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EP1454997	Damage tolerant TiAl alloys having a lamellar microstructure UNITED TECHNOLOGIES
IL-178955	Direct rolling of cast gamma titanium aluminide alloys UNITED TECHNOLOGIES
WO2014149122	Process for manufacturing a gamma titanium aluminide turbine component UNITED TECHNOLOGIES
FR2462484	Titanium alloys of the Ti.sub.3 Al type UNITED TECHNOLOGIES UNITED TECHNOLOGIES HARTFORD CONN YUNAITETSUDO TEKUNOROJIIZU
US5411700	Fabrication of gamma titanium (tial) alloy articles by powder metallurgy UNITED TECHNOLOGIES
WO2014149292	Titanium aluminide turbine exhaust structure UNITED TECHNOLOGIES
EP2423340	Process and system for fabricating gamma tial turbine engine components UNITED TECHNOLOGIES
FR2462483	Titanium alloys of the TiAl type UNITED TECHNOLOGIES UNITED TECHNOLOGIES HARTFORD CONN YUNAITETSUDO TEKUNOROJIIZU
GB8900043	Fabrication of gamma titanuim (TiAl) alloy articles by powder metallurgy UNITED TECHNOLOGIES
NO8900331	Fremgangsmåte for fremstilling av gjenstander av gamma-titan (TiAl) legering ved pulvermetallurgi UNITED TECHNOLOGIES

Damage tolerant TiAl alloys having a lamellar microstructure
EP1454997

- **Patent Assignee**
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- **International Patent Classification**
  B21C-023/00 C22C-014/00 C22C-021/00 C22C-030/00 C22F-001/00 C22F-001/18
- **US Patent Classification**
  PCLO=148421000 PCLO=148421000 PCLX=148669000 PCLX=148670000 PCLX=148671000 PCLX=420418000 PCLX=420419000 PCLX=420420000 PCLX=420421000
- **CPC Code**
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  2005US-11200397 2005-08-08

- **Fampat family**

EP1454997	A1	2004-09-08	[EP1454997]
US2004173292	A1	2004-09-09	[US20040173292]
JP2004263302	A	2004-09-24	[JP2004263302]
US6974507	B2	2005-12-13	[US6974507]
EP1454997	B1	2006-08-23	[EP1454997]
DE602004002005	D1	2006-10-05	[DE602004002005]
DE602004002005	T2	2007-01-18	[DE602004002005]
JP3923948	B2	2007-06-06	[JP3923948]
JP2007146300	A	2007-06-14	[JP2007146300]
US2008163958	A1	2008-07-10	[US20080163958]
US7479194	B2	2009-01-20	[US7479194]

- **Abstract:**
  (EP1454997)
  A damage tolerant microstructure for a lamellar alloy, such as a lamellar gamma TiAl alloy, is provided in accordance with the present invention. The alloy comprises a matrix and a plurality of grains or lamellar colonies, a portion of which exhibit a nonplanar morphology within said matrix. Each of the lamellar colonies contains a multitude of lamella with irregularly repeating order. The gamma TiAl platelets have a triangular (octahedral) unit cell and stack with gamma twins. The alpha 2 Ti3 Al platelets are irregularly interspersed. The unit cell for alpha 2 Ti3 Al is hexagonal. Each of the layers has a curved, nonplanar structure for resisting crack formation and growth.

Claims

(EP1454997)

