

UNITED STATES PATENT OFFICE

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PROCESS OF MAKING HARD CEMENTED
CARBIDE MATERIALSGregory J. Comstock, Edgewood, Pa., assignor to
Firth-Sterling Steel Company, McKeesport,
Pa., a corporation of PennsylvaniaNo Drawing. Application November 26, 1932;
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6 Claims. (Cl. 75-1)

This invention relates generally to a method of making hard cemented carbide materials by a cementing or sintering process, and more particularly to a method of forming a powdered mixture of hard metal carbide and metallic binding agent adapted for sintering or cementing to form a hard cemented carbide material such as can be used in tools, wire drawing dies, and the like.

At the present time it is known to make hard cemented carbide materials by grinding a mixture of powdered carbide such as tungsten carbide and powdered binding metal such as cobalt in a rolling barrel and thereafter sintering the mixed powder to produce the cemented material. In the grinding of the mixed powder in the rolling barrel, the powder becomes contaminated with some iron or iron oxide which is abraded off from the surface of the barrel, so that the composition of the powder after grinding is not exactly the same as that introduced into the rolling barrel. Furthermore, the practice as now carried out can only be applied where the binding agent is of such a character that it can be readily produced in powdered form, so that the two powders, namely, the hard metal carbide and the binding agent, can be intimately mixed in the rolling process.

The present invention provides a process which overcomes each of these objections to the prior known processes. By the present process no substantial amount of extraneous or undesired material is introduced during the grinding process, and, furthermore, the present process is applicable not only to those binding agents which can readily be produced in powdered form by reduction of the oxides of the binding agents or by other common methods of producing metallic powders, but is also applicable to a variety of other metallic binding agents. The character of the hard cemented carbide material is influenced greatly by the composition of the binding agent. The binding agent not only acts to bond the particles of hard carbide, but also imparts its own characteristics to the final composition. Thus, in many cases it is desirable to use as a binding agent some other metal or alloy than the commonly employed binding agents such as cobalt, nickel or iron. The difficulty in using other binding agents which would impart desirable properties to the final composition is in many cases that it is extremely difficult to make them into powder by reducing the oxide, as is commonly done in the case of cobalt, nickel and iron.

In accordance with my invention, the binding agent which is used to bond the hard metal carbide in the cemented composition is mixed with the hard metal carbide by grinding the hard metal carbide in a container having its grinding surface composed of the metallic binding agent. During the grinding, the hard metal carbide abrades off particles of the binding agent from the grinding surface of the container. The binding agent so abraded off is in extremely finely divided condition since it is obtained by the abrasive action of the hard metal carbide on the grinding surface. The hard metal carbide is itself in a very finely divided condition when introduced into the container and the particles of binding agent abraded off from the grinding surface of the container are necessarily smaller than the particles of hard metal carbide. The binding agent is used in relatively small proportions, as compared with the hard metal carbide, and for this reason it is a great advantage to have the particles of binding agent as small as possible in order that they will be distributed to the greatest extent throughout the powdered carbide. The mixture of hard metal carbide and metallic binding agent produced by the abrasive action of the carbide on the grinding surface of the mill composed of the binding agent is then sintered or cemented in the usual way to produce the hard cemented carbide composition. The mixed powders may be first compacted and then sintered, or pressure and heat may be applied simultaneously to the mixed powders in order to produce the cemented composition.

If it is desired to produce a hard cemented carbide material containing tungsten carbide and cobalt, the tungsten carbide prepared in any desired manner is introduced in powdered form into a rolling barrel which has its grinding surface composed of cobalt. This surface may be made by electroplating cobalt onto the interior surface of an ordinary cast iron rolling barrel or it may be made by melting and casting the cobalt into a cylindrical lining which is thereafter inserted into the rolling barrel. The rolling barrel is charged with steel or iron balls, and as the grinding progresses, the tungsten carbide abrades off particles of the cobalt from the grinding surface, producing a powdered mixture of tungsten carbide and cobalt, both of which are in very finely divided condition, but especially the cobalt since it has been abraded off from the cobalt surface of the rolling barrel by the tungsten carbide which was in finely divided form previous to its introduction into the rolling

barrel. This powdered mixture of tungsten carbide and cobalt is substantially free from extraneous matter such as iron or iron oxide which would be introduced had the tungsten carbide and cobalt both in powdered form been introduced and ground in a steel or iron rolling barrel.

A wide variety of metallic binding agents may be mixed in this manner with the hard metal carbide to produce mixed powders suitable for sintering to form the cemented composition. The other usual binding agents such as nickel or iron may be mixed with the hard metal carbide by providing the rolling barrel or other container with a grinding surface composed of either nickel or iron. If it is desired to use as the binding agent an alloy of these metals or an alloy of other metals, a container having its grinding surface composed of such alloy is used for grinding the hard metal carbide. A binding agent may be introduced into a mixture of hard carbides by grinding a mixture of the hard carbides in a container having its grinding surface composed of the binding agent.

