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Frehn

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[54] SINTER METAL ALLOY

[75] Inventor: **Fritz Frehn**, Krefeld, Germany

[73] Assignee: **Deutsche Edelstahlwerke Aktiengesellschaft**, Krefeld, Germany

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **29/182.7**, 29/182.8

[51] **Int. Cl.** **B22f 3/00**

[58] **Field of Search** 29/182.5, 182.7, 29/182.8; 75/203, 204

[56] **References Cited**

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Primary Examiner—Carl D. Quarforth
Assistant Examiner—R. E. Schafer
Attorney—Cushman et al.

[57] **ABSTRACT**

Very hard, corrosion-resistant low specific gravity sinter alloys comprise a major proportion of one or more carbides of titanium, chromium and vanadium and a minor proportion of an austenitic metal alloy containing 0.2 to 1.2 percent Cu, 0.2 to 1.2 percent of niobium/tantalum and/or titanium, 0.5 to 29 percent molybdenum, 0.005 to 0.1 percent boron, 10 to 66 percent nickel, and optionally carbon, chromium, aluminium, manganese, tungsten and iron.

3 Claims, No Drawings

SINTER METAL ALLOY

The invention relates to a sinter metal alloy that is very hard and tough, resistant to corrosion and also has a low specific gravity, and which comprises one or more of the carbides titanium, chromium and vanadium and an austenitic alloy as hereinafter set forth.

The alloy of the present invention, in addition to high wear resistance and resistance to corrosion, possesses maximum toughness allied with low specific gravity. Other features of the alloy are high compressive strength and hardness and oxidation resistance. Such characteristics are required by bearing materials exposed to high temperatures, or materials for making balls for ball mills.

Ceramic materials made of oxides such as alumina and silica; metal carbides such as tungsten-tantalum, niobium-titanium or molybdenum carbide; or borides, nitrides and silicides only partly meet the above stated requirements. Thus ceramic materials are too brittle, they easily splinter and their compressive strength and wear resistance are insufficient. Pure carbides are likewise too brittle and in the majority of instances have too high a specific gravity. Hard metals consisting of metal carbides and metal binders usually have too high a specific gravity and lack corrosion resistance. Hard metals based on titanium carbides with metallic binders have low specific gravities, but they lack toughness and corrosion resistance. Borides, nitrides and silicides individually are as brittle as glass and therefore are likewise unsuitable for the purposes of the present invention. Metal alloys do not comply with the desired properties because they lack compressive strength and hardness.

The invention provides a sinter metal alloy comprising 55 to 80 percent by weight of one or more of the carbides of titanium, chromium and vanadium in the form of individual or mixed carbides and
45 to 20 percent by weight of an austenitic metal alloy consisting essentially of

0 to 0.08 % carbon
0.2 to 1.8 % copper
0.2 to 1.2 % niobium/tantalum and/or titanium
0.5 to 29 % molybdenum
0.005 to 0.1 % boron
0 to 23 % chromium
0 to 1.7 % aluminium
0 to 1.9 % manganese
0 to 6.8 % tungsten
0 to 68 % iron
10 to 66 % nickel.

All percentages being by weight.

By the term "consisting essentially of" used herein and in the Claims hereof is meant that impurities and incidental ingredients may be present in such small quantities as not significantly to affect the stated characteristics.

A preferred alloy according to the invention comprises about 70 percent by weight of titanium carbide containing less than 0.01 percent of free carbon and 30 percent by weight of an austenitic nickel alloy consisting essentially of

16.8 % chromium
16.8 % molybdenum
0.8 % copper
4.7 % tungsten
0.3 % niobium

<0.03 % carbon
0.02 % boron
balance nickel.

A further preferred alloy according to the invention comprises about 70 percent by weight of titanium carbide containing less than 0.01 percent free carbon and 30 percent by weight of an austenitic steel alloy consisting essentially of

18.0 % chromium
1.0 % molybdenum
0.8 % copper
12.0 % nickel
0.3 % titanium
0.01 % boron
<0.03 % carbon
balance iron.

The specific gravity of the said preferred alloys is 5.80 g/cc., the hardness thereof is between 70 and 72 Rc, the compressive strength from 300 to 350 kg/mm^2 and the corrosion resistance, particularly under reducing conditions to halides, acid chloride solutions and hydrochloric acid, is satisfactory. The toughness of the sinter metal alloys according to the invention was tested on sintered balls which were dropped or projected from a height of 10 metres onto a concrete slab. The balls bounced to regain their original height without any tendency of splintering.

Sinter metal alloys according to the invention may be produced in conventional manner by first pre-grinding the alloying components to a maximum of 6 μ, the carbide component and the several elements or key alloys of the binder metal alloy are then wet ground in attrition mills to a final grain size of not more than 3 μ with a large proportion of fines and then dried, the milling liquid being expelled in a vacuum dryer. The thus-ground components are then mixed, and the mixture thoroughly kneaded with the addition of a liquid to the powder whereby granulation is effected and flowability is improved, and the granular mixture is then compacted using a mechanical or isostatic press, and the compacts thus obtained are then sintered to form an alloy and a crystalline solid solution, in a vacuum sintering furnace under a pressure of less than 10^{-2} torr at a temperature of from 1250° to 1350°C for a total, i.e. heating, holding and cooling, time of 8 to 48 hours.

Due to the excellent properties of the sinter metal alloy according to the invention, the alloy may be used for instance as a material for making balls for ball mills which are to work in a neutral, oxidising or corrosive atmosphere, e.g. at a temperature of up to 800°C. The alloy is also suitable for parts that in use are exposed to high temperatures, for example ball bearings, roller bearings, thrust bearings, slideways and gas bearings. Due to the austenitic structure of the binder metal alloy the sinter metal alloys according to the invention can be used for parts that must be non-magnetic, for instance for the punches or dies of presses that operate in a magnetic field.

What is claimed is:

1. A sinter metal alloy that comprises 55 to 80 percent by weight of one or more of the carbides of titanium, chromium and vanadium in the form of individual or mixed carbides and 45 to 20 percent by weight of an austenitic metal alloy consisting essentially of

0 to 0.08 % carbon
0.2 to 1.8 % copper
0.2 to 1.2 % niobium/tantalum and/or titanium

0.5 to 29 % molybdenum
0.005 to 0.1 % boron
0 to 23 % chromium
0 to 1.7 % aluminium
0 to 1.9 % manganese
0 to 6.8 % tungsten
0 to 68 % iron
10 to 66 % nickel.

2. A sinter metal alloy according to claim **1**, comprising about 70 percent by weight of titanium carbide containing less than 0.01 percent of free carbon and 30 percent by weight of an austenitic nickel alloy consisting essentially of

16.8 % chromium
16.8 % molybdenum
0.8 % copper
4.7 % tungsten
0.3 % niobium

<0.03 % carbon
0.02 % boron
balance nickel.

3. A sinter metal alloy according to claim **1**, comprising about 70 percent by weight of titanium carbide containing less than 0.01 percent free carbon and 30 percent by weight of an austenitic steel alloy consisting essentially of

18.0 % chromium
1.0 % molybdenum
0.8 % copper
12.0 % nickel
0.3 % titanium
0.01 % boron
<0.03 % carbon
balance iron.

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