

(19) World Intellectual Property
Organization
International Bureau



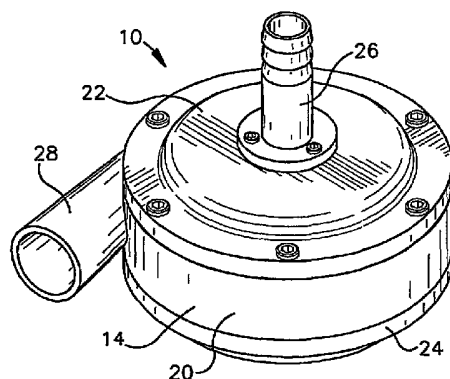
(43) International Publication Date
14 April 2005 (14.04.2005)

PCT

(10) International Publication Number
WO 2005/034312 A3

- (51) International Patent Classification⁷: H02K 7/09, 7/14, 21/24
- (21) International Application Number: PCT/US2004/032560
- (22) International Filing Date: 1 October 2004 (01.10.2004)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data: 60/508,618 2 October 2003 (02.10.2003) US
- (71) Applicants: FOSTER-MILLER, INC. [US/US]; 350 Second Avenue, Waltham, MA 02154 (US). THE CLEVELAND CLINIC FOUNDATION [US/US]; 9500 Euclid Avenue, Cleveland, OH 44195 (US).
- (72) Inventors: CHEN, Hsiang, Ming; 3 Dante Terrace, Latham, NY 12110 (US). SMITH, William, A.; 5480 Lansbury Lane, Lyndhurst, OH 44124 (US). VITALE, Nicholas, G.; 157 Williamsburg Street, Albany, NY 12203 (US). CHAPMAN, Peter, A., Jr.; 4 Scotland Lane, East Schodack, NY 12063 (US). DONAHUE, Arthur, C.; 131 Werking Road, East Greenbush, NY 12061 (US). MEEKER, David, C.; 21 Virginia Road, Natick, MA 01760 (US). PRISCO, Charles, J.; 23 Cedarcrest Drive, Saratoga Springs, NY 12866 (US).
- (74) Agent: SUTKUS, Richard, A.; Tarolli, Sundheim, Covell & Tummino L.L.P., 526 Superior Avenue, Suite 1111, Cleveland, OH 44114 (US).
- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).
- Published:
— with international search report
- (88) Date of publication of the international search report:
16 June 2005
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: ROTARY PUMP WITH ELECTROMAGNETIC LCR BEARING



(57) Abstract: A pump (10) includes a housing (14) having a fluid inlet (26) and a fluid outlet (28). A rotor (12) is disposed within the housing (14) and rotatable about an axis (16) to move fluid from the fluid inlet (26) to the fluid outlet (28). A magnetic axial bearing (286) for supporting the rotor (12) includes an axial bearing target (70) disposed on the rotor and an axial bearing stator (130) disposed on the housing, the axial bearing stator including multiple stator poles (132a, 132b, 132c) each including a first coil portion wound in a first direction and a second coil portion wound in a second direction opposite the first direction.

WO 2005/034312 A3

INTERNATIONAL SEARCH REPORT

National Application No
PCT/US2004/032560

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 H02K7/09 H02K7/14 H02K21/24

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)
 IPC 7 H02K A61M

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, PAJ, 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 5 078 741 A (BRAMM ET AL) 7 January 1992 (1992-01-07)	1-8, 21, 22, 25, 26, 28-30, 33, 35, 36, 38, 39, 42, 47, 48, 50
Y	abstract; figures 2, 21, 31-35 column 2, line 29 - column 4, line 60 column 13, line 51 - column 14, line 37 column 27, line 31 - line 65 ----- -/--	23

Further documents are listed in the continuation of box C. Patent family members are listed in annex.

