

[54] **THERMAL AND ABRASION RESISTANT
SINTERED ALLOY**

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75/175, 75/123 J, 75/123 K

[51] **Int. Cl.**..... **B22f 1/00**

[58] **Field of Search**..... 75/125, 123 J, 123 K;
29/182.1, 182, 156.7 A

[56] **References Cited**

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[57]

ABSTRACT

An alloy prepared by adding 0.3 to 5 percent by weight of a ferrocabide of an iron-carbon alloy containing one or more of carbide forming elements to a base comprising 0.6 to 2 percent of carbon, 0.5 to 5 percent of molybdenum, 6.0 to 15 percent of cobalt, 0.5 to 4 percent of nickel, by weight, and the balance iron and molding and sintering has large thermal resistance and abrasion resistance.

1 Claim, 2 Drawing Figures

FIG. 1

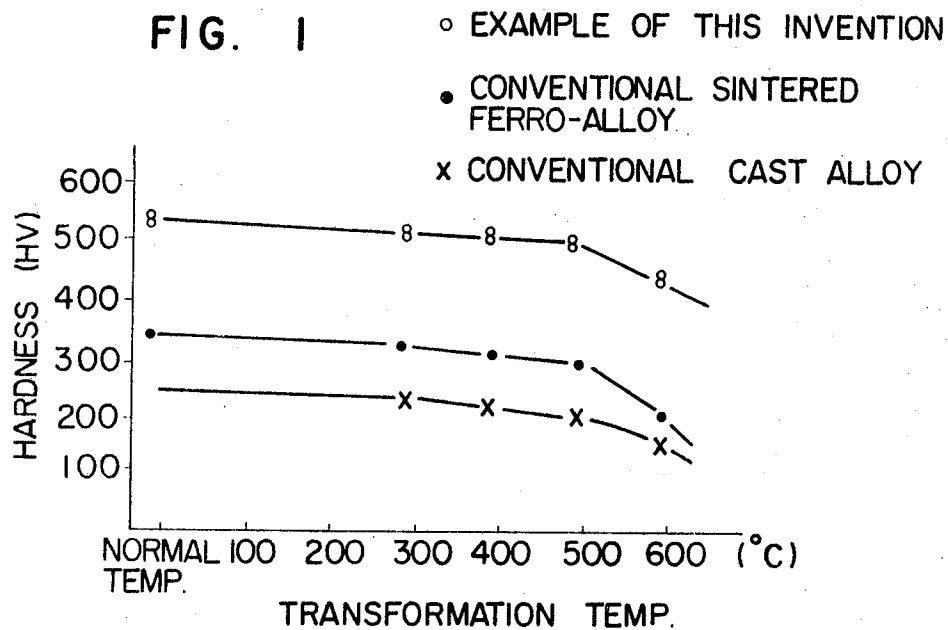
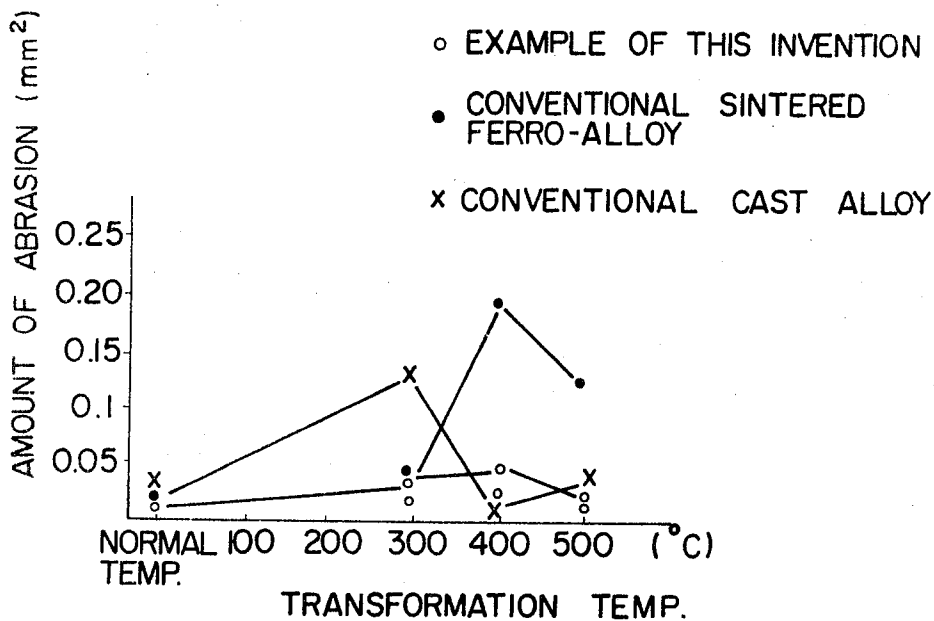