1. A lamellar Y TiAl alloy having a microstructure with a plurality of lamellar colonies having a nonplanar morphology.
2. A lamellar Y TiAl alloy according to claim 1, wherein each of said lamellar colonies exhibit a nonplanar morphology comprised of stacked nonplanar Y TiA1 and alpha 2 Ti3 Al lamella.
3. A lamellar gamma TiAl alloy according to claim 2, wherein said stacked nonplanar lamella comprise gamma TiAl platelets having a triangularly shaped unit cell and a stack with Y twins and irregularly interspersed alpha 2 Ti3 Al platelets.
4. A lamellar Y TiAl alloy according to any preceding claim, wherein said plurality of nonplanar lamellar colonies having said nonplanar morphology comprise at least 10% of the grains within said matrix.
5. A lamellar Y TiAl alloy according to any preceding claim, wherein said plurality of nonplanar lamellar colonies are located on outer edges of said matrix.
6. A lamellar Y TiAl alloy according to any preceding claim, wherein each of said plurality of grains having said nonplanar morphology has a size in the range of 0.8 to 1.09 microns.
7. A method for manufacturing a lamellar alloy having a plurality of grains with a nonplanar morphology comprising the steps of:
casting said lamellar alloy;
and
extruding said cast alloy at an extrusion temperature in the range of 1290 to 1315 degrees Celsius at an extrusion ratio in the range of 90:1 to 100:1 to form said grains with said non-planar morphology.
8. A method according to claim 7 wherein said casting step comprises casting a TiAl alloy.
9. A method according to claim 8, wherein said TiAl alloy consists of 46 wt% Al, 5 - 10 wt% Nb, 0.2 wt% boron, 0.2 wt% carbon, and the balance titanium and unavoidable impurities.
10. A method according to any of claims 7 to 9 wherein said alloy is extruded at the alpha transus temperature of the alloy.

Direct rolling of cast gamma titanium aluminide alloys
IL-178955

- **Patent Assignee**
  UNITED TECHNOLOGIES
- **Inventor**
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- **International Patent Classification**
  B21B-001/38 B21B-001/46 B21B-003/00 B22D-007/02 B22D-021/02 B23P-023/04 B32B-015/00 B32B-015/01 C22C-014/00 C22F-001/00 C22F-001/18
- **US Patent Classification**
  PCLO=428660000 PCLX=029527700 PCLX=428661000
- **CPC Code**
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- **Fampat family**

IL178955	D0	2007-03-08	[IL-178955]
CA2567421	A1	2007-05-09	[CA2567421]
KR20070049970	A	2007-05-14	[KR20070049970]
CN1962179	A	2007-05-16	[CN1962179]
EP1785502	A1	2007-05-16	[EP1785502]
US2007107202	A1	2007-05-17	[US20070107202]
JP2007131949	A	2007-05-31	[JP2007131949]
SG132614	A1	2007-06-28	[SG-132614]
US7923127	B2	2011-04-12	[US7923127]

- **Abstract:**
  (EP1785502)
  A process for producing sheets of gamma -TiAl includes the steps of forming a melt of a gamma -TiAl alloy; casting the gamma -TiAl alloy to form an as-cast gamma -TiAl alloy; encapsulating the as-cast gamma -TiAl alloy to form an as-cast gamma -TiAl alloy preform; and rolling the as-cast gamma -TiAl alloy preform to form a sheet comprising gamma -TiAl. (see diagramm)

Claims

(EP1785502)

1. A process for producing sheets of gamma -TiAl, comprising: forming a melt of a gamma -TiAl alloy;
casting said gamma -TiAl alloy to form an as-cast gamma -TiAl alloy;
encapsulating said as-cast gamma -TiAl alloy to form an as-cast gamma -TiAl alloy preform;
and rolling said as-cast gamma -TiAl alloy preform to form a sheet comprising gamma -TiAl.

2. The process of claim 1, wherein casting said gamma -TiAl alloy comprises: casting an ingot of said gamma -TiAl alloy;
and slicing said gamma -TiAl alloy ingot to form said as-cast gamma -TiAl alloy.

3. The process of claim 1 or 2, wherein encapsulating comprises: applying a thermal barrier material to said as-cast gamma -TiAl alloy;
and encapsulating said as-cast gamma -TiAl alloy within a canning material.

4. The process of any preceding claim, wherein encapsulating is performed at a temperature range of between about 1200 deg.C and 1250 deg.C.

