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EP1621774	Titanium aluminide wheel and steel shaft connection thereto BORG WARNER
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WO200946699	Joining and material application method for a workpiece having a workpiece region comprising a titanium aluminide alloy ACCESS & V ACCESS EV BORG WARNER TURBO SYSTEMS ENGI

Titanium aluminide wheel and steel shaft connection thereto
EP1621774

- **Patent Assignee**
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US2006021221	A1	2006-02-02	[US20060021221]
JP2006037952	A	2006-02-09	[JP2006037952]
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US7287960	B2	2007-10-30	[US7287960]
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- **Abstract:**
  (EP1621774)
  Titanium aluminide (TiAl) rotor shaft assembly (10) of a type used in a turbocharger has a TiAl rotor (20) with an axially protruded portion (40) that is fixedly joined to a recessed portion (50) of a metal shaft (30) by the synergistic combination of an interference fit, such as a heat shrinkage fit, further supported by a brazed joint (60) in which a thin layer of a brazing material (110) is interposed between the surface of the protruded portion (120) and the recessed surface (130). Optionally, one or both of the jointed surfaces have braze channels (90) to facilitate braze flow within the joint. Methods for producing the rotor shaft assembly (10) and a turbocharger having the rotor shaft assembly (10) are provided.

Claims

(EP1621774)

1. A rotor shaft assembly (10) comprising: a titanium aluminide rotor (20) comprising an axial protruded portion (40) and a metal shaft (30) comprising a recessed axial portion (50) adapted to accept said protruded portion (40), wherein said protruded portion (40) and said recessed portion (50) are joined by a brazed joint (60) and an interference fit.
2. The rotor shaft assembly (10) of claim 1, wherein the surface of the protruded portion (40) or the recessed portion (50) or both further comprise braze channels (90).
3. The rotor shaft assembly (10) of claim 2, wherein the braze channels (90) are formed by knurling or cross-hatching.
4. The rotor shaft assembly (10) of claim 3, wherein said cross-hatching comprises a left-handed helical channel and a right-handed helical channel.
5. The rotor shaft assembly (10) of claim 1, wherein said braze (110) is an active braze.
6. The rotor shaft assembly (10) of claim 1, wherein said shaft (30) is a steel shaft.
7. A method for joining a titanium aluminide rotor (20) comprising an axial protruded portion (40) and a metal shaft (30) comprising a recessed axial portion (50) adapted to accept said protruded portion (40), to produce a rotor shaft assembly (10), the method comprising: (a) mounting said axial protruded portion (40) to said recessed axial portion (50) to form an interference fit with a braze (110) disposed therebetween;
and (b) heating the braze (110) to a brazing temperature, whereby said rotor shaft assembly (10) is produced.
8. The method of claim 8, wherein said recessed axial portion (50) is at a higher temperature than said protruded portion (40) during pressing, whereby said interference fit is a shrinkage fit.
9. The method of claim 7, further comprising providing braze channels (90) upon the surface of the protruded portion (120) or the recessed portion (130) or both to enhance flow of liquid braze.
10. The method of claim 7, wherein said braze channels (90) are formed by knurling or cross-hatching.
11. The method of claim 7, wherein said cross-hatching comprises a left-handed helical channel and a right-handed helical channel.
12. The method of claim 7, wherein said braze (110) is an active braze.
13. The method of claim 7, wherein said shaft (30) is a steel shaft.
14. A turbocharger comprising the rotor shaft assembly (10) of claim 1.

Bonding of a titanium aluminide turbine rotor to a steel shaft
EP1507062

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  B22F-003/02 B22F-005/04 B22F-007/00 B22F-007/06 B22F-007/08 C22C-014/00 C22C-038/00 C22C-038/48 F01D-005/02 F01D-005/04 F01D-025/00 F02B-039/00
- **US Patent Classification**
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- **CPC Code**
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US2005036893	A1	2005-02-17	[US20050036893]
JP2005060829	A	2005-03-10	[JP2005060829]
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EP1507062	A3	2007-03-28	[EP1507062]
EP1507062	B1	2008-01-09	[EP1507062]
DE602004011156	D1	2008-02-21	[DE602004011156]
DE602004011156	T2	2008-12-24	[DE602004011156]
JP4698979	B2	2011-06-08	[JP4698979]

- **Abstract:**
  (EP1507062)
  A rotor shaft assembly (101) of a type used in a turbocharger, manufactured by mounting a powder compact (203) of a titanium aluminide rotor (103) to a pre-formed steel shaft (107), and sintering the combination, which provides a strong metallurgical bond between the shaft (107) and rotor (103). There is provided a rotor shaft assembly (101) and an inexpensive and efficient method of its manufacture, for an assembly capable of withstanding the high forces and fluctuating temperatures within a turbocharger.