FIG. 2



THERMAL AND ABRASION RESISTANT SINTERED ALLOY

BACKGROUND OF THE INVENTION

A publicly known metal such as chromium, cobalt, tungsten, etc. has not only a large abrasion resistance but also is prominent in its characteristics at elevated temperatures and is applied in various fields. However, such a metal has many problems to be solved when it is used as sintered parts for a machine. That is, such a metal has a high melting point so that the sintering temperature is, of necessity, required to be elevated and the sintering time has to be extended, and, therefore, it is naturally disadvantageous in cost.

SUMMARY OF THE INVENTION

The present invention provides a sintered alloy having large thermal resistance and abrasion resistance suitable for use as a sliding element such as, for example, a valve sheet, in which high thermal resistance and high abrasion resistance are required. That is, the present invention comprises a sintered thermal and abrasion resistant alloy comprising added 0.3 to 5 percent by weight of a ferro-carbide of an iron-carbon alloy containing one or more carbide forming elements to a base comprising, by weight, 0.6 to 2 percent of carbon, 0.5 to 5 percent of molybdenum, 6.0 to 15 percent of cobalt, 0.5 to 4 percent of nickel and the balance iron and molded and sintered.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a graph showing the hardness at elevated temperatures of sintered alloys of the Examples and of a conventional cast iron and sintered ferro alloy; and

FIG. 2 is a graph showing the abrasion resistance of sintered alloys of the Examples and of a conventional cast iron and a sintered ferro alloy.

DETAILED DESCRIPTION OF THE INVENTION

In the sintered alloy of the present invention, carbon is solidified in an iron base to form a fine pearlite structure and plays a large role in improving the strength of the alloy material, however, when the carbon content is less than 0.6 percent, by weight, the alloy changes to a ferrite structure which decreases the hardness necessary for abrasion resistance, while, with more than 2.0 percent of carbon, the alloy changes to a cementite-excessive structure which becomes unnecessarily high in hardness and increases in brittleness.

Molybdenum increases the tenacity of the alloy as well as the impact strength and endurance limit, and, on the other hand, improves the heat treatment property and stabilizes the structure after sintering to contribute to the thermal and abrasion resistance of alloy. However, there is little effect with less than 0.5 percent of molybdenum and even if more than 5 percent is present, no increased effect corresponding to the increase in level is obtained.

Nickel strengthens the base structure of the alloy and improves the thermal resistance and abrasion resistance. However, the effect is small with a nickel content of less than 1 percent, while, when it becomes more than 4 percent, the base structure locally changes to martensite so that the hardness increases unnecessarily.

Cobalt improves substantially the thermal resistance and abrasion resistance at elevated temperatures and has been established at 6 to 15 percent on the basis of a synergistic effect with other elements.

The ferro-carbide is an iron-carbon alloy containing one or more carbide-forming elements (for example, chromium, molybdenum, cobalt, tungsten, titanium, vanadium, boron, etc.) in a base and diffuses in the base structure without being decomposed at the time of sintering to improve the abrasion resistance of the alloy. However, with less than 0.3 percent, the effect is not remarkable while, with more than 5 percent, the hardness increases unnecessarily and the formability of the powder is reduced and the strength is lowered.