5. The process of any preceding claim, wherein rolling comprises: rolling said as-cast gamma -TiAl alloy preform at a temperature range of between about 1200 deg.C and 1400 deg.C;
and removing one or more encapsulation materials from said sheet.

6. The process of claim 5, wherein said temperature range is between about 1200 deg.C and 1250 deg.C.

7. The process of claim 5 or 6, wherein removing comprises mechanically removing said one or more encapsulation materials comprising a canning material and a thermal barrier material.

8. The process of claim 5 or 6, wherein removing comprises chemically removing said one or more encapsulation materials comprising a canning material and a thermal barrier material.

9. An article made from a sheet produced in accordance with a process, comprising: forming a melt of a gamma -TiAl alloy;
casting said gamma -TiAl alloy to form an as-cast gamma -TiAl alloy;
encapsulating said as-cast gamma -TiAl alloy to form an as-cast gamma -TiAl alloy preform;
and rolling said as-cast gamma -TiAl alloy preform to form the sheet comprising gamma -TiAl.

10. A preform, comprising: an as-cast gamma -TiAl alloy material disposed in a canning material, wherein said as-cast gamma -TiAl alloy material comprises a shape suitable for being rolled into a sheet.

11. The preform of claim 10, wherein said as-cast gamma -TiAl alloy material comprises titanium, aluminum and one or more metals selected from the group consisting of chromium, niobium, tantalum, tungsten, manganese, carbon, silicon and boron.

12. The preform of claim 10 or 11, wherein said canning material is a metal alloy.

13. The preform of any of claims 10 to 12, further comprising a thermal barrier material disposed between said as-cast gamma -TiAl alloy material and said canning material.

14. The preform of claim 13, wherein said thermal barrier material is a metal alloy.

15. The preform of claim 13 or 14, wherein said thermal barrier material is a coating or a foil.

16. The preform of any of claims 10 to 15, wherein said shape is substantially rectangular.

Process for manufacturing a gamma titanium aluminide turbine component
WO2014149122

- **Patent Assignee**
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- **International Patent Classification**
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- **CPC Code**
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  2013US-61787929 2013-03-15
  2013WO-US78182 2013-12-30

- **Fampat family**

WO2014149122	A2	2014-09-25	[WO2014149122]
WO2014149122	A3	2014-11-27	[WO2014149122]
EP2969319	A2	2016-01-20	[EP2969319]
US2016023307	A1	2016-01-28	[US20160023307]

- **Abstract:**
  (US20160023307)
  A process for manufacturing a turbine engine component includes the steps of: providing a powder containing gamma titanium aluminide; and forming a turbine engine component from said powder using a direct metal laser sintering technique. (From US2016023307 A1)

Claims

(US20160023307)

What is claimed is:

1.

A process for manufacturing a turbine engine component comprising the steps of: providing a powder containing gamma titanium aluminide; and

forming a turbine engine component from said powder using a direct metal laser sintering technique.

2. The process of claim 1, wherein said forming step comprises forming a turbine vane.

3. The process of claim 1, wherein said forming step comprises spreading a layer of said gamma titanium aluminide powder on a platform and directing an energy beam onto selected areas of said gamma titanium aluminide powder to thereby melt the powder.

4. The process of claim 3, wherein said forming step further comprises re-solidifying said gamma titanium aluminide by withdrawing said energy beam.

5. The process of claim 4, wherein said forming process further comprises repeating said spreading, directing, and re-solidying steps to build up layers forming said turbine engine component.

6. The process of claim 1, wherein said powder providing step comprises providing a powder of an alloy having a composition consisting of 43.5 at % Al, 4.0 at % Nb, 1.0 at % Mo, 0.2 at % B, bal Ti.

