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COMPOSITION OF MATTER

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

This application is a division of our copending application Serial No. 268,391, filed April 9, 1928 for composition of matter and method of making the same.

We have found that certain materials, which are hereinafter referred to as cutting agents, when held together by definite percentages of a suitable binder, provide a composition of matter having such characteristics as to render them suitable for a wide variety of purposes. Within the class of cutting agents are included such materials as silicon carbide, tungsten carbide, and zirconium oxide, preferably vitrified zirconium oxide, these materials being considered as cutting or abrasive agents due to their extreme hardness. The utility of the invention, however, is not limited necessarily with respect to the particular cutting agent employed, although those referred to give desirable results in accordance with the method hereinafter described.

While the present invention adapts itself to the use of a wide variety of binders, we preferably utilize a metallic binder comprising a high speed steel. Within this classification we include any of the well known types of high speed steels, such, for example, as those having 14% tungsten, those having 18% tungsten, or those having from 14% to 18% tungsten with from 3% to 8% of cobalt.

It is understood that chromium and vanadium should be present in the proportions usually adopted for these alloys, and that carbon is also present in these high speed steels according to the usual limits of composition.

Although in high speed steels chromium and vanadium are usually present, we include in the definition of high speed steels, steels which do not include these elements.

Where chromium is present it is usually present in amounts varying from 3% to 6%, vanadium from ½% to 2½%, and carbon from .3% to 1%. In high speed steels in which cobalt is present, molybdenum is also preferably utilized in amounts varying from ½% to 1½%.

In carrying out the present invention we preferably take the desired cutting agent or mixture of cutting agents and pulverize the same to very finely divided condition, preferably to a fineness which will pass through a 200 mesh screen. The same procedure of pulverizing or finely dividing is followed with the binding agent.

The cutting agent or agents and the binding agent having been reduced to the desired fineness, they are mixed together in varying proportions, depending upon the characteristics which are desired in the final composition. Where brittleness of the product is no limiting factor, smaller percentages of 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, we may utilize as high as 95% of the cutting agent or cutting agents with desirable results, while in the latter case the binding agent may be increased up to 95% or even higher. In some cases we have found that beneficial results are obtained by the mere addition of a trace of the cutting agent to a standard high speed steel.

In some cases it is desired to provide a composition of matter of such nature that it

lends itself to shaping and deforming by hot working. In such cases we 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.

Example I

A specific example of a composition suitable for use in the production of tools such as drawing dies, extrusion dies; high speed cutting tools such as bits, shapers, drills, cutters, saws and the like, is as follows:

Vitrified zirconium oxide, 87%; 13% of a high speed steel consisting of the following: C, .70; Si, .25; Mn, .25; S, .025; P, .035; W, 18.00; Cr, 4.90; Va, 1.25; balance iron.

Example II

As a specific example of a composition of brittle characteristics, adapting the composition to use for the production of dressing tools, metal grinding stones, knife sharpeners and the like, we refer to the following:

Vitrified ziroconium oxide, 95%; 5% of a typical high speed steel of the following composition: C, .75; Si, .25; Mn, .40; S, .025; P, .040; W, 18.50; Cr, 5.00; Va, 1.75; Mo, .75; Co, 8.50; balance iron.

Example III

Where it is important that the resulting product have workable characteristics we may use the following percentages:

Vitrified zirconium oxide 30%: 70% of a typical high speed steel: C, .40; Si, .25; Mn, .25; S. .025; P, .040; W, 14.00; Cr, 4.50; Va, 1.50; balance iron.

Having determined upon the proper composition depending upon the character which the resulting product is to have for its specific application, we 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 pressing; 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, we preferably form a paste by using a resin, such as gum tragacanth in the amount of one ounce of the gum tragacanth to a pint of liquid, such as 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 cold 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, we 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 the cases where a paste has been formed by the use of gum tragacanth the application of heat volatilizes the same from the mixture.

The hardness of the composition in accordance with our 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 having the configuration of the finished

article. In this manner, a completed article, such as a tool, can be formed directly from the mixture.

It will be understood by those skilled in the art that the present invention, according to the best of our present knowledge, results purely in a mechanical mixture or aggregate, the different materials utilized not combining chemically to any material degree under the temperature and pressure conditions to which they are subjected.

It is to be understood that we have described the present preferred embodiment of our invention, but that it is not limited except as required by the appended claims.

We claim:

1. A cutting composition comprising particles of finely divided vitrified zirconium oxide bonded in a matrix of sintered particles of high speed steel, the zirconium oxide constituting about 87% and the high speed steel about 13%, by weight of the tool.

2. A cutting composition comprising particles of finely divided vitrified zirconium oxide bonded in a matrix of sintered particles of high speed steel, the zirconium oxide constituting about 87% and the high speed steel about 13%, by weight of the tool, the high speed steel containing from about 14 to 18% of tungsten.

3. A cutting composition comprising finely divided particles of vitrified zirconium oxide bonded in a matrix of high speed steel, the zirconium oxide constituting from a major portion up to about 95% of the composition, the balance being high speed steel.

In testimony whereof we have hereunto set our hands.

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