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HARD METAL

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1 Claim. (Cl. 75—1)

The present application is a division of the application filed August 21, 1931, Serial No. 558,560, now Patent #1,910,532, issued May 23, 1933.

This invention relates to the composition and making of a so-called hard metal. According to this invention, the hard metal consists for the greater part of titanium carbide and contains besides a carrier metal or substance, i. e. a metal or substance in which the titanium carbide is embedded or which serves as a binding material for the titanium carbide. The carrier metal, also called auxiliary metal, may consist of a single metal or of a plurality of metals or of alloys or mixtures of same.

Compared with tungsten or wolfram carbide, the use of which for making hard metals is already known, titanium carbide has considerable advantages. In the first place, its unit of weight is substantially cheaper, and then it has a considerably lower specific gravity. As, when it is used for tools, etc., the volume of the quantity employed and not its weight is the major consideration, the price of the tools is thereby still more reduced. The hardness of titanium carbide is not less than that of tungsten carbide. On the contrary, it is possible with the same percentage of auxiliary metal to obtain a greater hardness of the finished article or body than is the case with a corresponding article containing wolfram carbide.

Titanium carbide is able in combination with a whole series of auxiliary metals to form exceedingly homogeneous bodies capable of great mechanical resistance. Such metals are in the first place cobalt and iron; alloys or mixtures of cobalt and iron may also be used. There are, besides, other metals which give excellent results. Nickel, for example, alone or in combination with other metals, is also suitable for this purpose. Furthermore, for example, alloys of cobalt, chromium and tungsten, with or without the addition of carbon, may be advantageously used.

That is to say, the alloy with which the titanium carbide is united is composed substantially of about 40 to 80% cobalt, about 20 to 35% chromium, and from a small but substantial amount up to 25% of tungsten, with or without a small amount of carbon, say from .75 to 2.5% carbon.

To utilize fully the excellent properties of the titanium carbide, it is, however, necessary to make a relatively large portion, i. e. at least two thirds of the whole mass, consist of titanium carbide. Bodies containing about 85 per cent of titanium carbide have proved particularly suitable. The carbide content may, however, be increased far beyond that value, for instance up to 95 per cent. An increase in the percentage of the carbide generally has the effect of increasing the hardness of the finished body, but the greater the carbide content, the more difficult it becomes to obtain a strong binding of the carbide mass. The higher the carbide content, the higher must the temperature be raised to obtain the solidification of the finished body. Temperatures of over 2000 deg. C. may even be required. The difficulties consist partly in the fact that the titanium carbide, owing to its relatively low specific gravity and the greater volume resulting therefrom and to the greater total surface of the same weight of powder, requires a relatively larger quantity of auxiliary metal to fill up the interstices between the carbide particles than is the case with the other heavier carbides. It has, however, been found that these difficulties can be well surmounted by choosing the solidifying temperatures correspondingly high. The procedure may, for instance, consist in grinding the carbide to powder and mixing same intimately with the necessary quantity of a powder consisting of cobalt metal or iron or of a mixture of cobalt and iron. This pulverized mass is pressed into the shape which the finished body is to have. The pressed body is then heated to a temperature high enough to ensure a sufficient solidification. For this purpose it is generally necessary to increase the temperature beyond the melting point of the auxiliary metal. The danger hereby arises that a reaction will take place between the titanium carbide and the other substances with which it comes into contact, for example, with the oxygen or nitrogen of the atmosphere. Under circumstances this is liable to impair the properties of the finished body considerably. Care must, therefore, be taken to avoid the presence of oxygen and nitrogen especially during the heating. For this reason the heating will mostly be performed in a hydrogen atmosphere or in another indifferent atmosphere or in a vacuum. It is also important to keep away even small traces of oxygen or nitrogen, as a satisfactory binding of the mass through the auxiliary metal would otherwise be out of question owing to the individual carbide particles covering themselves with layers of oxide or nitride, thus preventing the contact between the carbide and the auxiliary metal. Instead of bringing the bodies directly into their ultimate form and finishing them by the means of heat, it is also possible to make bodies which for the time are only heated to a

low temperature, for instance up to just below the melting point of the auxiliary metal or only a little above that temperature. Bodies of this kind may then still be relatively easily machined. They can be brought into the desired shape by cutting or dealing otherwise with them and the bodies so obtained then be finished by heating them to the higher solidifying temperature. Instead of employing the auxiliary metals themselves, chemical compounds of these auxiliary metals may be used. In that case the compounds are either ground to powder or dissolved and then mixed with the titanium carbide and heated in a reducing atmosphere, so that an intimate mixture of the titanium carbide with the auxiliary metal results. By this means, after the chemical compound is destroyed, a finer distribution of the auxiliary metal and a more intimate binding is obtained through the further heating. It is, for example, possible to employ the oxides or the oxalates of the auxiliary metals and carry out the reduction with hydrogen, in as pure a state as possible, at relatively low temperatures, for instance at the temperature at which the mass begins to get red hot, and only after that to continue the heating, under exclusion of oxygen and nitrogen. The process for making a hard metal may be carried out as follows. Titanium carbide powder, either all together without or with only a small addition of auxiliary metal, is pressed into the form of bodies which are then sintered at a high temperature. The sintered body is then brought into contact with the remaining quantity of the auxiliary metal with which it is to be impregnated and heated to the final solidifying temperature. It is naturally presupposed that the sintered body of the titanium carbide still possesses a sufficient porosity. The auxiliary metal may, for example in the form of a solid coherent body, be laid on the previously sintered body of titanium carbide and then heated with same in vacuo. The auxiliary metal is then absorbed by the previously sintered titanium carbide body and evenly distributed.

Another embodiment of the invention relates to the use of titanium carbide in conjunction with tungsten carbide, molybdenum carbide or tantalum carbide, with auxiliary metal in the form of an alloy composed substantially of cobalt, tungsten and chromium. In this embodiment, however, only a small fraction of the whole carbide mass may be other than titanium carbide, if the good properties previously described are not to be too much impaired. The addition of, for example, 10% to 20% of tungsten carbide, molybdenum carbide or tantalum carbide is quite permissible, provided the titanium carbide amounts to say 60% or higher with respect to the entire mass of the hard metal body. The presence of tungsten carbide, molybdenum carbide or tantalum carbide with the auxiliary metal of cobalt, tungsten and chromium, has the peculiar advantage in this composition of increasing the toughness, thought to be due to the slight superficial dissolving of the hard metal in the auxiliary metal in the form of a superficial alloy.

What is claimed is:

A formed metal body for uses requiring hardness and mechanical strength, said body comprising as essential constituents from about 60 to about 85% titanium carbide, from about 10 to about 20% of a hard metal carbide taken from the group consisting of tungsten carbide, molybdenum carbide and tantalum carbide, and the remainder substantially of auxiliary metal in the form of an alloy of cobalt, tungsten and chromium, substantially in the proportions of about 40 to 80% cobalt, about 20 to 35% chromium, and from a small but substantial amount up to 25% of tungsten.

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