Titanium alloys of the Ti.sub.3 Al type

FR2462484

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- **International Patent Classification**
  C22C-014/00
- **US Patent Classification**
  PCLO=420418000 PCLX=148669000 PCLX=420420000
- **CPC Code**
  C22C-014/00

- **Publication Information**
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- **Priority Details**
  1979US-06060264 1979-07-25

- **Fampat family**

FR2462484	A1	1981-02-13	[FR2462484]
DE3024641	A1	1981-02-19	[DE3024641]
JPS5620138	A	1981-02-25	[JP56020138]
GB2060693	A	1981-05-07	[GB2060693]
US4292077	A	1981-09-29	[US4292077]
GB2060693	B	1984-08-08	[GB2060693]
FR2462484	B1	1986-05-30	[FR2462484]
JPS6339651	B2	1988-08-05	[JP88039651]
JP1492605	C	1989-04-20	[JP1492605]
DE3024641	C2	1991-02-21	[DE3024641]

- **Abstract:**
  (US4292077)
  Titanium-aluminum-niobium alloys having narrow and critical composition ranges are disclosed. The alloys have room temperature tensile elongations of 1.5% or greater and creep strength to density ratios better than certain nickel superalloys. Thus, they may replace other heavier base alloys in many applications up to 750 (degree) C. Aluminum content must be closely controlled as excess amount decreases ductility while insufficient amount decreases creep strength. Niobium content is also critical as excess amount adversely affects creep strength-to-density ratio while insufficient amount decreases ductility. And there is an important interrelationship between niobium and aluminum. Disclosed are alloys having atomic percent compositions of 24-27 Al, 11-16 Nb, balance Ti; more preferred are alloys of 24.5-26 Al, 12-15 Nb, balance Ti. (Nominally, these alloys in weight percent are Ti-13/15Al-19.5/30Nb and Ti-13.5/15Al-25/28Nb.) Vanadium is uniquely found to be substitutional for niobium in the foregoing alloys in amounts up to 4 atomic percent, thereby reducing density and increasing strength-to-density ratio while maintaining properties. Mechanical properties are dependent on heat treatment. For the best combination of strength and ductility, the alloys are heated or forged above the beta transus and controllably cooled to produce a fine Widmanstatten microstructure.

Claims

(US4292077)

Having thus described a typical embodiment of our invention, that which we claim as new and desire to secure by Letters Patent of the United States is:

1.

A titanium aluminum alloy which may be cast and forged, having at least 1.5% tensile ductility at room temperature and good elevated temperature creep strength, consisting essentially by atomic percent of 25-27 Al, 12-16 Nb, balance Ti (nominally by weight, 13.5-15.3 Al, 23.4-30 Nb, balance Ti).

2. The alloy of claim 1 consisting essentially by atomic percent of 25-26 Al, 12-15 Nb, balance Ti (nominally 13.5-15 Al, 25-28 Nb, balance Ti).

3. The alloy of claim 1 consisting essentially by atomic percent of 25.5 Al, 13 Nb, balance Ti (nominally 14 Al, 25 Nb, balance Ti by weight).

4. The alloy of claim 1 wherein vanadium is substituted for Nb in atomic amounts of 1-4 percent.

5. The alloys of claims 1, 2, or 3 wherein vanadium is substituted for niobium in atomic amounts of up to 4 percent.

6. The alloy of claims 1, 2, or 3 heat treated first at a temperature above the beta transus, then cooled at a controlled rate, sufficient to produce a fine Widmanstatten structure similar to that shown in FIG. 7.

7. An alloy of claim 1 having between 1 and 4 atomic percent vanadium, heat treated by first solutioning at a temperature above the beta transus, then cooling sufficiently fast to produce a fine Widmanstatten microstructure similar to that shown in FIG. 7, and then aging at 700 (degree) -900 (degree) C. for 4-24 hours.

