Patented Sept. 3, 1940 2,213,208

UNITED STATES PATENT OFFICE

2,213,208

ALLOY

Anthony G. de Golyer, New York, N. Y.

No Drawing. Application June 4, 1938, Serial No. 211,809

3 Claims. (Cl. 75—171)

The present invention relates to a new and useful alloy and relates particularly to an alloy containing as essential components boron, tungsten, chromium, iron and cobalt.

An object of the present invention is to provide an alloy having certain inherent physical properties and characteristics which can be developed and controlled by means of thermal treatment, and further to provide an alloy which can be manufactured in finished or semi-finished forms by means of centrifugal casting.

The alloy of the present invention has a combination of physical properties and characteristics which render it especially valuable for metal cutting tools and many other industrial purposes.

I have found through experiment that by alloying or otherwise intimately combining boron, tungsten, chromium, iron and cobalt within the range of boron 0.25% to 5%, tungsten 5% to 30%, chromium 1% to 25%, iron 5% to 40% and cobalt substantially the balance that I obtain metallic compositions which possess a combination of valuable physical properties and characteristics. An important essential characteristic of the present composition is that it is well adapted for the manufacture of cast forms by means of centrifugal casting. Another advantage is that such cast forms are readily amenable to thermal treatment for the improvement and control of important physical properties.

I have found that the alloy disclosed herein cannot be economically forged or rolled as it is particularly resistant to deformation at both normal and elevated temperatures. This applies especially to ingots or other forms cast by ordinary methods. I have also found that it is virtually impossible to produce commercially satisfactory shapes or forms of the alloy by means of gravity casting. Such castings do not have the proper density and I have found that this boron containing composition has an appreciable ratio of shrinkage upon solidification, with the result that a central cavity or pipe invariably occurs in the casting. I have also found that, in general, the physical structure of castings produced by gravity methods is such as to render the alloys more or less unsuitable for use as metal cutting tools, as well as many other industrial applications.

I have discovered that by applying suitable pressure to the molten alloy while it is in the mold that I can produce cast forms having a relatively high density and the requisite physical structure. I have found that while various methods may be used for developing the necessary degree of pressure, that centrifugal casting offers an entirely satisfactory and economical means of manufacturing cast forms of the present composition. I have found that by means of centrifugal casting I can increase the density of cast forms of this alloy from 15% to 25% over the density values of forms cast by gravity methods. Another important advantage is that the centrifugally cast forms have, in general, an unusually uniform physical structure and are quite free from massive segregates of hard and brittle constituents.

Cast bodies of the alloy produced by centrifugal casting may be utilized in the as cast condition. However, I usually prefer to subject the castings to a suitable thermal treatment before using them for metal cutting tools and many other purposes.

I have found by research that the preferred structure of an aggregate of the present composition comprises at least two principal constituents: (*a*) A relatively hard, intermetallic compound of boron with one or more of the essential components; and (*b*) a solid solution of two or more of the essential components, which has a lower degree of hardness and functions as a matrix. For certain uses, an appreciable percentage of the intermetallic boron compound should be in the form of more or less finely divided particles dispersed throughout the matrix. An aggregate having the preferred physical structure possesses a combination of essential physical properties superior to the properties of a cast aggregate which has not been subjected to thermal treatment. The present alloy is characterized by being amenable to thermal treatment for the development of precipitation hardening.

A distinctive characteristic of a body of the alloy which has been subjected to suitable thermal treatment is the combination of relatively high hardness e. g. 63 to 70 Rockwell C, and high resistance to impact. Another important property is that virtually all of the degrees of hardness and resistance to impact developed by thermal treatment are retained when the alloy is subjected to temperatures up to approximately 600° C.

Although I usually prefer to have the alloy composed substantially of boron, tungsten, chromium, iron and cobalt within the percentages specified herein, I have found that the tungsten can be supplanted, in whole or in part by molybdenum, uranium or both.

Specific examples of the compositions within the scope of the present invention, which I have found to be valuable for various industrial purposes, are the following: Boron 0.90%, tungsten 12%, chromium 5%, iron 15%, cobalt substantially the balance; boron 1.20%, tungsten 18%, chromium 4%, iron 17%, cobalt substantially the balance; boron 1.65%, molybdenum 14%, chromium 6%, iron 24%, cobalt substantially the balance; boron 1.50%, tungsten 6%, molybdenum 12%, chromium 7%, iron 18%, cobalt substantially the balance.

I prefer to have the alloys of the presentinvention substantially free from carbon in order to avoid all of the disadvantages associated with alloys or compositions containing appreciable amounts of carbon, particularly when such alloys are used for metal cutting tools. I have found, however, that certain of the metals and alloys used in producing compositions of the present invention generally contain varying amounts of carbon as an impurity and, consequently, the alloys of the present invention will usually contain small amounts of carbon in the nature of an impurity incidental to manufacture. It is essential to restrict the amount of carbon so present to amounts which will not be adversely effective on the physical properties. I have found that amounts of carbon in excess of approximately 0.30% apparently act to embrittle the alloy and also to inhibit the desired and necessary physical reactions during thermal treatment.

I have also found that materials used in producing this alloy frequently contain other elements, more or less in the nature of impurities, such for example as manganese, silicon and aluminium. Consequently, the alloys of my invention may contain insignificant amounts of elements other than carbon in the nature of incidental impurities. In all cases, the amounts of such impurities should be restricted to percentages which will not adversely affect the properties of the alloy.

It will be evident, therefore, that the composition of the present invention comprises the following essential components: Boron 0.25% to 5%, metal selected from the group tungsten, molybdenum and uranium 5% to 30%, chromium 1% to 25%, iron 5% to 40% and the balance substantially cobalt.

I claim:

1. As a new article of manufacture, a centrifugally cast form of an alloy comprising as essential elements boron 0.25% to 5%, metal selected from the group tungsten, molybdenum and uranium 5% to 30%, chromium 1% to 25%, iron 5% to 40%, the balance cobalt except for minor amounts of incidental impurities in which carbon does not exceed approximately 0.30%; said cast form being characterized by a relatively fine and uniform grain structure, and being further characterized by being responsive to thermal treatment for the regulation of hardness.

2. As a new article of manufacture, a centrifugally cast form of an alloy comprising as essential elements boron 0.25% to 5%, tungsten 5% to 30%, chromium 1% to 25%, iron 5% to 40%, the balance cobalt except for minor amounts of incidental impurities in which carbon does not exceed approximately 0.30%; said cast form being characterized by a relatively fine and uniform grain structure, and being further characterized by being responsive to thermal treatment for the regulation of hardness.

3. As a new article of manufacture, a centrifugally cast form of an alloy comprising as essential elements boron 0.25% to 5%, molybdenum 5% to 30%, chromium 1% to 25%, iron 5% to 40%, the balance cobalt except for minor amounts of incidental impurities in which carbon does not exceed approximately 0.30%; said cast form being characterized by a relatively fine and uniform grain structure, and being further characterized by being responsive to thermal treatment for the regulation of hardness.

ANTHONY G. DE GOLYER.