United States Patent [19]

Firnhaber

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[54] **NICKEL-CHROMIUM ALLOYS**

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[51] **Int. Cl.** **C22c 19/00**

[58] **Field of Search** ..... 75/134 F, 171

[56] **References Cited**

UNITED STATES PATENTS

2,481,976	9/1949	Cape	75/171
3,170,789	2/1965	Woodward et al.	75/171
3,171,739	3/1965	Cape	75/134 F
3,384,478	5/1968	Firnhaber	75/171

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[57] **ABSTRACT**

A nickel-chromium alloy composed of the following ingredients in the following ranges of percentage by weight:

C	0.13–0.17
Mn	1.00–1.04
Fe	1.90–2.9
Si	0.84–1.14
W	5–9
Co	1.55–2.05
Cr	32.15–34.15
Ni	47–51
Mo	3.46–3.96

1 Claim, No Drawings

NICKEL-CHROMIUM ALLOYS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention is particularly useful in centrifuges which are used in the manufacture of glass wool, and is also useful in gas turbines and jet engines where the alloy is subjected to extremely high temperatures and thermal stresses.

2. Description of the Prior Art

In centrifuges which are used in the manufacture of glass wool, the metal from which the centrifuge is formed must be resistant to attacks by the corrosive qualities of molten glass used, which is high in borax and soda ash. In addition it is desirable in centrifuges or rotors of this type to have a multiplicity of relatively small peripheral holes from which the molten glass is thrown by centrifugal force into the path of fiberizing jets. The alloy, therefore, must be readily machinable. A rotor of this type is disclosed in my prior U.S. Pat. No. 3,227,536. Holes in centrifuges of this type are, of course, subject to wear, and it is highly desirable to be able to provide a centrifuge which can be used for a maximum number of hours before there is objectionable wear on the holes. Another problem with metal centrifuges is that in the larger sizes there is a problem of distortion in use.

In my prior U.S. Pat. No. 3,384,478, issued May 21, 1968, an alloy is disclosed which is useful in centrifuges. The present invention produces a harder metal of greater tensile strength in ranges above 2000° F. than the alloy of my prior patent, and an alloy which will not crack after prolonged exposure to these higher temperatures. Because of the novel increase in the percentage of tungsten with a decrease in the amount of nickel, the particular combination of ingredients of the present invention provides unusual crack resistance after prolonged exposure to temperatures above 2000° F. and is machinable by present machining methods in spite of the change in the amount of nickel.

Centrifuges formed by the alloy of the present invention have been found to stand up longer under the conditions encountered than centrifuges formed by the alloy of U.S. Pat. No. 3,170,789, it being noted that the alloy of the present invention has substantially less nickel and substantially more chromium than the alloy of U.S. Pat. No. 3,170,789, has substantially less tungsten, less iron, and less carbon. In addition, the alloy of the present invention contains molybdenum and cobalt in substantial quantities, which are not present in the alloy of the prior U.S. Pat. No. 3,170,789. The presence of cobalt in the recited range results in high stress resistance at elevated temperatures, resistance to oxidation, and resistance to reducing atmospheres at temperatures in excess of 2100° F. such as are encountered in the use of centrifuges. The presence of molybdenum in the range recited results in a further enhancement of the desirable effects of the cobalt and permits the formation of a casting which is machinable. By having less nickel and more chromium than the alloy of the prior U.S. Pat. No. 3,170,789, it is found that the integrity of the metal at elevated temperatures is improved and this further reduces the occurrence of creep and oxidation.

SUMMARY OF THE INVENTION

It is a general object of the present invention to provide an improved nickel-chromium alloy which is particularly suitable for use in forming centrifuges of the above type, and for use in gas turbines and jet engines.

A further object of the invention is to provide an alloy which is highly resistant to attack by the borax and soda ash present in molten glass.

A further object of the invention is to provide an improved alloy which makes it possible to form a distortion free centrifuge in large diameters.

A further object of the invention is to provide an improved alloy, particularly adapted for use in centrifuges, which permits said centrifuge to be operated at a temperature above 2000° F. for long period of time without major deformation.

With the above and other objects in view, the invention consists of the improved nickel-chromium alloy as set forth in the claims.

The nickel-chromium alloy of the present invention is composed of the following ingredients in the following ranges:

C	0.13	–	0.17
Mn	1.00	–	1.04
Fe	1.90	–	2.9
Si	0.84	–	1.14
W	5	–	9
Co	1.55	–	2.05
Cr	32.15	–	34.15
Ni	47	–	51
Mo	3.46	–	3.96

The nickel-chromium alloy of the present invention may be within the ranges disclosed in the above paragraph. However, a preferred formula is as follows:

C	.15
Mn	1.02
Fe	2.40
Si	.99
W	8.00
Co	1.80
Cr	33.15
Ni	48.78
Mo	3.71

For preparation, any of the conventional procedures for nickel alloys may be followed.

Centrifuges manufactured by an alloy as above described were used in the manufacture of glass fibers and the centrifuges were found to stand up for an exceptionally long time against attacks by a molten glass batch which is high in borax and soda ash. The centrifuge was used for 200 hours before there was any noticeable wear on the small holes in its periphery. The centrifuge was also operated at temperatures above 2000° F. without any major deformation. This alloy was the only one tested which did not distort when used for a centrifuge with a diameter as large as 12 inches, and no distortion was found when used with turbine blades and other critical parts of a gas turbine.

The alloy of the present invention was found to have superior creep resistance and strength at elevated temperatures and is sufficiently machinable.

Various changes and modifications may be made in the invention heretofore described as may be within the scope of the claims.

What I claim is:

1. An alloy in which the ingredients are in about the following percentages by weight:

C	.15
Mn	1.02
Fe	2.40
Si	.99
W	8.00
Co	1.80
Cr	33.15
Ni	48.78
Mo	3.71

said alloy being characterized by resistance to corrosive attack by molten glass, having superior creep resistance, having strength at elevated temperatures, and imparting resistance to deformation to articles made therefrom and resistance to cracking after prolonged exposure to elevated temperatures above 2000° F.

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