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(54) Title: PRECIPITATION HARDENABLE COBALT-NICKEL BASE SUPERALLOY AND ARTICLE MADE THEREFORM

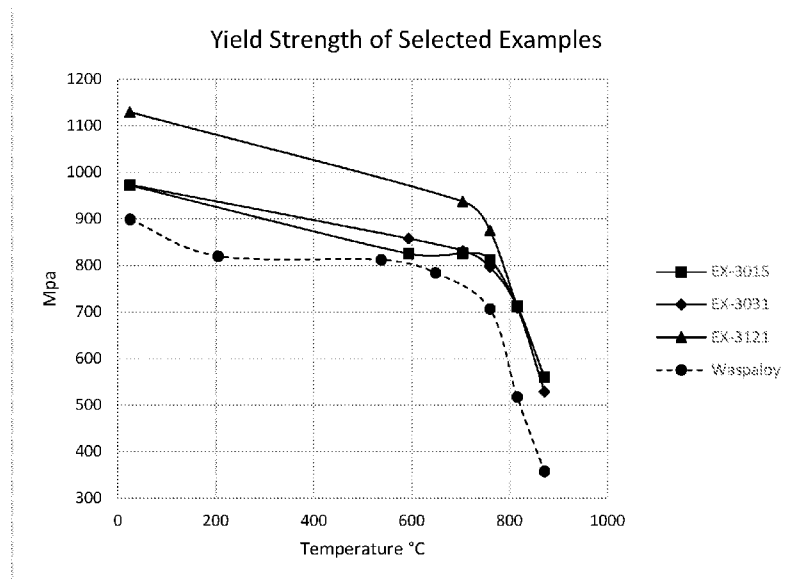


FIG. 4

(57) Abstract: A precipitation hardenable, cobalt-nickel base superalloy is disclosed. The is characterized by the following weight percent composition. C about 0.01 to about 0.15 Cr about 6.00 to about 15.00 Ni about 30.00 to about 45.00 W about 3.00 to about 15.00 Ti about 0.50 to about 4.00 Al about 3.00 to about 7.00 Nb up to about 2.50 Ta up to about 6.00 Hf up to about 1.50 Zr up to about 1.50 B up to about 0.20 Mo up to about 2.50 Si up to about 1.50 The balance of the alloy is cobalt and usual impurities. The alloy provides a novel combination of strength and ductility after long-term exposure to elevated operating temperatures as found in gas turbines and jet engines. A fine-grain steel article made from the alloy is also disclosed. The steel article is also characterized by a continuous surface layer of Al₂O₃ and Cr₂O₃ that protects the alloy from oxidation at the elevated operating temperatures.



KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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Published:

- *with international search report (Art. 21(3))*
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(88) Date of publication of the international search report:

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2018/028567

A. CLASSIFICATION OF SUBJECT MATTER
INV. C22C19/07 C22C19/05 C22C30/00
ADD.
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
C22C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2016/168662 A1 (HARDY MARK CHRISTOPHER [GB] ET AL) 16 June 2016 (2016-06-16) the whole document table 1, alloy B -----	1,2,6,7, 11
A	US 2015/010428 A1 (HARDY MARK CHRISTOPHER [GB] ET AL) 8 January 2015 (2015-01-08) the whole document claims 1, 17 -----	1,2,6,7, 11
A	US 2012/312434 A1 (SUZUKI AKANE [US] ET AL) 13 December 2012 (2012-12-13) the whole document -----	1,2,6,7, 11
A	EP 3 024 957 A1 (GEN ELECTRIC [US]) 1 June 2016 (2016-06-01) the whole document -----	1,2,6,7, 11

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search 10 January 2019	Date of mailing of the international search report 21/03/2019
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer von Zitzewitz, A
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2018/028567

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1, 2, 6, 7, 11

Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1, 2, 6, 7, 11

This invention relates to the problem of increasing the solid solution strength (p.6, 1.2). The feature solving this problem is to add > 0.50% Ta as defined by claim 1. This is known from D1.

2. claims: 3, 4, 8, 9, 12, 13

This invention relates to the problem of not lowering the strengthening capability (p.6, 1.25). The special technical feature not known from the prior art and relating to this problem is to keep the amount of Cr < 9.8% as defined in claims 3, 8 and 12.

3. claims: 5, 10

This invention relates to the problem of providing a stable microstructure (p.7, 1.4). The special technical feature not known from the prior art and relating to this problem is to add > 34% Ni as defined in claims 5 and 10.

4. claims: 14, 15

This invention relates to the problem of providing a fine grained microstructure (p.9, 1.18). The special technical feature not known from the prior art and relating to this problem is to assure that the grain size is <= ASTM number 6 as defined in claim 14.

5. claim: 16

This invention relates to the problem of protecting the surface of an article made from an alloy. The special technical feature not known from the prior art and relating to this problem is the surface layer comprising Al₂O₃ and Cr₂O₃ as defined in claim 16.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2018/028567

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2016168662 A1	16-06-2016	EP 3031938 A1 US 2016168662 A1	15-06-2016 16-06-2016

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