Fabrication of gamma titanium (tial) alloy articles by powder metallurgy
US5411700

- **Patent Assignee**
  UNITED TECHNOLOGIES
- **Inventor**
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- **International Patent Classification**
  C22C-001/04 C22C-014/00 C22F-001/10
- **US Patent Classification**
  PCLO=419029000 PCLX=075245000 PCLX=148421000
  PCLX=419048000 PCLX=420418000
- **CPC Code**
  C22C-001/04/91; C22C-014/00; C22F-001/10

- **Publication Information**
  US5411700 **A 1995-05-02 [US5411700]**
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  1987US-07132733 1987-12-14
  1989DE-3901979 1989-01-24

- **Fampat family**

US5411700	A	1995-05-02	[US5411700]
DE3901979	A1	1998-05-28	[DE3901979]
DE3901979	C2	1999-12-30	[DE3901979]

- **Abstract:**
  (US5411700)
  Powder metallurgy techniques are disclosed for fabricating gamma titanium alloy articles (TiAl type alloys) from mixture of powder wherein one species is based on Al3Ti and the other Ti3Al. Mixtures of these powders in the proper ratio can be compacted, worked, and heat treated to form the desired gamma TiAl alloy.

Claims

(US5411700)

I claim:

1. A method for producing gamma (TiAl) titanium alloy articles including the steps of:

a) compacting a mixture of Al3 Ti and Ti3 Al powders, whose overall composition lies within the TiAl phase field, into a preform;

b) hot working the preform into a final shape;

and

c) homogenizing the hot worked article under conditions which promote interdiffusion and TiAl formation.

2. A compacted precursor whose overall composition is that of TiAl consisting essentially of a compact formed of Ti3 Al and TiAl3 powders.

3. A crack free sheet material whose thickness is less than about 0.1 inch and whose overall composition is TiAl.

Titanium aluminide turbine exhaust structure
WO2014149292

- **Patent Assignee**
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  MERRY BRIAN D
- **International Patent Classification**
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- **US Patent Classification**
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- **CPC Code**
  B21K-007/12; B23K-031/02; F01D-025/16/2; F01D-025/30; F02C-003/04; F02C-007/20; F02K-001/78; F05D-2220/30; F05D-2230/236; F05D-2230/25; F05D-2230/60; F05D-2300/174; Y02T-050/671

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  2013US-61788040 2013-03-15
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- **Fampat family**

WO2014149292	A1	2014-09-25	[WO2014149292]
US2015377073	A1	2015-12-31	[US20150377073]

- **Abstract:**
  (US20150377073)
  A turbine exhaust case for a gas turbine engine includes a multiple of CMC turbine exhaust case struts between a CMC core nacelle aft portion and a CMC tail cone.

Claims

(US20150377073)

What is claimed is:

1.

A turbine exhaust case for a gas turbine engine comprising: a CMC core nacelle aft portion;

a CMC tail cone; and

a multiple of CMC turbine exhaust case struts between said CMC core nacelle aft portion and said CMC tail cone.

2. The turbine exhaust case as recited in claim 1, wherein said CMC core nacelle aft portion defines a trailing edge of a core nacelle

3. The turbine exhaust case as recited in claim 1, wherein said CMC core nacelle aft portion defines a portion of an outer aerodynamic surface to provide essentially uninterrupted flow along a core nacelle

4. A gas turbine engine comprising: a turbine case; and

a CMC turbine exhaust case mounted to said turbine case.

5. The gas turbine engine as recited in claim 4, wherein said turbine case is a low pressure turbine case.

6. The gas turbine engine as recited in claim 4, wherein said turbine case is manufactured of CMC.

7. The gas turbine engine as recited in claim 4, wherein said CMC turbine exhaust case comprises: a CMC core nacelle aft portion;

a CMC tail cone; and

a multiple of CMC turbine exhaust case struts between said CMC core nacelle aft portion and said CMC tail cone.

8. The gas turbine engine as recited in claim 4, wherein said CMC turbine exhaust case is mounted to said turbine case at a flange.

9. The gas turbine engine as recited in claim 4, wherein said multiple of CMC turbine exhaust case struts are bonded between said CMC core nacelle aft portion and said CMC tail cone.

