

REVISED VERSION

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
24 May 2007 (24.05.2007)

PCT

(10) International Publication Number
WO 2007/058951 A3

- (51) International Patent Classification:

HOIL 41/04 (2006.01)	H02N 2/10 (2006.01)
A61M 5/142 (2006.01)	H02N 2/14 (2006.01)
F04B 43/08 (2006.01)	A61M 39/28 (2006.01)
- (21) International Application Number:
PCT/US2006/043816
- (22) International Filing Date:
9 November 2006 (09.11.2006)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
11/271,705 10 November 2005 (10.11.2005) US
- (71) Applicant (for all designated States except US):
IRADIMED CORP [US/US]; 7457 ALOMA AVENUE, SUITE 201, Winter Park, FL 32792 (US).
- (72) Inventor; and
- (75) Inventor/Applicant (for US only): **SUSI, Roger, E.**

[US/US]; 4099 SCARLET IRIS PLACE, Winter Park, FL 32792 (US).

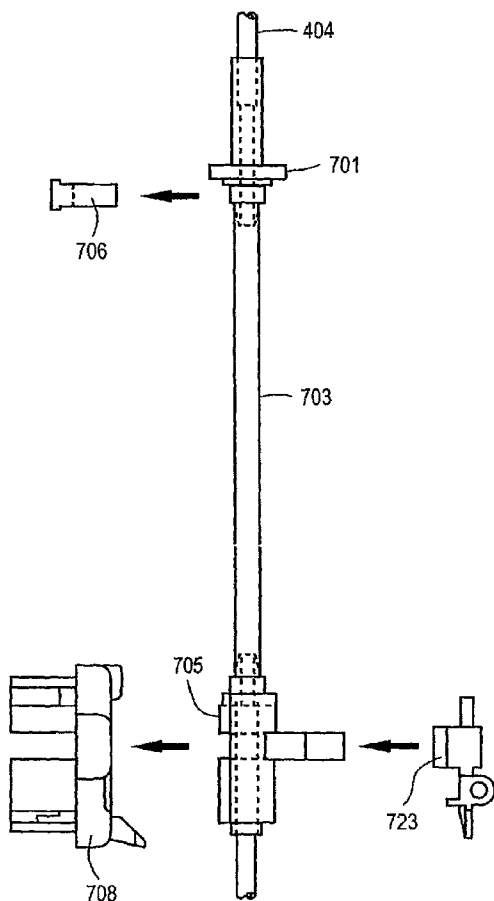
(74) Agent: **ALTMAN, Daniel, E.**; KNOBBE, MARTENS, OLSON & BEAR, LLP, 2040 Main Street, 14th Floor, Irvine, CA 92614 (US).

(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, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, 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, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,

[Continued on next page]

(54) Title: PERISTALTIC LIQUID INFUSION APPARATUS



(57) Abstract: Liquid infusion apparatus (41) includes non-magnetic materials in a pumping structure and ultrasonic drive motor therefor, and in a controller that supplies drive signals to the motor to facilitate convenient operation in intense magnetic fields without distorting the magnetic fields and without radiating objectionable radio-frequency interference. A non-MRI-compatible liquid infusion apparatus is temporarily replaced with MRI-compatible, non-magnetic liquid infusion apparatus without disconnecting a patient from an installed intravenous infusion set to continue infusing liquid within the MRI environment. The pumping apparatus operates on a segment (703) of a liquid conduit that is mounted in tension between a linear peristaltic pump and platen, with associated safety interlocks (705, 708, 723) to assure proper operation of infusing liquid into a patient compatibly with conditions in an MRI environment. Drive circuitry generates low-harmonic signals for operating the ultrasonic motor at variable speeds to compensate for flow rate discontinuities through the peristaltic pumping cycles.

WO 2007/058951 A3



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, IS, IT, LT, LU, LV, 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*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

(88) Date of publication of the international search report:
23 August 2007

Date of publication of the revised international search report:
22 November 2007

(15) Information about Correction:
see PCT Gazette No. 47/2007 of 22 November 2007

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.