° Special categories of cited documents :

<p>*A* document defining the general state of the art which is not considered to be of particular relevance</p> <p>*E* earlier document but published on or after the international filing date</p> <p>*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)</p> <p>*O* document referring to an oral disclosure, use, exhibition or other means</p> <p>*P* document published prior to the international filing date but later than the priority date claimed</p>	<p>*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</p> <p>*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</p> <p>*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.</p> <p>*&* document member of the same patent family</p>
--	--

Date of the actual completion of the international search 14 March 2005	Date of mailing of the international search report 23/03/2005
---	---

Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer Contreras Sampayo, J
--	---

INTERNATIONAL SEARCH REPORT

 International Application No
 PCT/US2004/032560

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SHEN J X ET AL: "A novel compact PMSM with magnetic bearing for artificial heart application" INDUSTRY APPLICATIONS CONFERENCE, 1999. THIRTY-FOURTH IAS ANNUAL MEETING. CONFERENCE RECORD OF THE 1999 IEEE PHOENIX, AZ, USA 3-7 OCT. 1999, PISCATAWAY, NJ, USA, IEEE, US, vol. 2, 3 October 1999 (1999-10-03), pages 1201-1207, XP010355293 ISBN: 0-7803-5589-X	1,3,4,6, 47,50
A	page 1201, column 2, line 27 - page 1203, column 2, line 18 page 1204, column 1, line 30 - page 1205, column 2, line 37; figures 1c,2,3,5,9,10	12,21
X	CHEN H M ET AL: "HIGH EFFICIENCY MAGNETIC BEARING FOR A ROTARY BLOOD PUMP" ASAIO JOURNAL, J.B.LIPPINCOTT CO., HAGERSTOWN, MD, US, vol. 44, no. 5, September 1998 (1998-09), pages M728-M732, XP000802392 ISSN: 1058-2916 abstract; figures 1-4 page 728, column 2 - page 29 page 730, column 1, line 11	21,22, 35-39, 42,45
X	US 6 126 638 A (WAMPLER ET AL) 3 October 2000 (2000-10-03) abstract; figures 1,3,11 column 1, line 16 - column 2, line 31 column 2, line 66 - column 3, line 9	1,3,4,6, 12,20, 47,50,51
X	DATABASE WPI Section PQ, Week 200349 Derwent Publications Ltd., London, GB; Class P34, AN 2003-514741 XP002319970 & CN 1 414 687 A (UNIV SHENYANG POLYTECHNIC) 30 April 2003 (2003-04-30) abstract	46,49
Y		23
A		9,10
A	EP 1 113 177 A (NTN CORPORATION; TERUMO KABUSHIKI KAISHA) 4 July 2001 (2001-07-04) abstract; figures 1a,3,6a,8a paragraphs '0015!, '0026! - '0036!	1,21,50
A	EP 0 901 797 A (HEARTWARE, INC; KRITON MEDICAL, INC) 17 March 1999 (1999-03-17) paragraphs '0023! - '0036!, '0045!, '0046!; figures 6-8	1,12,21, 50,51

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No US2004/032560

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
US 5078741	A	07-01-1992	US 5385581 A	31-01-1995
			US 5326344 A	05-07-1994
			US 4944748 A	31-07-1990
US 6126638	A	03-10-2000	AU 765716 B2	25-09-2003
			AU 1524200 A	19-06-2000
			CA 2352270 A1	08-06-2000
			EP 1135181 A1	26-09-2001
			JP 2002531185 T	24-09-2002
			WO 0032257 A1	08-06-2000
CN 1414687	A	30-04-2003	NONE	
EP 1113177	A	04-07-2001	JP 2001182683 A	06-07-2001
			JP 2001182682 A	06-07-2001
			AT 255685 T	15-12-2003
			DE 60006926 D1	15-01-2004
			DE 60006926 T2	17-06-2004
			EP 1113177 A2	04-07-2001
			US 2001016170 A1	23-08-2001
EP 0901797	A	17-03-1999	US 5840070 A	24-11-1998
			AT 288770 T	15-02-2005
			AU 730235 B2	01-03-2001
			AU 7993698 A	25-02-1999
			CA 2240555 A1	13-02-1999
			EP 0901797 A2	17-03-1999
			IL 124876 A	04-01-2004
			JP 11123239 A	11-05-1999
			US 2002102169 A1	01-08-2002
			US 6080133 A	27-06-2000
			US 6234998 B1	22-05-2001
			US 6368083 B1	09-04-2002
			US 2004234397 A1	25-11-2004