Patented Oct. 6, 1931 1,826,456

UNITED STATES PATENT OFFICE

GREGORY J. COMSTOCK, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO FIRTH-STERLING STEEL COMPANY, OF McKEESPORT, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA

METAL AGGREGATE

No Drawing. Application filed April 14, 1928. Serial No. 270,155.

This invention relates broadly to an improved composition of matter, and more particularly to a metal aggregate comprising the combination of a cutting agent or cutting agents of abrasive characteristics and a binding agent or binding agents.

It has heretofore been proposed in the art to which the present invention relates to provide hard metal alloys by combining tungstic carbide having from 3% to 10% carbon with not in excess of 10% of an alloying metal or alloying metals, preferably in a finely divided state, serving to reduce the sintering temperature of the resulting mass. This mass is then pressed into forms and the forms are sintered at a suitable temperature.

In the patent to Karl Schroter, No. 1,549,615, issued August 11, 1925, such a process is described. According to the disclosure in the above-mentioned patent, an alloy is produced which consists of a tungstic carbide with a carbon content of from 4% to 10%, in combination with an auxiliary metal of a considerably lower melting point, as, for instance, iron, cobalt or nickel, in quantities up to a maximum of 10%. The tungstic metal constitutes the predominating element and constitutes at least 80% of the total content of the alloy.

According to the disclosure in the patent, the effect of the auxiliary or alloying metal is to reduce the sintering point of the body to such an extent that it occurs at temperatures which lie in the neighborhood of 1,000° below the melting point of the carbide. The temperature at which the sintering occurs is affected by the quantity of the admixed auxiliary metal, which can be made as high as 10% of the alloy.

According to my invention, I provide a metallic aggregate consisting of a cutting agent or agents of abrasive characteristics and a binding agent or binding agents, suitable for the formation of tools, such as bits, shapers, drills, cutters, saws and the like, as well as dies for both drawing and extrusion purposes. It also contemplates the production of dressing tools, metallic grinding stones, knife sharpeners and other similar devices, and tools requiring high abrasive or cutting characteristics. The product resulting from the practice of my process is a homogeneous non-porous aggregate comprising a metallic oxide embedded in a matrix of a metallic binding agent. The metallic oxide and the metallic binding agent are not chemically combined, as is the case disclosed in the Schroter patent, nor is an alloy in any sense of the word formed.

According to my invention, the amount of metallic binding agent employed has no effect whatsoever on the melting temperature of the cutting or abrading material. Whether a small or a large percentage of binding agent is employed, it in no way affects the melting point of the cutting or abrading agent.

Again, according to my invention, any proportion of a metallic binding agent up to 99% by weight of the resulting aggregate may be employed, and irrespective of the amount of binding agent employed, the melting temperature of the metallic oxide employed as a cutting agent remains the same.

In carrying out the present invention, I utilize a cutting or abrading agent or agents in combination with a suitable metallic binding agent or agents which serve to bond together the particles of the cutting agent. As cutting agents, I may utilize vitrified zirconium oxide, tungsten carbide, silicon carbide, or any other suitable cutting or abrading agent. As binding agents I may employ nickel, cobalt, iron or chromium. The preferred combination of cutting agent or agents is vitrified zirconium oxide as the cutting agent, and metallic nickel as the binding agent.

I have found that desirable results may be accomplished by taking the desired quantity of vitrified zirconium oxide or an equivalent abrasive, reducing the same to finely divided form, preferably such that it will pass through a 200 mesh screen, and mixing the same with a desired amount of a suitable metallic binding agent of the character herein referred to, preferably metallic nickel, which has been similarly finely divided.

The cutting agent or agents and the binding agent or agents having been reduced to

the desired fineness, are mixed together in varying proportions, depending upon the characteristics which are desired in the final composition. Where brittleness of the product is not a limiting factor, smaller percentages of metallic binder may be used, but where strength and resistance to shock are required, larger percentages of binder must be present.

It is notable that where the binder is increased, the cutting or abrading value of the abrasive, and likewise the cutting or abrading value of the product, is necessarily decreased due to the relatively greater dispersion of the cutting particles. For example, in cases of the character first referred to, that is, where brittleness of the product is not a limiting factor, I may utilize as high as 99% of the cutting agent or cutting agents with desirable results, while in the latter case, where strength and resistance to shock are the dominating characteristics desired, I may use up to, say, 99% of the metallic binding agent, or even higher. In fact, an aggregate comprising only a trace of the cutting agent will show extremely great resistance to shock and extreme strength, and will, in addition, have improved cutting characteristics over alloys in which the cutting agent is not employed.

