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METHOD OF MAKING A HARD FACING ALLOY

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The present invention relates to a new hard wear resisting alloy particularly suitable where excessive wear, excessive oxidation and excessive abrasion are encountered. The alloy of the invention is particularly useful for dies, cutting tools, sand blast nozzles, and similar devices.

Various alloys have been used heretofore for such hard facing but most of these alloys develop an abnormal amount of pitting and blow holes, particularly when the facing is done by an oxy-acetylene torch. Blow holes and pits usually result from oxidation of carbon or other impurities in the alloy or from an incomplete fusion of the alloy ingredients. These pits and blow holes usually show up upon grinding the hard faced piece of the device and the facing in which the material is used becomes so pitted and full of blow holes that it will not function properly. The new improved alloy of the present invention by reason of the composition thereof and the method of manufacture employed is a homogeneous alloy which, on being cast into molds, forms sound castings and subsequently, even though fused by an oxy-acetylene torch, produces a hard facing that is substantially free from blow holes and pits when ground.

According to the present invention, the alloy is made in the following manner:

First, a mixture of iron powder and carbon black or lamp black is made; the iron powder preferably about 200 mesh constitutes 80% to 94% of the total weight and the carbon black or lamp black 20% to 6%. There is preferably a small excess of free carbon remaining. When this mixture is subjected to a heat treatment under controlled conditions, an iron carbide is formed. Tungsten carbide powder is then mixed with this iron carbide powder in the proportions of 95% by weight of tungsten carbide and 5% by weight of iron carbide.

When these powders are thoroughly mixed, they are pressed into convenient pellets by hydraulic pressure, the pellets being about two inches in diameter by one inch in height. The pellets are heat-treated in a dry hydrogen or other neutral atmosphere in order to pre-alloy the mixture and cause a partial sintering thereof. The sintering of the alloy may be carried out in a magnesia crucible, in a high frequency furnace or in any suitable furnace under dry hydrogen or a neutral atmosphere, conditions being such as to prevent excessive oxidation and decarburization.

Chromium and cobalt in proper proportions are then put into a crucible and melted, where-

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upon the sintered tungsten iron carbide pellets are added. When a thorough fusion of these materials has taken place, certain grain refiners or deoxidizers are added to the melt. These deoxidizing additions, and grain refiners may be one or more of such metals as calcium, silicon, manganese, boron or an alloy of silicon, aluminum and zirconium or ferrous alloys of the metals of the IV, V and VI periodic groups such as ferrotitanium, ferrovanadium, ferrochromium, etc., in an amount sufficient to leave a metallic residue not in excess of 5% of the total weight of the melt.

The melt is then cast into suitable molds to form a cast ingot of approximately $\frac{1}{4}$ to $\frac{3}{8}$ of an inch in diameter by 14 to 16 inches long. On cooling, these ingots are trimmed and dressed and they are then ready for use as a hard facing material. The resulting alloys have a hardness on the Rockwell A scale of the order of 80-83 and they are highly resistant to oxidation and abrasion. The preferred composition of the alloy is as follows:

	Per cent
25 Tungsten	31.00
Iron	2.00
Carbon	2.25
Chromium	24.50
30 Deoxidizers	2.50
Cobalt	Balance

The proportions of the ingredients may be varied within certain limits without materially affecting the desirable characteristics of the alloy. The following ranges have been found suitable:

	Per cent
40 Tungsten	24-45
Iron	1- 5
Carbon	2- 5
Chromium	20-25
Deoxidizers	0.5- 5
45 Cobalt	Balance

The carbon, of course, is added mainly as carbide in combination with tungsten and iron. It is possible, however, that during the fusion of the ingredients, some carbon is taken up by the chromium so that some chromium carbide is formed. Tungsten carbide may be replaced in whole or in part by molybdenum carbide, the proportions of molybdenum carbide or tungsten-molybdenum carbide content remaining substantially the same as in the examples given for tungsten.

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The deoxidizing additions, though small in amount, perform the function of removing oxygen and perhaps nitrogen from the alloy and effecting a general scavenging thereof. This action permits a finer grain formation and adds to the strength and toughness of the alloy. There is, accordingly, in the final product a practical absence of pits and blow holes that ordinarily characterize alloys of this type.

The alloy may be cast in a mold to form any desired predetermined shape, such as rings, dies, cylinders, and the like, and then ground to finished size. By heating the alloy after casting at a temperature of about 1000° C. for a period of 6-10 hours, added strength and hardness are imparted to the piece.

Having thus described our invention, what we claim is:

Process of making a hard facing alloy which comprises pressing into pellets and sintering about 95% by weight of tungsten carbide powder and about 5% by weight of iron carbide powder; preparing a melt of chromium and cobalt and adding thereto and fusing therewith said tungsten iron carbide pellets; then adding deoxidizing and grain refining material of the group consisting of calcium, silicon, manganese, boron, alloys of silicon, aluminum, and zirconium, and ferrous alloys of titanium, vanadium and chro-

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mium; and casting the same into ingots; the proportions of the ingredients forming said alloy being about 24% to 45% of tungsten, 1% to 5% of iron, 2% to 5% of carbon, 20% to 25% of chromium, 0.5% to 5% of deoxidizing and grain refining metal and the balance cobalt.

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