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[Continued on next page]

(54) Title: RADIOPAQUE ALLOY AND MEDICAL DEVICE MADE OF THIS ALLOY

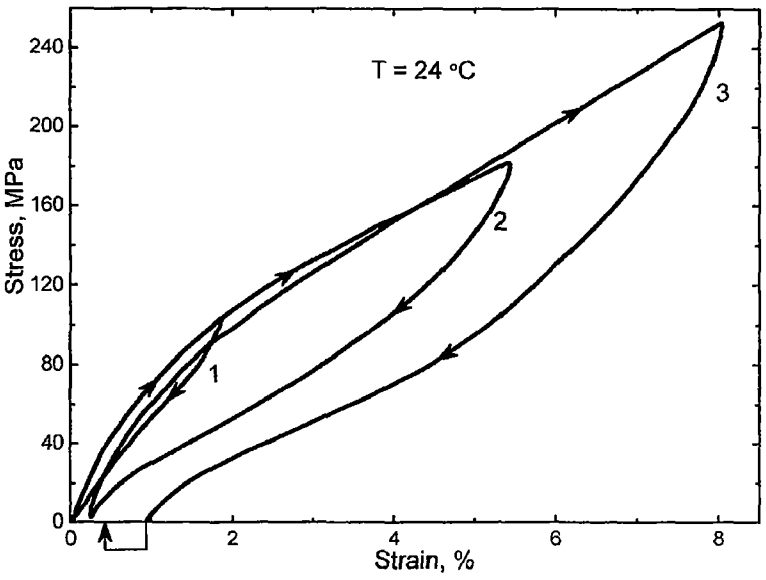


FIG. 13

(57) Abstract: A radiopaque alloy based on titanium nickelide and having shape memory and superelastic properties includes, according to one embodiment, at least one radiopaque alloying element selected from the group consisting of gold, platinum, and palladium at a concentration of from about 10 at.% to about 20 at.%, and at least one additional alloying element selected from the group consisting of aluminum, chromium, cobalt, iron, and zirconium, where the additional alloying element has a concentration of from about 0.5 at.% to about 4 at.%. The alloy includes titanium at a concentration of from about 48 at.% to about 52 at.%, and the balance of the alloy is nickel. The radiopaque alloy preferably exhibits superelastic behavior suitable for medical device applications in the human body.

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A. CLASSIFICATION OF SUBJECT MATTER
INV. C22C14/00 C22C19/03 C22F1/10 C22F1/18 A61L29/02
A61L31/02 A61L31/18

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 C22F

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 practical, 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	DATABASE WPI Week 199916 Thomson Scientific, London, GB; AN 1999-186659 XP002520197 & JP 11 036024 A (FURUKAWA ELECTRIC CO LTD) 9 February 1999 (1999-02-09) abstract; claim 4; table 2	1,2,4,5
Y	the whole document	1,2,4,5, 26,27, 30,31
Y	WO 2005/102407 A (ADVANCED CARDIOVASCULAR SYSTEM [US]) 3 November 2005 (2005-11-03) abstract; figure 5; table 1 page 18, line 30 - page 19, line 3	1,2,4,5, 26,27, 30,31

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[X] Further documents are listed in the continuation of Box C.

[X] 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 document 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	Date of mailing of the international search report
19 March 2009	01/07/2009