10. A method of assembling a gas turbine engine comprising: mounting a CMC turbine exhaust case to a turbine case.

11. The method as recited in claim 10, further comprising: bolting the CMC turbine exhaust case to the turbine case.

12. The method as recited in claim 10, further comprising: defining at least a portion of a core nacelle with the CMC turbine exhaust case.

13. The method as recited in claim 10, further comprising: defining at least a portion of an aerodynamic outer surface of a core nacelle with the CMC turbine exhaust case.

14. The method as recited in claim 10, further comprising: defining a trailing edge of a core nacelle with the CMC turbine exhaust case.

Process and system for fabricating gamma tial turbine engine components
EP2423340

- **Patent Assignee**
  UNITED TECHNOLOGIES
- **Inventor**
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- **International Patent Classification**
  B21J-001/00 B21J-001/02 B21J-001/06 B21J-005/00 B21K-003/04 B23H-001/00 B23H-007/00 B23P-015/02 B26D-001/00 B26F-003/00 B30B-011/00 C22B-009/04 C22B-009/20 C22B-034/12 C22C-014/00 C22F-001/18 F01D-005/00
- **US Patent Classification**
  PCLO=148671000 PCLX=148421000 PCLX=148557000
- **CPC Code**
  B21J-001/00; B21J-001/02; B21J-001/06; B21J-005/00/2; B21K-003/04; B23H-001/00; B23P-015/02; C22B-009/04; C22B-009/20; C22B-034/12/95; C22C-014/00; C22F-001/18/3

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  2010US-12870909 2010-08-30

- **Fampat family**

EP2423340	A1	2012-02-29	[EP2423340]
US2012048430	A1	2012-03-01	[US20120048430]
US8876992	B2	2014-11-04	[US8876992]

- **Abstract:**
  (EP2423340)
  A process for manufacturing a turbine engine component (10) comprises the steps of: casting ingots made of a gamma TiAl material using a double vacuum arc remelting casting technique; subjecting the cast ingots to a hot isostatic pressing to close porosity; forming at least one pancake of the gamma TiAl material by isothermally forging the hot isostatic pressed ingots; sectioning each pancake into a plurality of blanks; heat treating the blanks to produce a desired microstructure and mechanical properties; and machining the blanks into finished turbine engine components (10). A system for performing the process is also disclosed. (see diagramm)

Claims

(EP2423340)

1. A process for manufacturing a turbine engine component (10) comprising the steps of: casting ingots made of a gamma TiAl material using a double vacuum arc remelting casting technique; subjecting said cast ingots to a hot isostatic pressing to close porosity; forming at least one pancake of said gamma TiAl material by isothermally forging the hot isostatic pressed ingots; sectioning each said pancake into a plurality of blanks; heat treating said blanks to produce a desired microstructure and mechanical properties; and machining the blanks into finished turbine engine components (10).

2. The process of claim 1, wherein said casting step comprises casting ingots of a gamma TiAl alloy having a composition of 43.5 at% Al, 4.0 at% Nb, 1.0 at% Mo, 0.2 at% B, and the balance Ti.

3. The process of claim 1 or 2, wherein said hot isostatic pressing step is performed at a temperature in the range of from 2100 deg.F to 2240 deg.F (1149 deg.C to 1227 deg.C) for a time period in the range of from six to eight hours at a pressure in the range of from 20 ksi to 35 ksi.

4. The process of any of claims 1 to 3, wherein said isothermal forging step is performed at a temperature in the range of from 1850 deg.F to 2200 deg.F (1010 deg.C to 1204 deg.C) using a strain rate in the range of from 0.015/min to 0.6/min.

5. The process of any preceding claim, wherein said sectioning step is performed by one of electro-discharge (EDM) machining and waterjet machining.

6. The process of any preceding claim, wherein said heat treating step comprises subjecting each said blank to a first heat treatment at a temperature in the range of from 2200 deg.F to 2300 deg.F (1204 deg.C to 1262 deg.C) for a time period in the range of from one hour to two hours, cooling each said blank, and then subjecting each said blank to a second heat treatment at a temperature in the range of from 1550 deg.F to 1700 deg.F (843 deg.C to 927 deg.C) for a time period in the range of from four to six hours.

