

UNITED STATES PATENT OFFICE

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HEAT-RESISTANT ALLOY

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5 Claims. (Cl. 75-170)

1

This is a division of my copending application Serial No. 357,283, filed September 18, 1940, and entitled Strong, machinable, heat-resistant alloy.

The present invention relates to alloys and more particularly to a forgeable alloy which possesses high strength at elevated temperatures. The alloy is not easily machinable but on account of its strength at elevated temperatures it is particularly suitable for use in devices such as superchargers and gas turbines which operate at temperatures in the neighborhood of 1200° to 1600° F. and under stresses up to about 20,000 pounds per square inch.

Heretofore four alloys have been employed extensively in such devices. These alloys consist of:

	Per cent
(1) Nickel -----	55
Molybdenum -----	20
Manganese -----	2
Iron -----	Balance

	Per cent
(2) Nickel -----	66
Molybdenum -----	25
Manganese -----	2
Iron -----	Balance

	Per cent
(3) Nickel -----	20
Chromium -----	13
Tungsten -----	2
Molybdenum -----	0.6
Carbon -----	0.44
Iron -----	Balance

	Per cent
(4) Chromium -----	18-25
Nickel -----	8-20
Iron -----	Balance

Alloy 2 is the strongest of these four alloys. At 1300° F. it has a 100 hour strength of 38,000 pounds per square inch and a 1000 hour strength of 18,000 pounds per square inch. The 100 hour strength, for example, is the stress which will produce failure in 100 hours. While the high temperature properties of the latter alloy are entirely satisfactory it is almost impossible to machine it. Alloy 1 may be machined although it is extremely difficult to do so. Alloys 3 and 4 are more readily machined, but are considerably weaker than 1 or 2 at high temperatures.

The alloy which constitutes the present invention is precipitation hardened and consists of about 50 to 70% nickel, 15 to 25% molybdenum, 0.5 to 5% titanium, 0.5 to 4% manganese and the balance iron. A preferred composition consists of about 55% nickel, 20% molybdenum, 3% titanium, 2% manganese with the balance iron. The alloy may be precipitation hardened by heat-

2

ing at a temperature of about 1000° to 1300° C. quenching and then reheating or drawing the alloy for one or more hours at a temperature of about 800 to 1000° C.

The presence of titanium permits the alloy to be precipitation hardened and renders it strong at high temperatures. The manganese makes the alloy more readily forgeable and also serves to deoxidize it. The manganese also will combine with any sulphur present in the alloy forming a high melting point sulphide.

The precipitation hardened alloy, at 1300° F., has a 100 hour strength of 40,000 pounds per square inch and a 1000 hour strength of 32,000 pounds per square inch and is therefore stronger than the best prior art alloy. In addition however the alloy is easily forgeable and may be machined although it is not freely machinable. As a result the present material is extremely desirable material for use in the manufacture of devices such as superchargers, gas turbines, and the like, which operate under high stress and at elevated temperatures.

The alloy ingredients hereinbefore pointed out, are the only ones necessary to provide a forgeable alloy having high strength at elevated temperatures. If desired, tungsten may be substituted in whole or in part for the molybdenum. However, such substitution generally will not be found to be desirable for economic reasons. Cobalt may be substituted for a portion of the nickel although such substitution neither improves nor detracts from the properties of the alloy. A small quantity of chromium may be present in the alloy and will increase the resistance of the alloy to oxidation. However, as the quantity of chromium is increased the alloy becomes increasingly difficult to forge and machine.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An alloy containing about 50 to 70% nickel, 15 to 25% molybdenum, 0.5 to 5% titanium, 0.5 to 4% manganese, and the balance substantially all iron.

2. A forgeable, precipitation hardened alloy containing about 50 to 70% nickel, 15 to 25% molybdenum, 0.5 to 5% titanium, 0.5 to 4% manganese and the balance substantially all iron, a portion of said nickel content being replaceable by cobalt without materially changing the inherent characteristics of said nickel-molybdenum-titanium-manganese-iron alloy.

3. An alloy consisting of about 55% nickel, 20% molybdenum, 3% titanium, 2% manganese and the balance iron.

4. An alloy which is forgeable and characterized by its high strength at temperatures in the neighborhood of 1200 to 1600° F., said alloy containing a plurality of ingredients in which the

3

following are the only ones necessary to attain said characteristics:

	Per cent
Nickel -----	50 to 70
Molybdenum -----	15 to 25
Titanium -----	0.5 to 5
Manganese -----	1 to 3
Iron -----	Balance

4

5. A forgeable alloy containing about 50 to 70% of nickel, 15 to 25% of metal from the group consisting of tungsten and molybdenum, 0.5 to 5% titanium, 0.5 to 4% manganese, and the balance substantially all iron.

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