by frictional stress.

A further object of my invention is the provision of a method for manufacturing tools or machine parts in the manner that the properties of the hard alloys having a high resistance to wear are taken advantage of to the greatest possible extent.

According to the invention hard alloys consist of:

	Percent
Tungsten carbide	91 to 94
Cobalt	5 to 7
Tungsten	0.3 to 1
Chromium	0.5 to 2

These constitutents are finely pulverized, then pressed to a shape and finally sintered. In the manufacture of the above-mentioned hard alloys various methods may be employed as hereinafter described. Irrespective of the method employed care should be taken to see that the alloy contains besides the above-mentioned constituents a further amount of 0.05 to 0.2% of carbon. A corresponding amount of elementary carbon may be added to the mentioned mixture before pressing, or an already pressed body may be sintered in a carbonaceous atmosphere or in a carbon crucible. In the final product the added carbon is bound to one or more of the other ingredients, thus forming a carbide or a solid solution.

Hard alloys are known in the art which contain substances of the same nature as the alloys according to the invention, but the compositions thereof differ from those of the present alloys. Although only very small amounts of tungsten, chromium and carbon are added according to the present invention to the tungsten carbide these admixtures are nevertheless of importance. The tests have shown that only in the above-mentioned composition the alloy of the above-indicated substances attains a very great hardness and resistance to wear, whereas these properties are considerably impaired, if the percentage of the constituents surpasses the upper or lower limits above indicated. I have, therefore, found that the properties depend entirely upon the use of the above-indicated admixtures and upon relatively narrow limits within which the percentage of the admixtures under consideration is to be chosen.

The above-mentioned properties are revealed even during the manufacture of the alloys. A known method of manufacture may be carried out as follows: A pressing is first made from the pulverized mixture of the constituents. This pressing is very brittle, and its surface cannot, therefore, be machined. However, it is often necessary to machine the surface with the aid of tools so as to give it the final form. To this end, the pressing is first sintered at a comparatively low temperature. This temperature lies above 700° C. when manufacturing the known hard alloys. After this preliminary sintering the pressing is so solidified that its surface may be machined by grinding or by cutting tools or that the pressing may be cut in pieces. Thereupon the pressing is finally sintered at a temperature of 1400° C. and more so that it attains the desired hardness. If this method of manufacture is applied to the above-indicated composition of this invention the pressings resulting from the preliminary sintering are so hard that they are practically no longer capable of being machined. The preliminary sintering is, therefore, effected at a temperature lower than 700° C., particularly at a temperature of about 500° C. The pressing attains already at such a temperature a strength sufficient for machining, while its hardness has not yet attained too high a value.

A further method of manufacture consists in adding a binding agent, as a rule an organic agent, such as alcohol or glycerine, to the pulverized mixture, in pressing the mixture thus treated to shaped bodies, and in drying the same. The binding agent imparts to the body already when dried a strength sufficient for certain purposes so that it may be machined. After the surface of the body has been machined, the latter is sintered at a high temperature in one operation. As binding agents such organic substances may be employed which volatilize without leaving residues when sintering. However, also binding agents, such as, for instance, synthetic resin may be employed which leave a carbonaceous residue. In this case, the amount of binding agent or the degree of dilution of a solution containing the binding agent may be so chosen that the carbonaceous residue amounts to 0.05–0.2% of the total weight of the composition. The amount and the nature of the binding agent depend, in this case, on whether the sintering is effected in vacuum or in a carbonaceous atmosphere.

A particularly advantageous alloy according to the invention has, for instance, the following composition:

	Percent
WC	93.5
Cr	0.5
W	0.4
Co	5.5

An amount less than 0.1% of additional carbon is added to these substances. A comparison of an alloy made of the last-mentioned constituents with the best sintered alloy of tungsten carbide and cobalt available on the market shows that the wear of the latter per time unit is four times greater than that of the alloy made according to the invention.

In tools or similar highly stressed machine parts the form and arrangement of the body consisting of hard metal may be particularly adapted to the properties of the novel alloy. Such an adaptation will presently be described. In some machine parts and tools the different points of the surface thereof are differently stressed. Some points of the tools are subjected to a considerable wear, whereas at other points of the same tool the tenacity is more important. Thus, when machining some materials the life of the tool is in some cases not so much dependent upon the properties of the cutting edge as upon the behavior at another point of the tool. For instance, lathe tools wear away so as to form a cavity at the point at which the rolling up chip contacts with the tool; i. e. behind the cutting edge proper. The tool may become useless owing to the wearing away behind the cutting edge, although the latter might be in good condition.

The alloys according to the invention may be employed in such cases to prolong the life of the tools. To this end, the tools are made by employing two different hard metals, one of which consists of the alloys above described, whereas the other hard metal is selected with regard to a particularly great tenacity and particularly good cutting properties.

In the accompanying drawing some applications of the method according to my invention are shown by way of example.

Fig. 1 shows a sectional view of a lathe tool, Fig. 2 is a sectional view of a lathe tool provided with a profile cutting edge and Fig. 3 represents a draw plate or die.

