

Description

The present invention relates to an alloy mix suitable for the repair of articles which are used in a high temperature environment. The invention also relates to a method of achieving a repair with the alloy. Examples of alloy mixes used for this purpose are disclosed in French Specification 2,296,461.

According to the present invention an alloy mix suitable for repair of Nickel based alloy articles which are used in a high temperature environment comprises a first alloy, the constituents of which by weight percentage are:

TABLE I

Al	2	-	3
Co	9	-	11
Cr	8	-	10
Fe	0	-	1.8
Hf	1.0	-	1.5
Ta	1.0	-	1.5
Ti	1.25	-	1.75
W	6	-	8
B	2.8	-	3.4
Y	0.001	-	0.02
Ni	Remainder		

mixed with a second alloy, the constituents of which by weight are:

TABLE II

C	.13	-	.17
Al	5.25	-	5.75
B	0.01	-	0.02
Co	9.0	-	11.0
Cr	8	-	10
Hf	1.3	-	1.7
Ta	2.25	-	2.75
Ti	1.25	-	1.75
W	9.5	-	10.5
Zr	0.03	-	0.08
Ni	Remainder		

and wherein the weight percentages of the first alloy to the second alloy is in the range 60:40 to 50:50 and wherein both alloys are in powder form.

The invention further provides a method of repairing a component with said alloy, which comprises the steps

of mixing the alloy with a binder, applying the bound alloy to the component, heating the component in steps to a desired maximum, quenching the component in an inert gas to about 75% of the maximum temperature so reached, reheating the component at a constant rate to several pre-selected values of temperature, interspersed with periods of time which start as each selected temperature is reached including the desired final temperature, inert gas quenching the component to below a given value, followed by cooling the component to room temperature in ambient air.

The invention will now be described, by way of example.

A gas turbine blade (not shown) of the kind which is used in a gas turbine engine and made from a nickel based alloy, frequently has score marks and/or fissures accidentally machined thereon, during an electro discharge machining operation on it.

The score marks must be filled in order to avoid cracking of the blade and to maintain proper flow conditions over the blade surface when in service.

The filling must be a metal which is compatible with the metal from which the blade is constructed and further, must be workable at temperatures below those which the blade operates in a gas turbine engine and yet, after the repair, must be in a condition which does not result in the filling being lost under those conditions. Thus a first alloy is made up from the following constituents, the quantities of each of which is stated by weight percentage.

TABLE I

Al	2	-	3
Co	9	-	11
Cr	8	-	10
Fe	0	-	1.8
Hf	1.0	-	1.5
Ta	1.0	-	1.5
Ti	1.25	-	1.75
W	6	-	8
B	2.8	-	3.4
Y	0.001	-	0.02
Ni	Remainder		

A second alloy is provided which is made up from the following constituents, again stated by weight percentage. The second alloy is a propriety alloy, sold as MarM002.

TABLE II

5	C	.13	-	.17
	Al	5.25	-	5.75
	B	0.01	-	0.02
10	Co	9.0	-	11.0
	Cr	8	-	10
	Hf	1.3	-	1.7
	Ta	2.25	-	2.75
15	Ti	1.25	-	1.75
	W	9.5	-	10.5
	Zr	0.03	-	0.08
20	Ni	Remainder		

Both of the alloys are ground to a powder, the size of the particles of which is less than 106 μm .

The powders are then mixed thoroughly by any known and convenient means, to provide in powder form, an alloy mix in the ratio 60:40 to 50:50 by weight of the first and second alloys respectively.

As stated hereinbefore, the filling must be compatible with the metal from which the component is made. Thus, the alloy mix of the present invention may be used to effect a repair of a component which is made from MarM002.

To enable applications of the powdered alloy mix into the fissure or score mark, it is further mixed with an acrylic or water based binder of any suitable, freely available type and is then loaded into a syringe, use of which also ensures accuracy of position and quantity applied.