Claims

(EP1507062)

1. A process for axially bonding the hub (109) of a titanium aluminide (TiAl) turbine rotor (103) to a pre-formed steel shaft (107) of a rotor shaft assembly (101) of a type used in a turbocharger for rotating about its axis (111) to drive a compressor, said process comprising:
(a) axially mounting a preformed steel shaft (107), to the hub (209) of a compact (203) of said rotor (103), wherein said compact comprises a TiAl powder admixed with a binder, to form a mounted compact (201) optionally comprising a clearance (211) between said hub (209) of said compact (203) and said shaft (107), and
(b) debinding and sintering said mounted compact (201), wherein said rotor compact (203) and said clearance (211) are selected to provide a tight fit of said hub (209) to said shaft (107) during sintering, whereby said rotor (103) and said shaft (107) are bonded to form said rotor shaft assembly (101).
2. The process of claim 1, wherein said sintering is performed from about 1200 DEG.C to about 1430 DEG.C for a period from about 45 min to about 2 hours.
3. The process of claim 1, wherein said powders have a particle size of from about 1 m to 40 m.
4. The process of claim 3, wherein said powders have a particle size of from about 1 m to 10 m.
5. The process of claim 1, wherein said binder is selected from the group consisting of waxes, polyolefin, polyethylene, polypropylene, polystyrene, polyvinyl chloride, polyethylene carbonate, polyethylene glycol, and microcrystalline wax, or a mixture thereof.
6. The process of claim 1, wherein said debinding is carried out at temperature of between about 200 DEG.C and 250 DEG.C.
7. A rotor shaft assembly (101) prepared according to the process of claim 1.
8. The rotor shaft assembly (101) of claim 7, in which said shaft (107) comprises stainless steel.
9. The rotor shaft assembly (101) of claim 7, in which the proximal end of said shaft (107) has a shape selected from the group consisting of a knurled shaft (301), a polygonal shaft (305), a flatted shaft (309), a threaded shaft (313), and a notched shaft (107).
10. The rotor shaft assembly (101) of claim 7, further comprising one or more cavities (119) disposed between the proximal end (113) of said shaft (107) and said hub (109).

Process and apparatus for casting titanium aluminide components
WO201520704

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- **International Patent Classification**
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WO2015020704	A2	2015-02-12	[WO201520704]
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CN105324196	A	2016-02-10	[CN105324196]
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- **Abstract:**
  (WO201520704)
  The invention relates to a process for casting TiA1 components, comprising the following process steps: producing a melt (S) of the TiA1 material below an inert gas fill (IF); placing a casting mold (1) on a gate (2) in a gastight manner; flooding the casting mold (1) with inert gas (IG) by opening a closure mechanism (7) which is arranged at the gate (2) and is connected to an inert gas source (8); pressing the melt (S) through the gate (2) into the casting mold (1) by increasing the pressure (P) of the inert gas fill (IF) above the melt (S) while at the same time evacuating the inert gas (IG) from the casting mold (1), and stopping the inflow of inert gas (IG) as soon as it is determined that the melt (S) passes above the position of the closure mechanism (7). (From WO2015020704 A2)

Claims

(WO201520704)

CLAIMS

1.

A process for casting TiAl components, comprising the following process steps:

- producing a melt (S) of the TiAl material below an inert gas fill (IF); placing a casting mold (1) on a gate (2) in a gastight manner;

flooding the casting mold (1) with inert gas (IG) by opening a closure mechanism (7) which is arranged at the gate (2) and is connected to an inert gas source

(8);

- pressing the melt (S) through the gate (2) into the casting mold (1) by increasing the pressure (P) of the inert gas fill (IF) above the melt (S) while at the same time evacuating the inert gas (IG) from the casting mold (1), and

stopping the inflow of inert gas (IG) as soon as it is determined that the melt (S) passes above the position of the closure mechanism (7).