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Ugarte, Eva

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2008/086994

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	ECKELMEYER ET AL: "The effect of alloying on the shape memory phenomenon in nitinol" SCRIPTA METALLURGICA, ELSEVIER SCIENCE LTD., KIDLINGTON, GB, vol. 10, no. 8, 1 August 1976 (1976-08-01), pages 667-672, XP024133911 ISSN: 0036-9748 [retrieved on 1976-08-01] the whole document figure 4	1,2,4,5
Y	YANG W S ET AL: "Ductilization of Ti-Ni-Pd shape memory alloys with boron additions" SCRIPTA METALLURGICA ET MATERIALIA, OXFORD, GB, vol. 28, no. 2, 15 January 1993 (1993-01-15), pages 161-165, XP024182201 ISSN: 0956-716X [retrieved on 1993-01-15] the whole document	5
P,A	JAN VAN HUMBEECK: "SMART MATERIALS. Chapter 2.4 Shape Memory Alloys" 20 November 2008 (2008-11-20), CRC PRESS , USA , XP008103933 ISBN: 978 1 420 04372 3 paragraph [20.4.2.3] - paragraph [20.4.2.4]	
A	RONALD NOEBE: "ADVANCED STRUCTURAL MATERIALS [...]. Chapter 7: NiTi-Based High-Temperature Shape-Memory Alloys..." 21 December 2006 (2006-12-21), CRC PRESS , USA , XP008103927 ISBN: 978 1 574 44634 0 page 157, paragraph 7.4.1.2; figure 7.10 paragraphs [7.4.2] - [7.4.6]	1
A	page 163, lines 26-32	5
A	paragraph [7.4.7]; figure 7.24	2,4
A	US 5 885 381 A (MITOSE KENGO [JP] ET AL) 23 March 1999 (1999-03-23) abstract; example 6; table 1 column 3, lines 57-67	
A	US 2004/187980 A1 (JUNG JIN-WON [US] ET AL) 30 September 2004 (2004-09-30) abstract; figure 8; examples 2,3; table 14	1-5
A	WO 2006/066114 A (COOK UROLOGICAL INC [US]; COOK IRELAND LTD [IE]; LAVELLE SHAY [IE]) 22 June 2006 (2006-06-22) abstract the whole document	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2008/086994

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 allsearchable 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 reportcovers 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.:

see add. sheet(s)

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: 1,2,4,5,26,27,30,31

Radiopaque alloy, having shape memory and superelastic properties comprising :
a) 48-52 at% Ti;
b) at least one of Pd, Pt and Au in an amount of 15-35 at% for Pd and 10-35 at% each for Pt and Au.
c) at least one of Fe and Co in an amount of 0.5-8 at% each.
d) optionally, at least one of Al, Cr and Zr, in an amount of <2 at% for Al and Cr and of <6 at% for Zr.
e) optionally, 0.05-0.2 at% of B.
f) the balance Ni
and its use in a medical device

---

2. claims: 3,28,29

Radiopaque alloy, having shape memory and superelastic properties comprising :
a) 48-52 at% Ti;
b) at least one of Pd, Pt and Au in an amount of 15-35 at% for Pd and 10-35 at% each for Pt and Au.
d) at least one of Al, Cr and Zr, in an amount of <2 at% for Al and Cr and of <6 at% for Zr.
f) the balance Ni
and its use in a medical device

---

3. claims: 6-16,32,33

Radiopaque nickel-titanium alloy, comprising :
a) 48-52 at% Ti;
b) at least one of Pd, Pt and Au in an amount of 10-20 at% each.
c+d) at least one of Fe, Co, Al,Cr,Zr in an amount of 0.5-4 at% each.
e) optionally 0.05-0.2 at%B.
f) the balance Ni.
g) a radiopacity greater than the one of the binary Ni-Ti alloy and a recoverable strain of at least 2% upon removal of a deforming stress at body temperature.
And its use in a medical device

---

4. claims: 17-25,34,35

Radiopaque nickel-titanium alloy, comprising :
a) 48-52 at% Ti.
b) at least one of Pd, Pt and Au in a TOTAL amount of 10-35 at%.
c+d) at least one of Fe, Co, Al, Cr, Zr in a TOTAL amount of 0.5-13 at%.
f) the balance Ni.
g) a radiopacity greater than the one of the binary Ni-Ti alloy and a recoverable strain of at least 2% upon removal of a deforming stress at body temperature.
And its use in a medical device

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2008/086994

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 11036024 A	09-02-1999	NONE	
WO 2005102407 A	03-11-2005	EP 1735025 A1	27-12-2006
US 5885381 A	23-03-1999	NONE	
US 2004187980 A1	30-09-2004	EP 1629134 A2	01-03-2006
		WO 2005111255 A2	24-11-2005
WO 2006066114 A	22-06-2006	AU 2005316431 A1	22-06-2006
		CA 2590156 A1	22-06-2006
		EP 1830719 A1	12-09-2007