



(51) International Patent Classification:
A61C 8/00 (2006.01)

(21) International Application Number:
PCT/US2014/041321

(22) International Filing Date:
6 June 2014 (06.06.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/831,799 6 June 2013 (06.06.2013) US
61/971,177 27 March 2014 (27.03.2014) US

(71) Applicants: **TRUSTEES OF BOSTON UNIVERSITY** [US/US]; One Silber Way, Boston, Massachusetts 02215 (US). **FRAUNHOFER USA, INC.** [US/US]; 44792 Helm Street, Plymouth, Michigan 48170 (US).

(72) Inventors: **GYURKO, Robert**; 60 Ash Hill Rd., Reading, Massachusetts 01867 (US). **DIBART, Serge**; 54 Clements Rd., Waltham, Massachusetts 02453 (US). **SHARON, An-**

dre; 149 Greenwood St., Newton, Massachusetts 02459 (US). **SAUER-BUDGE, Alexis**; 117 S. Great Rd., Lincoln, Massachusetts 01773 (US). **WIRZ, Holger**; 17 Palmer St., Medford, Massachusetts 02155 (US).

(74) Agent: **THOMPSON, James F.**; Bainwood, Huang & Associates, LLC, 2 Connector Road, Westborough, Massachusetts 01581 (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, BN, 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, IR, IS, JP, KE, KG, 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, 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.

[Continued on next page]

(54) Title: NON-CYLINDRICAL DENTAL IMPLANT SYSTEM

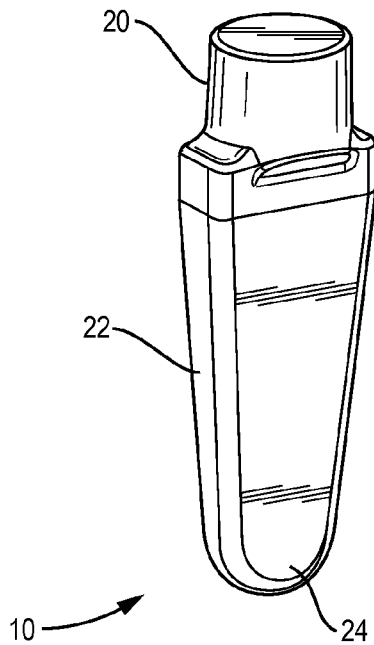
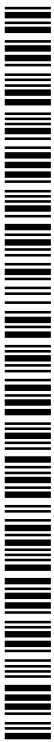


FIG. 2

(57) Abstract: A dental implant includes an upper connector portion and lower implantation portion, the connector portion receiving a dental crown or similar prosthesis, the implantation portion having rectangular cross section and linear vertical profile with machine taper. An outer surface of the implantation portion provides frictional fit with a correspondingly shaped surrounding bone surface. A bone removal tool includes a hand-held actuator generating high-frequency, small-amplitude vibration, and an attached metal tool tip having elongated head portion and curved neck portion. The head portion has rectangular cross section and linear taper, and an outer surface of the head portion has a saw-toothed grinding pattern for removing bone. The neck portion is dimensioned and configured to establish mechanical resonance of the tool tip including axial reciprocating action of the head portion in response to the actuator vibration.



(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, KM, ML, MR, NE, SN, TD, TG).

Published:

- *with international search report (Art. 21(3))*
- *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:
29 January 2015

INTERNATIONAL SEARCH REPORT

International application No PCT/US2014/041321

A. CLASSIFICATION OF SUBJECT MATTER INV. A61C8/00 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) A61C A61B		
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, COMPENDEX, INSPEC		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2012/173577 A1 (HAYDAR IMAD [SY]) 20 December 2012 (2012-12-20) pages 3-11 figures 1-13	1-8
A	----- US 2003/118968 A1 (MASSOUD YEHIA ALY [US]) 26 June 2003 (2003-06-26) figures 1-8 paragraphs [0035] - [0046]	1-8
A	----- DE 21 15 682 A1 (DR WALTER HÄFNER) 19 October 1972 (1972-10-19) pages 5-9 figures 1-7 -----	1-8
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> 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	Date of mailing of the international search report	
28 August 2014	09/12/2014	
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 Pisseloup, Arnaud	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/041321

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.:

1-8

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.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2014/041321

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2012173577 A1	20-12-2012	US 2014127644 A1 WO 2012173577 A1	08-05-2014 20-12-2012
US 2003118968 A1	26-06-2003	NONE	
DE 2115682 A1	19-10-1972	NONE	

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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

1. claims: 1-8

A dental implant comprising a unitary body of a high-strength surgical metal suitable for implantation in a live jaw bone, the body including an upper connector portion and an elongated lower implantation portion, the connector portion being configured to extend above a ridge of the jaw bone at an implantation site and receive a separate dental prosthesis, the implantation portion having a substantially rectangular cross section and a linear vertical profile with a machine taper to a lower end, an outer surface of the implantation portion having sufficient roughness to provide a frictional fit with a correspondingly shaped surrounding bone surface at the implantation site upon application of axial implantation force to the dental implant.

2. claims: 9-12

A bone removal tool, comprising:
a hand-held actuator operative to generate a high-frequency, small-amplitude mechanical vibration at an actuated end; and
a metal tool tip at the actuated end of the hand-held actuator, the tool tip having a base portion, an elongated head portion and a curved neck portion, the base portion being rigidly attached to the actuated end of the actuator to receive the small-amplitude mechanical vibration therefrom, the head portion having a substantially rectangular cross section and a linear taper to a distal end, an outer surface of the head portion having a saw-toothed grinding pattern for removing bone, the curved neck portion being dimensioned and configured to establish a predetermined mechanical resonance of the tool tip including an axial reciprocating action of the head portion relative to the base portion in response to the small-amplitude mechanical vibration of the hand-held actuator.