2. The process as claimed in claim 1, characterized by the process step of reducing the pressure (P) of the inert gas fill (IF) as soon as the casting mold (2) has been filled, and restarting the supply of inert gas (IG) to the closure mechanism (7) until the fill level of the melt (S) has reached below the closure mechanism (7).

3. The process as claimed in claim 2, wherein the filling of the casting mold (2) is detected through a discharge of melt (S) at an evacuation opening (10) of the casting mold (2). 4.

The process as claimed in claim 3, wherein the casting mold filling is detected optically.

5. The process as claimed in one of claims 2 to 4, characterized by the process step of closing the closure mechanism (7) while maintaining the supply of inert gas (IG) to the melt (S) below the gate (2).

6. The process as claimed in one of claims 1 to 5, wherein melt (S) is supplied proceeding from a melting crucible (5), provided with the inert gas fill (IF), via a riser (4) to the closure mechanism (7) and the gate (2).

7. The process as claimed in one of claims 1 to 6, wherein the inert gas (IG) is supplied from a vessel (8) as an inert gas source to the closure mechanism (7) via a connection line (11).

8. The process as claimed in one of claims 1 to 7, wherein the closure mechanism (7) is controlled by means of a system monitoring device (9).

9.

An apparatus (12) for casting TiAl components,

- having a melting crucible (5);

having a riser (4), which connects the melting crucible (5) to a gate (2); and

having a casting mold (1) which can be placed on the top of the gate (2), wherein

- an openable and closable closure mechanism (7) is arranged at the gate

(2).

10. The apparatus as claimed in claim 9, wherein the closure mechanism (7) is connected to a system monitoring device (9) for signaling purposes.

11. The apparatus as claimed in claim 9 or 10, wherein the closure mechanism (7) is fluidically connected to an inert gas source (8) via a connection line (11). 12.

The apparatus as claimed in claim 11, wherein the inert gas source (8) is in the form of a vessel.

13. The apparatus as claimed in one of claims 9 to 12, wherein provision is made of an optical detection device (12), which monitors an evacuation opening (10) of the casting mold (1).

14. The apparatus as claimed in either of claims 9 and 10, wherein the casting mold (1) is arranged in an exchangeable molding box (6).

TiAl ALLOY, IN PARTICULAR FOR TURBOCHARGER APPLICATIONS, TURBOCHARGER COMPONENT, TURBOCHARGER AND METHOD FOR PRODUCING THE TiAl ALLOY

WO2015119927

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- **Abstract:**
  (WO2015119927)
  The invention relates to a TiAl alloy comprising the elements C, Si, B, Al and Ti, wherein a C fraction is 0.5 wt%, an Si fraction is 0.05-2.5 wt%, a B fraction is 0.4 wt% and an Al fraction is 25-43 wt%, in each case in relation to the total weight of the alloy.

Claims

(WO2015119927)

CLAIMS

1. A TiAl alloy comprising the elements C, Si, B, Al and Ti, wherein a C fraction is 0.5 wt%, an Si fraction is 0.05 -2.5 wt%, a B fraction is 0.4 wt% and an Al fraction is 25-43 wt%, in each case in relation to the total weight of the alloy.

2. The TiAl alloy as claimed in claim 1, characterized in that the C fraction is 0.4 wt%, the Si fraction is 0.08 -2.2 wt%, the B fraction is 0.3 wt% and the Al fraction is 28-39 wt%, in each case in relation to the total weight of the alloy.

3. The TiAl alloy as claimed in claim 1 or 2, furthermore comprising Nb, wherein an Nb fraction is 0.1-8.0 wt%, preferably 0.15-6.5 wt%, in relation to the total weight of the alloy.

4. The TiAl alloy as claimed in one of the preceding claims, furthermore comprising Cr and/or V and/or Mo, wherein a Cr fraction is 0.1-4.0 wt%, preferably 0.15-3.5 wt%, and/or a V fraction is 2.0 wt%, preferabl y 1.7 wt%, and/or an Mo fraction is 1.4 wt%, preferabl y 1.2 wt%, in each case in relation to the total weight of the alloy.