The invention is particularly applicable to those metallic binding agents or alloys which it is difficult to produce in powdered form by reduction of their oxides or by other common methods of producing metallic powders. These binding agents may be produced in powdered form mixed with the hard metal carbide by grinding the carbide in a container having its grinding surface composed of the binding agent so as to abrade off particles of the binding agent. For example, manganese steel is very tough and has a high resistance to abrasion and is, therefore, well adapted for use as a binding agent in hard carbide materials. The disadvantage of manganese steel, however, is that it is extremely difficult to produce in powdered form. In my process, manganese steel can be used as the binding agent by making the grinding surface of the rolling barrel of manganese steel and abrading off particles of the steel by grinding a hard metal carbide in the barrel. The invention is not restricted to any particular metal or alloy as the material of which the grinding surface is composed. Alloy steels other than manganese steel may be used in a similar manner. Thus, the alloy steels referred to in my Patents No. 1,815,613, granted July 21, 1931, and No. 1,826,455, granted October 6, 1931, may be used to form the grinding surface of the rolling barrel. In like manner, I may use alloys sold under the trade name "Stellite" which contain some or all of the elements cobalt, nickel, chromium, tungsten, molybdenum, and uranium in various combinations either with or without iron, an alloy sold under the trade name "Nichrome" composed essentially of nickel, chromium, and iron, or other alloys having the required strength and bonding properties for suitably bonding the hard metal carbides. I may use metallic tantalum, alloys of cobalt or nickel with titanium, or alloys of zirconium or chromium in the same manner.

If the grinding of the hard carbide in contact with a surface composed of the binding agent is carried out for a long enough period, all of the required binding agent may be produced by abrading off particles of the binding agent. On the other hand, if it is desired to modify the properties of the cemented composition by including not only the usual metallic binding agents such as cobalt, nickel and iron, but also a binding agent which it is difficult to produce in powdered form, a hard carbide may be ground in

contact with a cobalt surface in order to abrade off particles of cobalt and then in contact with a surface composed of manganese steel in order to abrade off particles of the steel. If it is desired to introduce manganese steel into a mixture of powdered tungsten carbide and cobalt, the powdered mixture may be ground in contact with a grinding surface composed of manganese steel. In other words, the present invention may be used to provide in powdered form all of the binding agent desired in the composition or it may be used as a binding agent additive so as to incorporate additional binding agents with other binding agents which have been formed in some other manner. As an example of the use of the present invention for incorporating a binding agent additive, tungsten carbide may be ground in contact with a grinding surface composed of a titanium alloy in order to abrade off particles of the alloy. Cobalt in powdered form may then be added to the mixture of tungsten carbide and titanium alloy and the grinding continued to produce a uniform mixture. In this case the titanium alloy is used in a relatively small proportion, as compared with the cobalt, and may, therefore, be termed a binding agent additive.

The present process is applicable to the production of mixed powders containing a metallic binding agent and any hard metallic carbide. As illustrative of the hard metal carbides which may be used, I mention tungsten carbide, chromium carbide, molybdenum carbide, vanadium carbide, titanium carbide, tantalum carbide, zirconium carbide, thorium carbide, uranium carbide, and columbium carbide.

The term "a relatively continuous surface composed of said binding agent" has been used to distinguish the present process in which the hard carbide is ground in a container having its grinding surface composed of the binding agent from the prior known processes in which the binding agent is in powdered form before mixing with the hard metal carbide.

I have given certain examples to illustrate the manner in which my process may be carried out. It is to be understood, however, that the invention may be otherwise practiced within the scope of the following claims.

I claim:

1. In the manufacture of hard cemented carbide material containing a hard metal carbide and a metallic binding agent, the step comprising grinding the hard metal carbide in a container having a grinding surface containing a substantial amount of a metal of the group consisting of cobalt and nickel.

2. In the manufacture of hard cemented carbide material containing a hard metal carbide and a metallic binding agent, the step comprising grinding the hard metal carbide in a container having its grinding surface composed of a material containing a substantial amount of a metal of the group consisting of cobalt and nickel.

3. The process of making hard metal compositions from powdered material, which comprises grinding a mixture of a hard metal carbide and a binding metal in a container composed of a chromium bearing alloy, whereby chromium is introduced into the mixture by the abrasive action of the mixture, and sintering the mixture.

4. The process of making hard metal compositions from powdered material, which comprises grinding a mixture of a hard metal carbide and a binding metal of the group consist-

ing of cobalt and nickel in a container composed of a chromium bearing alloy, whereby chromium is introduced into the mixture by the abrasive action of the mixture, and sintering the mixture.

abrasive action of the mixture, and sintering the mixture.

5 5. The process of making hard metal compositions from powdered material, which comprises grinding a mixture of a hard metal carbide and a binding metal of the group consisting of cobalt and nickel in a container composed of an alloy of chromium and cobalt, whereby
10 chromium is introduced into the mixture by the

6. The process of making hard metal compositions from powdered material, which comprises grinding a mixture of a hard metal carbide and a binding metal of the group consisting of cobalt and nickel in a chromium plated container, whereby chromium is introduced into the mixture by the abrasive action of the mixture, and sintering the mixture.

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