The present invention will be further illustrated by the following Examples by which the present invention is not intended to be limited. All percents are by weight.

EXAMPLE 1

0.7 percent of graphite powder (−100 mesh), 0.6 percent (as molybdenum) of ferro-molybdenum powder (−150 mesh), 0.6 percent of carbonyl nickel (−250 mesh), 6.5 percent of cobalt powder (−150 mesh), 0.39 percent of ferro-carbide powder (alloy powder comprising 3.25 percent of carbon, 39.0 percent of nickel, 29.0 percent of chromium, 15.5 percent of tungsten, 10.0 percent of cobalt, and the balance iron (−150 mesh), and 1 percent of zinc stearate as a lubricant were added to reduced iron powder (−100 mesh) and mixed and molded under a pressure of 6 ton/cm² and sintered at 1,120° to 1,170°C for 30 to 60 minutes in an atmosphere of decomposed ammonium gas. The sintered material so obtained had a density of 6.6 g/cm³ and a Rockwell B scale hardness of 91.

EXAMPLE 2

4.75 percent of ferro carbide powder (alloy powder comprising 3.51 percent of carbon, 14.1 percent of chromium, 4.3 percent of molybdenum, 1.51 percent of vanadium, 1.97 percent of cobalt and the balance iron (−150 mesh) was added and a sintered material comprising 1.76 percent of carbon, 4.62 percent of molybdenum, 3.82 percent of nickel, 13.9 percent of cobalt and the balance iron was made under the same conditions as described in Example 1. The sintered material so obtained had a density of 6.8 g/cm³ and a Rockwell B scale hardness of 96.

To examine the abrasion resistance of the sintered alloys obtained in Examples 1 and 2, a hardness test at elevated temperatures and an abrasion test using a valve sheet abrasion testing machine (rotation number 3,000 rpm, spring pressure 35 Kg, valve velocity at the time of valve closing 0.5 m/sec., width of valve 1 mm, number of repeating test 8×10^5 , material SUH 31 B) were run. Incidentally, for comparison, the same tests were run on a conventionally known cast iron and a sintered ferro alloy. In this case, the composition of cast iron and ferro alloy were as follows:

Sintered ferro alloy:

Carbon 1 percent, chromium 3 percent, copper 3 percent, the balance iron.

Cast iron:

Carbon 3.02 percent, silicon 2.01 percent, manganese 0.48 percent, chromium 0.81 percent, the balance iron.

FIG. 1 shows the results of the measurement of the hardness at elevated temperatures of the sintered alloys in Examples 1 and 2 in comparison with a conventionally known cast iron and sintered ferro alloy. As is apparent from FIG. 1, the sintered alloys in Examples 1 and 2 are higher in hardness than the conventional cast iron and sintered ferro alloy and are excellent in hardness characteristics.

FIG. 2 shows the abrasion test results on the sintered alloys of Examples 1 and 2 in comparison with a conventionally known cast iron and sintered ferro alloy. The sintered alloy of the present invention was very small in amount and abraded and stable at elevated

temperatures. Thus, the alloy of the present invention has large thermal resistance and abrasion resistance.

What is claimed is:

1. A thermal and abrasion resistant sintered alloy comprising a molded and sintered powdery composition comprising (a) by weight 0.3 to 5 percent of a ferro carbide of an iron-carbon alloy containing one or more carbide-forming elements and (b) by weight 0.6 to 2 percent of carbon, 0.5 to 5 percent of molybdenum, 6.0 to 15 percent of cobalt, 0.5 to 4 percent of nickel and the balance iron.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,837,816

Dated September 24, 1974

Inventor(s) Kentaro Takahashi et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the Heading:

The claimed Priority Data was omitted. Should read:

--September 2, 1972

Japan.....66980/71--

Signed and sealed this 19th day of November 1974.

(SEAL)

Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

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