After cleaning the component, the powder mix is applied to the fissure via the syringe and then the component is placed in an vacuum furnace, which then purged of air, so as to avoid oxidising of the assembly.

A heating and cooling cycle is then effected as follows:

- a) Heat to 450°C and hold for 30 minutes.
- b) Increase to 950° and hold for 30 minutes.
- c) Increase to 1190°C and hold for 30 minutes. The increases in heat should be achieved as quickly as possible, such that they are effectively steps.
- d) After holding the temperature at 1190°C for 30 minutes, the component is gas fan quenched to 900°C and thereafter, the heat is again increased, this time with a specific rate of increase as follows:
- e) Heat from 900° up to 1080°C at 50° per hour and hold for 30 minutes.
- f) Heat from 1080°C up to 1140°C at 50°C per hour and hold for 30 minutes.
- g) Heat from 1140°C to 1190°C at 50° per hour and hold for 30 minutes.
- h) Gas fan quench to below 100°C and then to room temperature in ambient room atmosphere.

The first mentioned heating and quenching effects alloying of the two alloys and brazing of the resulting alloy to the component. The second mentioned heating steps effect diffusion of the new alloy and the material of the component across the interface, so as to provide an integral product.

The second gas fan quenching cools the component sufficiently to avoid oxidising of its surface when it is removed from the heating device, into ambient atmosphere.

Components made from the alloy described in table II herein and repaired by the alloy achieved by mixing and heating the alloys disclosed in tables I and II as described hereinbefore, have been mechanically stress tested and have been found to possess those appropriate characteristics which are present in undamaged components made from the alloy in table II herein.

Claims

1. An alloy mix suitable for the repair of nickel based alloy components which are used in a high temperature



TABLE II

5	C	.13	-	.17
	Al	5.25	-	5.75
	B	0.01	-	0.02
10	Co	9.0	-	11.0
	Cr	8	-	10
	Hf	1.3	-	1.7
	Ta	2.25	-	2.75
15	Ti	1.25	-	1.75
	W	9.5	-	10.5
	Zr	0.03	-	0.08
20	Ni	Remainder		

Both of the alloys are ground to a powder, the size of the particles of which is less than 106 um.

The powders are then mixed thoroughly by any known and convenient means, to provide in powder form, an alloy mix in the ratio 60:40 to 50:50 by weight of the first and second alloys respectively.

As stated hereinbefore, the filling must be compatible with the metal from which the component is made. Thus, the alloy mix of the present invention may be used to effect a repair of a component which is made from MarM002.

To enable applications of the powdered alloy mix into the fissure or score mark, it is further mixed with an acrylic or water based binder of any suitable, freely available type and is then loaded into a syringe, use of which also ensures accuracy of position and quantity applied.

After cleaning the component, the powder mix is applied to the fissure via the syringe and then the component is placed in an vacuum furnace, which then purged of air, so as to avoid oxidising of the assembly.

A heating and cooling cycle is then effected as follows:

- a) Heat to 450°C and hold for 30 minutes.
- b) Increase to 950° and hold for 30 minutes.
- c) Increase to 1190°C and hold for 30 minutes. The increases in heat should be achieved as quickly as possible, such that they are effectively steps.
- d) After holding the temperature at 1190°C for 30 minutes, the component is gas fan quenched to 900°C and thereafter, the heat is again increased, this time with a specific rate of increase as follows:
- e) Heat from 900° up to 1080°C at 50° per hour and hold for 30 minutes.
- f) Heat from 1080°C up to 1140°C at 50°C per hour and hold for 30 minutes.
- g) Heat from 1140°C to 1190°C at 50° per hour and hold for 30 minutes.
- h) Gas fan quench to below 100°C and then to room temperature in ambient room atmosphere.

The first mentioned heating and quenching effects alloying of the two alloys and brazing of the resulting alloy to the component. The second mentioned heating steps effect diffusion of the new alloy and the material of the component across the interface, so as to provide an integral product.