In Fig. 1, 1 denotes the usual support of steel, on which a hard metal is arranged and which is clamped in the support of the machine tool. The piece of hard metal welded to the steel body 1 consists of two different sections.

The section 2 forms the cutting edge and consists of an alloy particularly suitable for this purpose; for instance a sintered alloy containing more than 80% WC and, besides, Ti, C and Co. The point at which the rolling up cutting contacts with the tool is on the surface of the section 3. The latter consists of one of the above-described alloys containing 91 to 94% WC, 5 to 7% Co, 0.3 to 1% W, 0.05 to 0.2% C. The sections 2 and 3 may be separately prepared and then welded or soldered together and with the steel body 1. Also the following methods of manufacture may be employed.

A pulverized mixture already prepared for manufacturing the section 2 is first placed in a mold and pressed. Another pulverized mixture for manufacturing the section 3 is then placed in the same mold and likewise pressed. The sections of different materials thus united, of which one section comprises an alloy according to the invention are sintered together.

Another method which is particularly advantageous when the two hard metal sections differ in composition considerably, consists in pressing the single sections and subjecting them to a preliminary sintering at a low temperature. The parts are arranged upon each other after machining the surface, if necessary, and are finally sintered together at a higher temperature.

A further method consists in pressing first one part and in sintering the same. The pulverized mixture of the second part is then placed on the presintered body, pressed and finally heated together with the moderately presintered part. This method may also be employed to advantage if the other alloy—employed besides the alloys according to the invention—consists of an alloy produced by fusing.

The tools may also be manufactured in such a manner that the relative position of the two differently composed hard metal parts is retained when regrinding the cutting edge.

Such a tool is shown by way of example in Fig. 2. The part 3 consists of an alloy containing 91 to 94% WC, 5 to 7% Co and small amounts of W, Cr, and C, whereas the part 2 consists of a different hard alloy. The cutting edge is ground at the upper surface.

The part 2 of the hard metal piece of the die shown in Fig. 3 coming first into contact with the metal to be drawn consists of material having good drawing properties; the part 3 arranged behind the part in the drawing direction consists of one of the above-mentioned alloys resistant to wear according to the invention. The parts 2 and 3 of hard metal united may be placed in a known manner in the holder 1 consisting of steel.

The hard alloys prepared according to the invention are also of advantage in such cases in which it is necessary to employ alloys which besides having mechanical properties are acid and vapor proof. These alloys are, for instance, suitable for the manufacture of valve seats of highly stressed internal combustion engines.

I claim as my invention:

1. The process of producing a material for tools, dies, hard machine parts and the like which comprises preparing a finely divided mixture of 91 to 94% tungsten carbide, 5 to 7% cobalt, 0.3 to 1% tungsten and 0.5 to 2% chromium, pressing said mixture to a shaped body, sintering said body, and adding a further amount of 0.05 to 0.2% carbon during one of the aforesaid steps of the process.

2. The process of producing a material for tools, dies, hard machine parts and the like which comprises pressing a finely divided mixture of 91 to 94% tungsten carbide, 5 to 7% cobalt, 0.3 to 1% tungsten, 0.5 to 2% chromium and 0.5 to 0.2% pulverized carbon to a shaped body and sintering said pressed body.

3. The process of producing a material for

tools, dies, hard machine parts and the like which comprises mixing the following finely divided ingredients: 91 to 94% tungsten carbide, 5 to 7% cobalt, 0.3 to 1% metallic tungsten, 0.5 to 2% metallic chromium, pressing said mixture and sintering said pressed mixture in a carbonaceous atmosphere until the same takes up a further amount of 0.05 to 0.2% carbon.

4. The process of producing a material for tools, dies, hard machine parts and the like which comprises preparing a finely divided mixture containing at least 91% tungsten carbide, 5 to 7% cobalt, 0.4 to 1% metallic tungsten and 0.5 to 2% chromium, pressing said mixture to a body, sintering said body and adding thereto a further amount of 0.05 to 0.2% carbon during one of the aforesaid steps of the process.

5. The process of producing a hard material which comprises alloying by the combined action of pressure and heat a mixture containing at least 91% tungsten carbide, 5 to 7% cobalt, 0.3 to 1% metallic tungsten, 0.5 to 2% chromium and an additional amount of 0.05 to 0.2% carbon, the heating being effected at a temperature below 700 degrees centigrade, machining the surface of the alloyed body and sintering said body at a temperature above 1400 degrees centigrade.

6. The process of producing a hard material comprising the steps of preparing a pulverized mixture containing at least 91% tungsten-carbide, 5 to 7% cobalt, 0.3 to 1% tungsten, 0.5 to 2% chromium and 0.05 to 0.2% carbon, pressing said mixture to a shaped body, sintering said body at a temperature of about 500 degrees centigrade, machining the surface of the body and sintering the same at a temperature above 1400 degrees centigrade.

7. A shaped hard body for tools and hard machine parts containing a composition of about 93.5% WC, about 0.5% Cr, about 0.4% W, about 5.5% Co and less than 0.1% of more carbon, said composition being combined and solidified by pressing and sintering said components.

GÜNTHER RITZAU.