7. The process of any preceding claim, wherein said heat treating step comprises heating each said blank to form a duplex microstructure consisting of gamma, (alpha 2/Y) lamellar colonies with beta /B 2 phases.

8. The process of any preceding claim, wherein said heat treating step comprises heating each said blank to form a duplex microstructure consisting of 49 vol% gamma, 39 vol% (alpha 2/Y) lamellar colonies with 12 vol% of beta /B2 phases.

9. The process of any preceding claim, wherein said machining step comprises using ECM machining of the blade blanks to form finished turbine blades.

10. A system for manufacturing a turbine engine component (10) comprising: means for casting ingots made of a gamma TiAl material using a double vacuum arc remelting casting technique; means for subjecting said cast ingots to a hot isostatic pressing to close porosity; means for forming at least one pancake of said gamma TiAl material by isothermally forging the hot isostatic pressed ingots; means for sectioning each said pancake into a plurality of blanks; means for heat treating said blanks to produce a desired microstructure and mechanical properties; and means for machining the blanks into finished turbine engine components (10).

11. The system of claim 10, wherein said casting means comprises means for casting ingots of a gamma TiAl alloy having a composition of 43.5 at% Al, 4.0 at% Nb, 1.0 at% Mo, 0.2 at% B, and the balance Ti.

12. The system of claim 10 or 11, wherein said sectioning means comprises an electro-discharge (EDM) machine.

13. The system of any of claims 10 to 12, wherein said machining means comprises an ECM machine for machining the blade blanks into form finished turbine blades (10).

Titanium alloys of the TiAl type
FR2462483

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- **International Patent Classification**
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- **CPC Code**
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- **Priority Details**
  1979US-06060265 1979-07-25

- **Fampat family**

FR2462483	A1	1981-02-13	[FR2462483]
DE3024645	A1	1981-02-19	[DE3024645]
JPS5641344	A	1981-04-18	[JP56041344]
GB2060694	A	1981-05-07	[GB2060694]
US4294615	A	1981-10-13	[US4294615]
GB2060694	B	1984-08-08	[GB2060694]
FR2462483	B1	1985-03-08	[FR2462483]
JPH0127138	B2	1989-05-26	[JP89027138]
JP1546272	C	1990-02-28	[JP1546272]
DE3024645	C2	1991-03-21	[DE3024645]

- **Abstract:**
  (US4294615)
  Cast and forged titanium alloys suited for use at temperatures over 600 (degree) C. are based on TiAl gamma phase structure. Useful alloys have about 1.5% or greater tensile ductility at temperatures of 260 (degree) C. and below, thereby making them fabricable and suited for engineering applications. Disclosed are alloys having weight percent compositions of 31-36 aluminum, 0-4 vanadium, balance titanium (in atomic percent, about: 45-50Al, 0-3V, bal Ti). The inclusion of about 0.1 weight percent carbon improves creep rupture strength. To obtain high tensile strength, the alloys are forged at about 1025 (degree) C. and aged at about 900 (degree) C.; to obtain higher creep rupture strength and tensile ductility, a solution anneal at about 1150 (degree) C. is interposed before aging.

Claims

(US4294615)

We claim:

1.

A cast and forged titanium alloy with ductility at room temperature and good high temperature strength, consisting essentially of by weight percent 31-36 aluminum, 0.1-4 vanadium, balance titanium (in atomic percent, about: 45-50Al, 0.1V, bal Ti).

2. A cast and forged titanium alloy with ductility at room temperature and good high temperature strength, consisting essentially of by weight percent 34-36 aluminum, 0.7-2.0 vanadium, balance titanium (in atomic percent, about: 48-50Al, 0.5-1.5V, bal Ti).