The second gas fan quenching cools the component sufficiently to avoid oxidising of its surface when it is removed from the heating device, into ambient atmosphere.

Components made from the alloy described in table II herein and repaired by the alloy achieved by mixing and heating the alloys disclosed in tables I and II as described hereinbefore, have been mechanically stress tested and have been found to possess those appropriate characteristics which are present in undamaged components made from the alloy in table II herein.

Claims

1. An alloy mix suitable for the repair of nickel based alloy components which are used in a high temperature



environment comprises a first alloy, the constituents of which by weight are:

TABLE I

Al	2	-	3
Co	9	-	11
Cr	8	-	10
Fe	0	-	1.8
Hf	1.0	-	1.5
Ta	1.0	-	1.5
Ti	1.25	-	1.5
W	6	-	8
B	2.8	-	3.4
Y	0.001	-	0.02
Ni	Remainder		

mixed with a second alloy the constituents of which by weight are:

TABLE II

C	.13	-	.17
Al	5.25	-	5.75
B	0.01	-	0.02
Co	9.0	-	11.0
Cr	8	-	10
Hf	1.3	-	1.7
Ta	2.25	-	2.75
Ti	1.25	-	1.75
W	9.5	-	10.5
Zr	0.03	-	0.08
Ni	Remainder		

and wherein the weight percentage of the first alloy to the second alloy is in the range 60:40 to 50:50 and wherein both alloys are in powder form.

2. An alloy mix as claimed in claim 1 wherein the weight percentages of the first alloy to the second alloy is 60:40.
3. An alloy as claimed in claim 1 wherein the grain size of the powders is less than 106 μm .
4. A method of repairing score marks and/or fissures in a component made from an alloy the constituents of which are



5	C	.13	-	.17
	Al	5.25	-	5.75
	B	0.01	-	0.02
	Co	9.0	-	11.0
	Cr	8	-	10
10	Hf	1.3	-	1.7
	Ta	2.25	-	2.75
	Ti	1.25	-	1.75
	W	9.5	-	10.5
15	Zr	0.03	-	0.08
	Ni	Remainder		

comprising the steps of applying to said score marks and/or fissures, a mixture of a first powdered alloy the constituents of which comprise

25	Al	2	-	3
	Co	9	-	11
	Cr	8	-	10
	Fe	0	-	1.8
30	Hf	1.0	-	1.5
	Ta	1.0	-	1.5
	Ti	1.25	-	1.5
	W	6	-	8
35	B	2.8	-	3.4
	Y	0.001	-	0.02
	Ni	Remainder		

and a second powdered alloy, the constituents of which are as those of the component, which mixture is bound by an acrylic or water based binder, heating and then cooling the component in an inert atmosphere so as to effect brazing of the mixture to the component in said inert atmosphere and effect diffusion of the mixture and the component material across the interface therebetween.

- 45 5. A method of repairing score marks and/or fissures in a component as claimed in claim 4 wherein said heating and cooling steps comprise:

- 50 a) Heat in an inert atmosphere to 450°C and hold for 30 minutes.
 b) Increase heat to 950°C and hold for 30 minutes.
 c) Increase heat to 1190°C and hold for 30 minutes.
 d) Quench by inert gas to a reduced temperature of 900°C
 e) Re-heat to 1080°C at a rate of 50°C per hour and hold for 30 minutes.
 f) Increase heat to 1140°C at a rate of 50°C per hour and hold for 30 minutes.
 g) Increase heat to 1190°C at a rate of 50°C per hour and hold for 30 minutes.
 55 h) Quench by inert gas to below 100°C and then expose to room atmosphere and temperature.