5. The TiAl alloy as claimed in one of the preceding claims, characterized in that the alloy is composed of Ti, Al, C, Si, B, Al, Mo, Cr, V and Nb, wherein a C fraction is 0.5 wt%, an Si fraction is 0.05 -2.5 wt%, a B fraction is 0.4 wt%, an Al fraction is 25-43 wt%, an Nb fraction is 0.1-8.0 wt%, a Cr fraction is 0.1-4.0 wt%, a V fraction is 2.0 wt%, and a Mo fraction is 1.4 wt%, in each c ase in relation to the total weight of the alloy, with a remainder = Ti.

6. The TiAl alloy as claimed in one of the preceding claims, characterized in that the alloy is subjected to a heat treatment and hot isostatic pressing.

7. The TiAl alloy as claimed in one of the preceding claims, characterized in that it has an average grain size of 1 to 3 .mu..iota..eta..

8. The TiAl alloy as claimed in one of the preceding claims, characterized in that it has a lamellar structure and a spacing between the lamellae is 1.5 .mu..iota..eta., preferably 1 .mu..iota..eta.. 9.

A turbocharger component, in particular turbine rotor, composed of a

TiAl alloy as claimed in one of claims 1 to 8.

10. A turbocharger comprising at least one component, in particular a turbine rotor, which is composed of a TiAl alloy comprising the elements C, Si, B, Al and Ti, wherein a C fraction is 0.5 wt%, an Si fraction is 0.05 -2.5 wt%, a B fraction is 0.4 wt% and an Al fraction is 25 -43 wt%, in each case in relation to the total weight of the alloy.

11. The turbocharger as claimed in claim 10, characterized in that, in the TiAl alloy, the C fraction is 0.4 wt%, the Si fraction is 0.08 -2.2 wt%, the B fraction is 0.3 wt% and the Al fraction is 28 -39 wt%, in each case in relation to the total weight of the alloy.

12. The turbocharger as claimed in claim 10 or 11, characterized in that the TiAl alloy furthermore comprises Nb, wherein an Nb fraction is 0.1 -8.0 wt%, preferably 0.15-6.5 wt%, in relation to the total weight of the alloy.

13. The turbocharger as claimed in one of claims 10 to 12, characterized in that the TiAl alloy furthermore comprises Cr and/or V and/or Mo, wherein a Cr fraction is 0.1 -4.0 wt%, preferably 0.15-3.5 wt%, and/or a V fraction is 2.0 wt%, preferably 1.7 wt%, and/or an Mo fractio n is 1.4 wt%, preferabl y 1.2 wt%, in each case in relation to the total weight of the alloy.

14. The turbocharger as claimed in one of claims 10 to 13, characterized in that the TiAl alloy is composed of Ti, Al, C, Si, B, Al, Mo, Cr, V and Nb, wherein a C fraction is 0.5 wt%, an Si fraction is 0.05 -2.5 wt%, a B fraction is 0.4 wt%, an Al fraction is 25-43 wt%, an Nb fraction is 0.1-8.0 wt%, a Cr fraction is 0.1-4.0 wt%, a V fraction is 2.0 wt%, and a Mo fraction is 1.4 wt%, in each case in rel ation to the total weight of the alloy, with a remainder = Ti.

15. The turbocharger as claimed in one of claims 10 to 14, characterized in that the TiAl alloy is subjected to a heat treatment and hot isostatic pressing.

16. The turbocharger as claimed in one of claims 10 to 15, characterized in that the TiAl alloy has an average grain size of greater than 2 .mu..iota..eta. and/or a lamellar structure, wherein a spacing between the lamellae is 1.5 .mu..iota..eta., preferabl y 1 .mu..iota..eta..

17.

A method for producing a TiAl alloy as claimed in one of claims 1 to 8, comprising the steps:

melting the alloy elements to form an alloy material,

subjecting the alloy material to heat treatment, and
- subjecting the alloy material to hot isostatic pressing.

18.

The method as claimed in claim 17, characterized in that the heat treatment comprises the following steps:

heating the alloy material to approximately 1260deg.C within two hours, - holding the alloy material at a temperature of approximately 1260deg.C for three hours, and

cooling the alloy material in a nitrogen inert gas atmosphere to a temperature of 650deg.C with a cooling rate of 7 K/sec.