In some cases it is desired to provide a composition of matter of such nature that it lends itself to shaping and deformation by hot working. In such cases, I utilize not less than 30%, and preferably not less than 50%, of the binding agent, although variations in this amount may be made one way or the other while retaining some degree of workability.

Having determined upon the proper composition depending upon the character which the resulting product is to have for its specific application, I may proceed in accordance with any of four different methods. The first of these involves the pressing to shape followed by fusing without any subsequent pressure; the second involves the pressing to shape followed either in sequence or simultaneously by heat and pressure; the third involves the application of heat and pressure simultaneously without any preliminary pressure; while the fourth involves the application of heat followed by the application of pressure, without any preliminary pressing.

In accordance with the first method, which will hereinafter be referred to as the cold compacting method, I preferably form a paste by using a resinous material such, for example, as gum tragacanth, in the amount of one ounce of the gum tragacanth to a pint of water, and add this paste to the mixture of cutting agent or cutting agents and binding agent in the ratio of about ½ of 1% by weight. This mixture is then subjected to pressure while cold, the pressure preferably being of the order of 150 tons to the square inch.

This produces a closely compacted mixture which is then subjected to a temperature sufficiently high to melt the binding agent and cause it to actually flow around the cutting agent or cutting agents, so that upon cooling, such agent or agents will be substantially uniformly dispersed or distributed throughout the product with each particle firmly bonded in the binding material, which in this case forms a metal matrix.

In the second method the preliminary steps of forming a paste-like mixture, and pressing the same, are followed. Thereafter this mixture is subjected to heat to fuse the binding agent, and either simultaneously with the application of the heat, or subsequently thereto while the mixture is still hot, is subjected to pressure.

In the third method, the preliminary compacting is dispensed with, the mixture being subjected in a suitable mold to heat and pressure simultaneously.

In accordance with the fourth method, which also obviates the necessity for any preliminary cold pressing, the mixture is subjected to the desired temperature conditions, and thereafter, while still hot, is subjected to pressure.

The second, third and fourth methods have the advantage of providing pressure at such a time as to tend to close up any pores which may have formed under the heat treatment by reason of the volatilization of any of the ingredients. Also, these three last-mentioned processes require a materially lower pressure, pressures as low as from 75 to 150 pounds per square inch producing satisfactory results with some mixtures.

In heating, in each of the methods above referred to, I prefer to employ temperatures in the neighborhood of 2800° F., although it will be obvious that this temperature depends on the particular metallic binder employed, and may vary within fairly wide limits. During the heating, suitable precautions must be taken to prevent oxidation of the product. This may be accomplished, for example, by heating in a reducing atmosphere of hydrogen.

In all cases where a paste has been formed by the use of a resinous material, the application of heat volatilizes the same from the mixture.

The hardness of the composition in accordance with my invention is such that once it has been produced it does not lend itself to grinding or cutting by known methods. It is therefore desirable, in case the proportions are not such as to produce a workable product, i. e., a product lending itself to shaping or deformation when heated to a suitable temperature, to subject the mixture to pressure

in a mold of the desired configuration of the finished article. In this manner, a completed article, such as a tool, can be formed directly from the mixture.

It is to be understood that the form of the invention described is the preferred embodiment and that the invention is not limited except as required by the appended claims, it being understood that the examples herein specified are given by way of illustration only and not by way of limitation.

I claim:

1. A sintered aggregate comprising finely divided vitrified zirconium oxide bonded in a matrix of nickel, the aggregate being amenable to shaping while hot, the nickel constituting at least 30% of the aggregate.

2. A sintered aggregate comprising finely divided vitrified zirconium oxide bonded in a matrix of nickel, the aggregate being amenable to shaping while hot, the nickel constituting at least 50% of the aggregate.

3. A sintered aggregate comprising finely divided vitrified zirconium oxide bonded in a matrix of nickel, the zirconium oxide constituting from a major portion to about 95% of the aggregate.

4. A sintered aggregate comprising finely divided vitrified zirconium oxide bonded in a matrix of nickel, the zirconium oxide constituting from about 80% to about 95% of the aggregate.

5. A sintered aggregate comprising finely divided vitrified zirconium oxide bonded in a matrix of nickel, the zirconium oxide constituting about 94% and the nickel about 6% of the aggregate.

In testimony whereof I have hereunto set my hand.

GREGORY J. COMSTOCK.