



(51) International Patent Classification:

C22C 38/02 (2006.01) C22C 38/18 (2006.01)
C22C 38/04 (2006.01) C22C 38/40 (2006.01)
C22C 38/08 (2006.01)

(21) International Application Number:

PCT/US2012/039917

(22) International Filing Date:

30 May 2012 (30.05.2012)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

13/161,146 15 June 2011 (15.06.2011) US

(71) Applicant (for all designated States except US): **ATI PROPERTIES, INC.** [US/US]; 1600 N.E. Old Salem Road, Albany, Oregon 97321 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **STEFANSSON, Njall** [US/US]; 105 Standing Rock, McMurray, Pennsylvania 15317 (US). **HASEK, Bradley** [US/US]; 3214 Tee Court, Presto, Pennsylvania 15142 (US). **BAILEY, Ronald E.** [US/US]; 313 Oak Forest Drive, Pittsburgh, Pennsylvania 15216 (US). **PARAYIL, Thomas** [IN/US]; 103 Peppertree Drive, New Kensington, Pennsylvania 15068 (US). **NICHOLS, Andrew** [US/US];

2040 Murdstone Drive, Pittsburgh, Pennsylvania 15241 (US).

(74) Agents: **VICCARO, Patrick J.** et al.; 1000 Six PPG Place, Pittsburgh, Pennsylvania 15222 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, 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.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: AIR HARDENABLE SHOCK-RESISTANT STEEL ALLOYS, METHODS OF MAKING THE ALLOYS, AND ARTICLES INCLUDING THE ALLOYS

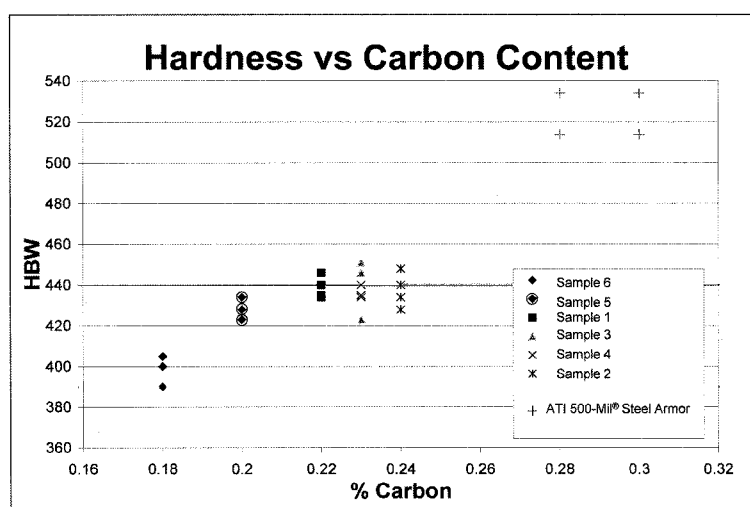


Figure 2

(57) Abstract: An air hardenable steel alloy is disclosed comprising, in percent by weight: 0.18 to 0.26 carbon; 3.50 to 4.00 nickel; 1.60 to 2.00 chromium; 0 to 0.50 molybdenum; 0.80 to 1.20 manganese; 0.25 to 0.45 silicon; 0 to less than 0.005 titanium; 0 to less than 0.020 phosphorus; 0 up to 0.005 boron; 0 up to 0.003 sulfur; iron; and impurities. The air hardenable steel alloy has a Brinell hardness in a range of 352 HBW to 460 HBW. The air hardenable steel alloy combines high strength, medium hardness and toughness, as compared with certain know air hardenable steel alloys, and finds application in, for example, any of a steel armor, a blast-protective hull, a blastprotective V-shaped hull, a blast-protective vehicle underbelly, and a blast-protective enclosure.

**Declarations under Rule 4.17:**

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(88) Date of publication of the international search report:

1 August 2013

Published:

- *with international search report (Art. 21(3))*

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2012/039917

A. CLASSIFICATION OF SUBJECT MATTER INV. C22C38/02 C22C38/04 C22C38/08 C22C38/18 C22C38/40 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	WO 2011/037759 A2 (ATI PROPERTIES INC [US]; SWIATEK GLENN J [US]; BAILEY RONALD E [US]) 31 March 2011 (2011-03-31)	1,19,20
Y	paragraph [0049]; table 3 -----	22,23
X	LAURALICE C.F. CANALE, XIN YAO, JIANFENG GU, GEORGE E. TOTTEN: "A historical overview of steel tempering parameters", INT. J. MICROSTRUCTURE AND MATERIALS PROPERTIES, vol. 3, no. 4/5, 31 December 2008 (2008-12-31), pages 474-525, XP009168875, Inderscience Enterprises Ltd.	21
Y	figures 6, 21, 23; table 4 ----- -/-	22,23
☒ 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 13 May 2013		Date of mailing of the international search report 17/05/2013
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 Huber, Gerrit

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2012/039917

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E	WO 2012/094160 A2 (ATI PROPERTIES INC [US]; STEFANSSON NJALL [US]; BAILEY RONALD E [US];) 12 July 2012 (2012-07-12)	1,2,19
L	paragraph [0007] paragraph [0027] - paragraph [0028] tables 1, 2	1,2,19
X	----- Z ZHANG ET AL: "Microstructure evolution of hot-work tool steels during tempering and definition of a kinetic law based on hardness measurements", MATERIALS SCIENCE AND ENGINEERING A, vol. 380, no. 1-2, 30 August 2004 (2004-08-30), pages 222-230, XP055060251, ISSN: 0921-5093, DOI: 10.1016/j.msea.2004.03.067 figure 10	21
X	----- Crucible Industries: "CRUCIBLE S7 XL", 10 September 2010 (2010-09-10), XP002695512, Retrieved from the Internet: URL: http://www.crucible.com/eselector/prodbyapp/tooldie/crus7xlt.html [retrieved on 2013-04-16] the whole document	21
A	----- EP 0 731 332 A2 (ALLEGHENY LUDLUM CORP [US]) 11 September 1996 (1996-09-11) claims 8-10	20

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2012/039917

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2011037759	A2	31-03-2011	
		AU 2010298597 A1	22-03-2012
		CA 2772528 A1	31-03-2011
		EP 2480694 A2	01-08-2012
		JP 2013505836 A	21-02-2013
		KR 20120088663 A	08-08-2012
		TW 201116633 A	16-05-2011
		US 2011067788 A1	24-03-2011
		WO 2011037759 A2	31-03-2011

WO 2012094160	A2	12-07-2012	
		TW 201237189 A	16-09-2012
		US 2012174760 A1	12-07-2012
		WO 2012094160 A2	12-07-2012

EP 0731332	A2	11-09-1996	
		AT 174685 T	15-01-1999
		BR 9600928 A	30-12-1997
		CA 2171079 A1	07-09-1996
		DE 69601138 D1	28-01-1999
		DE 69601138 T2	02-06-1999
		EP 0731332 A2	11-09-1996
		ES 2128142 T3	01-05-1999
		JP 3676480 B2	27-07-2005
		JP H08320198 A	03-12-1996
		US 5749140 A	12-05-1998
