Dec. 31, 1957 R. L. PETTIBONE 2,818,332

HIGH TEMPERATURE, HIGH STRENGTH ALLOY

Original Filed Aug. 6, 1953 2 Sheets-Sheet 1

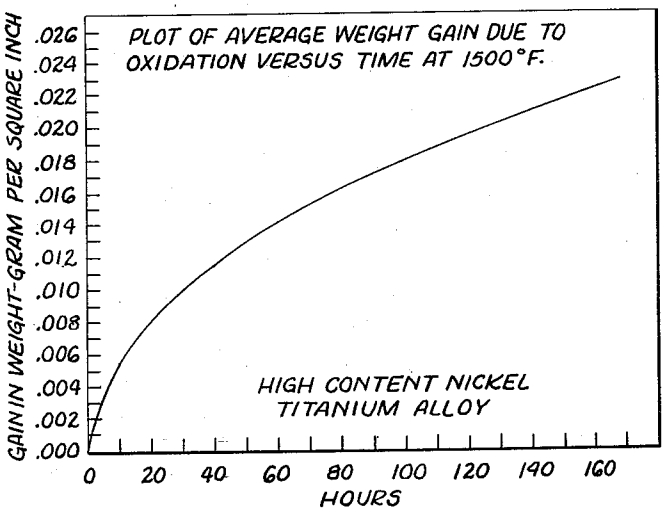


Fig. 1

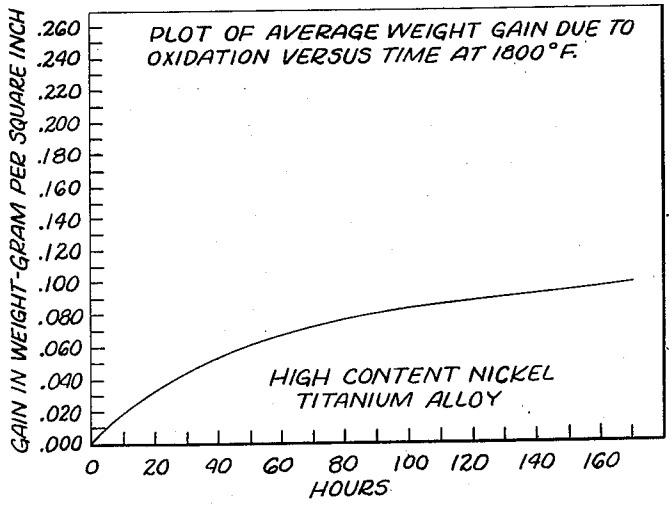


Fig. 2

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HIGH TEMPERATURE, HIGH STRENGTH ALLOY

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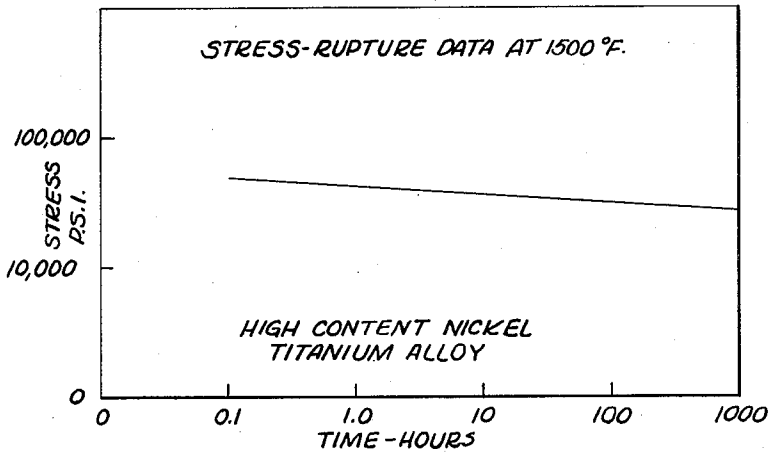


Fig. 3

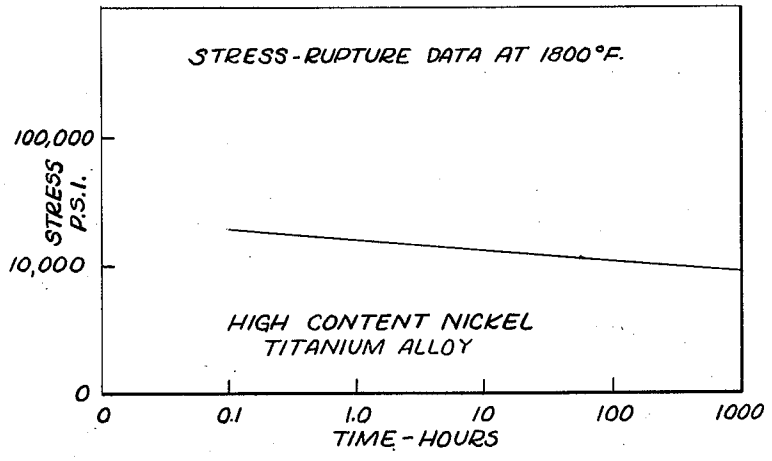


Fig. 4

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HIGH TEMPERATURE, HIGH STRENGTH ALLOY

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Continuation of application Serial No. 372,668, August 6, 1953. This application October 22, 1956, Serial No. 617,372

2 Claims. (Cl. 75—134)

This invention relates to alloys and more particularly to high temperature, high strength titanium alloys and constitutes a continuation of application abandoned Serial No. 372,668, filed August 6, 1953.