Patentansprüche

1. Legierungsmischung geeignet zum Reparieren von Werkstücken aus Nickellegierungen, die in einer Umgebung mit hoher Temperatur benutzt werden, wobei die Legierungsmischung eine erste Legierung aufweist, deren Bestandteile in Gewichtsprozent die folgenden sind:

TABELLE I

Al	2	-	3
Co	9	-	11
Cr	8	-	10
Fe	0	-	1.8
Hf	1.0	-	1.5
Ta	1.0	-	1.5
Ti	1.25	-	1.5
W	6	-	8
B	2.8	-	3.4
Y	0.001	-	0.02
Ni	Rest		

und diese erste Legierung mit einer zweiten Legierung vermischt ist, deren Bestandteile in Gewichtsprozent die folgenden sind:

TABELLE II

C	.13	-	.17
Al	5.25	-	5.75
B	0.01	-	0.02
Co	9.0	-	11.0
Cr	8	-	10
Hf	1.3	-	1.7
Ta	2.25	-	2.75
Ti	1.25	-	1.75
W	9.5	-	10.5
Zr	0.03	-	0.08
Ni	Rest		

und wobei der Gewichtsprozentsatz der ersten Legierung zu dem Gewichtsprozentsatz der zweiten Legierung im Bereich zwischen 60:40 und 50:50 liegt, und wobei beide Legierungen in Pulverform vorliegen.

2. Legierungsmischung nach Anspruch 1, bei welcher die Gewichtsprozentsätze von erster zu zweiter Legierung 60:40 betragen.



3. Legierung nach Anspruch 1, bei welcher die Teilchengröße des Pulvers kleiner als 106 µm ist.
4. Verfahren zum Reparieren von Kerben und/oder Rissen in einem Werkstück, welches aus einer Legierung besteht, die aus folgenden Bestandteilen besteht:

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C	.13	-	.17
Al	5.25	-	5.75
B	0.01	-	0.02
Co	9.0	-	11.0
Cr	8	-	10
Hf	1.3	-	1.7
Ta	2.25	-	2.75
Ti	1.25	-	1.75
W	9.5	-	10.5
Zr	0.03	-	0.08
Ni	Rest		

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welches Verfahren die folgenden Schritte umfaßt: in die Kerben und/oder Risse wird eine Mischung aus einer ersten und einer zweiten pulverisierten Legierung eingebracht, wobei die Bestandteile der ersten Legierung die folgenden sind:

30

Al	2	-	3
Co	9	-	11
Cr	8	-	10
Fe	0	-	1.8
Hf	1.0	-	1.5
Ta	1.0	-	1.5
Ti	1.25	-	1.75
W	6	-	8
B	2.8	-	3.4
Y	0.001	-	0.02
Ni	Rest		

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5. Verfahren zum Reparieren von Kerben und/oder Rissen in einem Werkstück nach Anspruch 4, bei welchem die Erhitzungs- und Abkühlungsstufen die folgenden Schritte umfassen:
- a) Es erfolgt eine Erhitzung in einer inerten Atmosphäre auf 450°C, und diese Temperatur wird 30 Minuten lang gehalten.



- b) Die Temperatur wird auf 950°C erhöht und 30 Minuten lang gehalten.
 c) Die Temperatur wird auf 1190°C erhöht und 30 Minuten lang gehalten.
 d) Es erfolgt eine Abschreckung durch ein inertes Gas auf eine verminderte Temperatur von 900°C.
 e) Es erfolgt eine Wiedererhitzung auf 1080°C mit einer Rate von 50°C pro Stunde, wobei die Temperatur 30 Minuten lang gehalten wird.
 f) Es erfolgt eine Erhitzung auf 1140°C mit einer Rate von 50°C pro Stunde, die 30 Minuten lang gehalten wird.
 g) Es erfolgt eine Erhitzung auf 1190°C mit einer Rate von 50°C pro Stunde, die 30 Minuten lang gehalten wird.
 h) Es erfolgt eine Abschreckung durch ein inertes Gas auf unter 100°C und dann auf Raumtemperatur in der umgebenden Atmosphäre.