Joining and material application method for a workpiece having a workpiece region comprising a titanium aluminide alloy

WO200946699

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- **US Patent Classification**
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DE102007048789	A1	2009-05-20	[DE102007048789]
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KR20100091178	A	2010-08-18	[KR20100091178]
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JP2011502786	A	2011-01-27	[JP2011502786]

- **Abstract:**
  (US20100297468)
  The invention concerns a method to create fusion-integrated joints of workpieces, in which a workpiece area formed on a workpiece made from a TiAl alloy and a workpiece area formed on another workpiece made from a TiAl alloy or a different high temperature material are joined in a joint area using a joining additive, where the joining additive contains at least one of the elements gallium and indium. The invention also concerns a method to create a material deposit on a workpiece, in which a deposit material is applied to a workpiece area made from a TiAl alloy, where a fusion-integrated joint is produced between the deposit material and the workpiece area, where the deposit material contains at least one of the elements gallium and indium and a filler material. (From US2010297468 A1)

Claims

(US20100297468)

1. A method for creating fusion-integrated joints of workpieces in which a first workpiece area formed on a first workpiece made from a TiAl alloy and a second workpiece area formed on a second workpiece made in a joint area from a TiAl alloy or a different high temperature material are joined by using a joining additive, where the joining additive contains at least one of the elements gallium and indium.
2. A method of depositing material on a workpiece, in which a deposit material is deposited onto a workpiece area made from a TiAl alloy, where a fusion-integrated joint is produced between the deposit material and the workpiece area, where the deposit material contains at least one of the elements gallium and indium and a filler material.
3. A method in accordance with claim 1, wherein the first workpiece area formed on the first workpiece and the second workpiece area formed on the second workpiece are joined in a fusion-integrated manner by means of soldering, where a solder is used as the joining additive.
4. A method in accordance with claim 1, wherein the first workpiece area formed on the first workpiece and the second workpiece area formed on the second workpiece are joined by welding in a fusion-integrated manner, where a weld additive is used as the joining additive.
5. Method in accordance with claim 1, wherein the joining additive used is in the form of a type of additive selected from the following group of additives consisting of: wire, foil, ribbon, powder, paste and coating.
6. Method in accordance with claim 1, wherein a binary silver-gallium alloy is used as the joining additive.
7. A method in accordance with claim 1, wherein the first workpiece area on which the first workpiece is formed from the TiAl alloy is joined in a fusion-integrated manner to the second workpiece area formed on the second workpiece made of a different high temperature material selected from the following group of high temperature materials consisting of: steel, superalloys, titanium alloys and intermetallic compounds.
8. A method in accordance with claim 2, wherein the fusion-integrated joint between the application material and the workpiece area is produced by soldering.
9. A method in accordance with claim 2, wherein the fusion-integrated joint between the deposit material and the workpiece area is produced by welding.
10. Method in accordance with claim 2, wherein the deposit material is used in the form of a powder or paste.
11. A method in accordance with claim 2, wherein the filler material contains a powdery filler material.
12. A method in accordance with claim 11, wherein a powder made from a TiAl alloy is used as a powdery filler material.
13. The use of a method in accordance with claim 2 for fusion-integrated joints of system components selected from the following group of systems consisting of: turbochargers and turbines.
14. The use of a method in accordance with claim 2 for processing in a production process or the repair of a system component selected from the following group of systems consisting of: turbochargers and turbines.
15. A workpiece bond, produced in accordance with a method of claim 1, in which a fusion-integrated joining connection is formed between a first workpiece area formed on a first workpiece made from a TiAl alloy and a second workpiece area formed on a second workpiece made from a TiAl alloy or a different high temperature material in a joint area by using a joining additive containing at least one of the elements gallium and indium.
16. The workpiece bond in accordance with claim 15, characterised by the fact that the first workpiece and the second workpiece are system components selected from the following group of systems consisting of: turbochargers and turbines.
17. A workpiece that is processed in accordance with a method to create a material deposit in accordance with claim 2, with a workpiece area made from a TiAl alloy, on which the material deposit is formed from a deposit material containing at least one of the elements gallium and indium and a filler material.
18. The workpiece in accordance with claim 17, designed as a system component selected from the following group of systems consisting of: turbochargers and turbines.