Although an extensive amount of money and time has been expended in the quest of a reasonably economical alloy for use in the fabrication of turbine buckets and the like capable of withstanding elevated temperatures for prolonged periods of time while being resistant to oxidation and capable of maintaining high strength, no alloy prior hereto has been known to fulfill the necessary requirements.

Broadly, the invention comprehends the provision of alloys having a high content of titanium and nickel that have high temperature, high strength characteristics and that are economical as compared to previous alloys for like applications such as to turbine buckets, wherein resistance to high temperature and oxidation is essentially necessary.

Among the principal objects of the invention, is the provision of high content nickel-titanium alloys, that;

a. Are reasonably economical;

b. Can be easily produced, such as by powder metallurgy techniques;

c. Have excellent properties at elevated temperatures;

d. Have excellent stress-rupture characteristics at high temperatures for prolonged periods of time and good resistance to oxidation at said high temperatures;

e. Provide for the production of articles therefrom having good ductility;

f. Have low density, thus making very suitable for high speed rotation such as for use as turbine buckets in jet engines; and

g. Have excellent corrosion resistance to salts, etc. in atmosphere.

Other objects and advantages of the invention will appear from the following description, taken in connection with the drawings from a part of the specification; and in which:

Figure 1 is a weight gain due to oxidation curve of a high content nickel-titanium alloy at 1500° F.

Figure 2 is a weight gain due to oxidation curve of a high content nickel-titanium alloy at 1800° F.

Figure 3 is a stress-rupture curve of a high content nickel-titanium alloy at 1500° F.

Figure 4 is a stress-rupture curve of a high content nickel-titanium alloy at 1800° F.

The high content nickel-titanium alloys defined hereinafter were devised primarily for use in production of turbine blades or buckets for gas turbines, gas engines and, as such, possess high strength at elevated temperatures, capable of withstanding the operative conditions to which subjected. Furthermore, through known method of said fabrication, such as powder metallurgy, it is possible to easily and economically produce alloys of this type whereby economical end products are possible, possessing better properties than alloys previously used in the production of turbine blades or buckets.

The high content nickel-titanium alloys having the desired high temperature, high strength characteristics come within the following range of analysis, by weight:

	Percent
Nickel	39–41
Titanium	34–36
Carbon	14–16
Chromium	9–11

An analysis, by weight, of the aforesaid high content nickel-titanium alloys possessing substantially optimum high temperature, high strength characteristics, is as follows:

	Percent
Nickel	40
Titanium	35
Carbon	15
Chromium	10

The aforesaid specifically defined alloy has a density ranging substantially between 6.2 and 6.35 grams per cubic centimeter, thus making the alloy suitable for use in the manufacture of turbine buckets of jet engines or other elements to be subjected to high speed operation. Thus, this alloy not only has the necessary qualties of good ductility, excellent corrosion resistance, excellent oxidation resistance and capable of maintaining its high strength at high temperature, but when combined with low weight provides one of the most suitable alloys ever developed for turbine bucket use.

Figures 1 and 2 are curves showing the average weight gain due to oxidation of high content nickel-titanium alloys at the respective temperatures of 1500° F. and 1800° F. The weight gain is computed in grams per square inch of alloy, for a period of time in hours, to which the alloy is subjected to a predetermined oxidizing atmosphere.

Figures 3 and 4 are stress-rupture curves of high content nickel-titanium alloys, wherein the alloys are subjected to the respective temperatures of 1500° F. and 1800° F. The stress is computed in pounds per square inch as against time to fail in hours.

Whereas the curves of Figures 1 and 2 represent the fact that the high content nickel-titanium alloys covered hereby have excellent oxidation resistance as compared to other alloys for a like use such as turbine buckets, the curves of Figures 3 and 4 represent that the high content nickel-titanium alloys covered hereby have higher stress-rupture values than alloys heretofore developed and used for turbine buckets or the like.

One method of producing articles of the aforesaid high content nickel-titanium alloys is by powder metallurgy techniques wherein a titanium-carbon skelton or porous body is infiltrated with an infiltrant having the proper constituent metals, whereby the end product will have the proper alloy analysis. It is conceivable that the alloy defined hereby can or will be capable of production by other methods and accordingly, it is the alloy analysis herein sought to be covered rather than method of production thereof, as evidenced by the appended claims.

What I claim is:

1. A high temperature, high strength alloy consisting of, by weight, 39–41% nickel, 34–36% titanium, 14–16% carbon and 9–11% chromium.

2. A high temperature, high strength alloy containing, by weight, approximately 40% nickel, 35% titanium, 15% carbon and 10% chromium.

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