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2006/043816

A. CLASSIFICATION OF SUBJECT MATTER
 INV. H01L41/04 A61M5/142 F04B43/08 H02N2/10
 ADD. H02N2/14 A61M39/28

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)
 A61M F16K F04B H01L H02N 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 practical, search terms used)

EPO-Internal , WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 689 043 A (BISHA JON [US]) 25 August 1987 (1987-08-25)	1-13, 23-28
Y	column 3, line 19 - column 7, line 25; figures 1-7D	14-16, 29,30
X	-----	
X	US 2002/165503 A1 (MORRIS MATTHEW G [US] ET AL) 7 November 2002 (2002-11-07) paragraphs [0040], [0041], [0048]; figures 1-18	1-13, 23-28
X	-----	
X	EP 0 606 099 A2 (TERUMO CORP [JP]) 13 July 1994 (1994-07-13) column 7, line 26 - column 9, line 17; figures 1-9	1-13, 23-28
X	-----	
X	US 6 503 221 B1 (BRIGGS KENNETH D [US] ET AL) 7 January 2003 (2003-01-07) column 12, lines 26-61; figures 1-11	1-13, 23-28
	----- -/-	

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 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

25 June 2007

Date of mailing of the international search report

26. 09. 2007

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
 NL - 2280 HV Rijswijk
 Tel. (+31-70) 340-204 o. Tx. 31 651 epo nl,
 Fax: (+31-70) 340-3013

Authorized officer

Bjorkl und, Andreas

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2006/043816

Box 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.: 17-22
because they relate to subject matter not required to be searched by this Authority, namely:

Claims 17-22 define methods for infusing liquid into a patient. They are methods for treatment of the human or animal body by therapy under Rule 39.1(iv) PCT.
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 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 seamhahlfi claims.
2. As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
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.:

Remark on Protest

- The additional search fees were accompanied by the applicant's protest.
- 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: 1-16, 23-30

Claims 1-16 and 23-30 essentially define a liquid infusion apparatus comprising a liquid conduit and flow controller for selectively impeding flow through the conduit.

2. claims: 31-36

Claims 31-36 essentially define a drive circuitry for an ultrasonic motor comprising an oscillator, a circuit and a pair of air-core transformers.

3. claims: 37-38

Claims 37-38 essentially define a liquid pumping apparatus including a peristaltic pump operated by an ultrasonic motor, and a controller for applying drive signals to modulate the speed of the motor, and a corresponding method of controlling a peristaltic pumping apparatus operated by an ultrasonic motor.

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2006/043816

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 447 985 A (ABBOTT LAB [US]) 25 September 1991 (1991-09-25) column 5, line 32 - column 7, line 32; figures 1-14 -----	1-13, 23-28
Y	wo 03/105925 A2 (SUSI ROGER E [US]) 24 December 2003 (2003-12-24) the whole document -----	14-16, 29-38
A	US 5 967 484 A (MORRIS MATTHEW G [US]) 19 October 1999 (1999-10-19) column 4, lines 43-46; figures 1-8 -----	5
A	US 5 864 331 A (ANAND PREM K [US] ET AL) 26 January 1999 (1999-01-26) column 10, lines 58-65; figure 6 -----	15,30
A	US 4 798 590 A (O'LEARY WILLIAM J [US] ET AL) 17 January 1989 (1989-01-17) column 4, lines 4-8 -----	
Y	US 6 316 862 B1 (NAKATA MASAO [JP] ET AL) 13 November 2001 (2001-11-13) column 3, line 18 - column 8, line 63; figures 1-10 -----	31-36
Y	US 5 021 700 A (TAKAHASHI KENICHIROH [JP] ET AL) 4 June 1991 (1991-06-04) column 1, line 25 - column 6, line 36; figures 1-6 -----	31-36
Y	EP 0 602 635 A1 (MATSUSHITA ELECTRIC IND CO LTD [JP]) 22 June 1994 (1994-06-22) column 3, line 53 - column 6, line 15; figures 1-13 column 14, line 12 - column 17, line 45 -----	31-36
Y	US 5 563 464 A (OKUBO MITSUMASA [JP] ET AL) 8 October 1996 (1996-10-08) column 5, line 1 - column 16, line 45; figures 1-25 -----	31-36
Y	US 4 888 514 A (TAKAHASHI KEN-ICHIROH [JP] ET AL) 19 December 1989 (1989-12-19) the whole document -----	31-36
Y	US 6 198 285 B1 (KORMOS DONALD W [US] ET AL) 6 March 2001 (2001-03-06) column 6, lines 9-28 -----	31-36
Y	us 5 130 619 A (IZUNO YUJI [JP]) 14 July 1992 (1992-07-14) column 7, lines 15,16 -----	31-36
	-/--	