3. The alloys of claims 1 or 2 characterized by tensile elongations of greater than about 1.5% at 20 (degree) C. and 3% at 260 (degree) C.

4. The alloys of claims 1 or 2 further having up to 0.1 weight percent carbon to improve creep rupture strength.

5. The alloys of claims 1 or 2 forged at about 1000 (degree) -1050 (degree) C. and heat treated at 815 (degree) -950 (degree) C. to obtain hgh tensile strength.

6. The alloys of claims 1 or 2 forged at about 1000 (degree) -1050 (degree) C. with a two step heat treatment consisting of a solution anneal of 1100 (degree) -1200 (degree) C. followed by an aging treatment of 815 (degree) -950 (degree) C. to develop high creep-rupture strength and improved tensile ductility.

Fabrication of gamma titanuim (TiAl) alloy articles by powder metallurgy GB8900043

- **Patent Assignee**
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- **International Patent Classification**
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- **CPC Code**
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- **Priority Details**
  1989GB-0000043 1989-01-03

- **Fampat family**

GB8900043	D0	2013-11-13	[GB8900043]
GB2517653	A	2015-03-04	[GB2517653]

- **Abstract:**
  (GB2517653)
  Powder metallurgy techniques are disclosed for fabricating gamma titanium alloy articles (TiAl type alloys) from mixture of powder wherein one species is based on A13Ti and the other Ti3A1. Mixtures of these powders in the proper ratio can be compacted, worked and heat treated to form the desired gamma TiAl alloy.

Claims

(GB2517653)

Claims
1. A method for producing gamma (TiAl) titanium alloy articles including the steps of:
a) compacting a mixture of A1 3 Ti and Ti 3 A1 powders, whose overall composition lies within the TiAl phase field, into a preform;
b) hot working the preform into a final shape;

and c) homogenizing the hot worked article under conditions which promote interdiffusion and
TiAl formation.
2. A compacted precursor whose overall composition, is that of TiAl consisting essentially of a compact formed of Ti 3 Al and TiA1 3 powders.
3. A crack free sheet material whose thickness is less than about 0.1 inch and whose overall composition is TiAl.
CLAIMS
1. A method for producing gamma (TiAl) titanium alloy articles including the steps of:
(a) compacting a mixture of A1 3 Ti and Ti 3 A1 powders, whose overall composition lies within the TiAl phase field, into a preform;

(b) hot working the preform into a final shape;
and
(c) homogenizing the hot worked article under conditions which, promote interdiffusion and TiAl formation.
2. A compacted precursor whose overall composition is that of
TiAl consisting essentially of a compact formed of Ti 3 A1 and TiA1 3 powders.
3. A method for producing gamma (TiAl) titanium alloy articles substantially as herein particularly described with reference to the accompanying figures.
4. Titanium alloy articles when produced by the method of
claim 1.
5. Titanium alloy articles when produced by the method of
6. Claim 3.

Fremgangsmåte for fremstilling av gjenstander av gamma-titan (TiAl) legering ved pulvermetallurgi

NO8900331

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- **International Patent Classification**
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- **Priority Details**
  1989NO-0000331 1989-01-26

- **Fampat family**

NO890331	A	1994-11-29	[NO8900331]

- **Abstract:**

(NO8900331)
Pulvermetallurgiske teknikker for fremstilling av gjenstander av gamma-tltanlegeringer (legeringer av TIAl-typen) fra en pulverblandlng hvor en av forbind- elsene er basert på A13T1 og den andre på T13A1. Blandinger av disse pulvrene i det riktige forholdet kan kompakteres, bearbeides og varmebehandles for oppnåelse av den ønskede gamm-TlAl-legering. Det er beskrevet en fremgangsmåte for fremstilling av nevnte legeringsgjenstander, et kompaktert forløperprodukt til slike gjenstander samt et sprekkfrltt platematerlale som er basert på de fremstilte produktene.

Claims

(NO8900331)

NO890331 1989-01-26 [1989NO-0000331]