Revendications

1. Mélange d'alliages, adapté pour la réparation de pièces en alliage à base de nickel, qui sont utilisées dans un environnement à haute température, comprenant un premier alliage, dont les constituants sont, en poids :

TABLE I

Al	2	-	3
Co	9	-	11
Cr	8	-	10
Fe	0	-	1,8
Hf	1,0	-	1,5
Ta	1,0	-	1,5
Ti	1,25	-	1,5
W	6	-	8
B	2,8	-	3,4
Y	0,001	-	0,02
Ni	Restant		

mélangé avec un deuxième alliage, dont les constituants sont, en poids :



TABLE II

5	C	0,13	-	0,17
	Al	5,25	-	5,75
	B	0,01	-	0,02
10	Co	9,0	-	11,0
	Cr	8	-	10
	Hf	1,3	-	1,7
	Ta	2,25	-	2,75
15	Ti	1,25	-	1,75
	W	9,5	-	10,5
	Zr	0,03	-	0,08
20	Ni	Restant		

et dans lequel le pourcentage en poids du premier alliage par rapport au deuxième alliage est dans la plage de 60 : 40 à 50 : 50, et dans lequel les deux alliages sont sous forme pulvérulente.

2. Mélange d'alliages selon la revendication 1, dans lequel les pourcentages en poids du premier alliage par rapport au deuxième alliage sont de 60 : 40.
3. Alliage selon la revendication 1, dans lequel la taille des grains des poudres est inférieure à 106 µm.
4. Procédé de réparation de marques d'éraflures et/ou de fissures dans une pièce réalisée à partir d'un alliage dont les constituants sont :

35	C	0,13	-	0,17
	Al	5,25	-	5,75
	B	0,01	-	0,02
40	Co	9,0	-	11,0
	Cr	8	-	10
	Hf	1,3	-	1,7
	Ta	2,25	-	2,75
45	Ti	1,25	-	1,75
	W	9,5	-	10,5
	Zr	0,03	-	0,08
50	Ni	Restant		

comprenant les étapes d'appliquer auxdites marques d'éraflures et/ou auxdites fissures, un mélange d'un premier alliage en poudre dont les constituants comprennent :



5	Al	2	-	3
	Co	9	-	11
	Cr	8	-	10
	Fe	0	-	1,8
	Hf	1,0	-	1,5
10	Ta	1,0	-	1,5
	Ti	1,25	-	1,5
	W	6	-	8
	B	2,8	-	3,4
15	Y	0,001	-	0,02
	Ni	Restant		

20 et d'un deuxième alliage en poudre, dont les constituants sont semblables à ceux de la pièce, lequel mélange est lié par un liant à base d'acrylique ou d'eau, de chauffer puis de refroidir la pièce dans une atmosphère inerte, de façon à effectuer un brasage du mélange sur la pièce dans ladite atmosphère inerte, et à effectuer une diffusion du mélange et du matériau de la pièce au travers de l'interface située entre les deux.

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5. Procédé de réparation de marques d'éraflures et/ou de fissures dans une pièces selon la revendication 4, dans lequel lesdites étapes de chauffage et de refroidissement comprennent les étapes de :

- 30 a) chauffer dans une atmosphère inerte à 450°C, et maintenir cette température pendant 30 minutes,
 b) augmenter la température à 950°C et la maintenir pendant 30 minutes,
 c) augmenter la température à 1190°C et la maintenir pendant 30 minutes,
 d) tremper par du gaz inerte, à une température réduite de 900°C,
 e) rechauffer à 1080°C, avec un taux de 50°C par heure, et maintenir cette température pendant 30 minutes,
 f) augmenter la température à 1140°C, avec un taux de 50°C par heure, et maintenir cette température pendant 30 minutes,
 35 g) augmenter la température à 1190°C avec un taux de 50°C par heure, et maintenir cette température pendant 30 minutes,
 h) tremper par du gaz inerte à une température inférieure à 100°C, et ensuite exposer à l'atmosphère et à la température ambiantes.

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