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2006/043816

C(Continuation π). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2002/127114 A1 (BARAK SWI [IL]) 12 September 2002 (2002-09-12) paragraphs [0019] - [0023]; claim 14; figures 1-6B -----	37,38
Y	US 5 522 799 A (FURUKAWA TOSHIO [JP]) 4 June 1996 (1996-06-04) column 2, line 55 - column 3, line 23; figures 1-27 column 23, lines 53-58 column 25, lines 3-13 column 40, lines 15-32 -----	37,38
Y	US 6 213 723 B1 (DANBY HAL [6B] ET AL) 10 April 2001 (2001-04-10) column 11, line 54 - column 12, line 3; figures 1-30 -----	37,38

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2006/043816

Patent document cited in search report	Publication date	Publication date	Patent family member(s)	Publication date
US 4689043	A	25-08-1987	AU 604477	B2 20-12-1990
			AU 6952487	A 24-09-1987
			CA 1238832	A1 05-07-1988
			DE 3774598	D1 02-01-1992
			EP 0238227	A2 23-09-1987
			JP 1730395	C 29-01-1993
			JP 4018867	B 27-03-1992
			JP 62221365	A 29-09-1987
US 2002165503	A1	07-11-2002	AT 364415	T 15-07-2007
			CA 2444403	A1 14-11-2002
			CN 1507359	A 23-06-2004
			CZ 20033292	A3 16-06-2004
			EP 1383559	A1 28-01-2004
			HU 0400062	A2 28-04-2004
			JP 2004528117	T 16-09-2004
			MX PA06010076	A 06-12-2004
			NO 20034904	A 30-12-2003
			NZ 528962	A 29-07-2005
			PL 363987	A1 29-11-2004
			RU 2286179	C2 27-10-2006
			WO 02089876	A1 14-11-2002
EP 0606099	A2	13-07-1994	NONE	
US 6503221	B1	07-01-2003	AT 287501	T 15-02-2005
			AU 736882	B2 02-08-2001
			AU 7956898	A 30-12-1998
			CA 2292660	A1 17-12-1998
			DE 69828689	D1 24-02-2005
			DE 69828689	T2 16-03-2006
			EP 0988451	A1 29-03-2000
			ES 2236911	T3 16-07-2005
			JP 2002504971	T 12-02-2002
			WO 9857064	A1 17-12-1998
			US 2002147425	A1 10-10-2002
EP 0447985	A	25-09-1991	AU 641734	B2 30-09-1993
			AU 7277291	A 19-09-1991
			CA 2038314	A1 16-09-1991
			JP 4224288	A 13-08-1992
			US 5039279	A 13-08-1991
WO 03105925	A2	24-12-2003	AU 2003247559	A1 31-12-2003
			EP 1530440	A2 18-05-2005
			JP 2006523123	T 12-10-2006
			US 2005256388	A1 17-11-2005
US 5967484	A	19-10-1999	NONE	
US 5864331	A	26-01-1999	US 5861865	A 19-01-1999
US 4798590	A	17-01-1989	NONE	
US 6316862	B1	13-11-2001	JP 2001025273	A 26-01-2001
US 5021700	A	04-06-1991	NONE	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2006/043816

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0602635	A1	22-06-1994	DE 69324113 D1 29-04-1999
			DE 69324113 T2 18-11-1999
			US 5461273 A 24-10-1995

US 5563464	A	08-10-1996	NONE

us 4888514	A	19-12-1989	DE 3835090 A1 27-04-1989

us 6198285	B1	06-03-2001	US 2001035752 A1 01-11-2001

us 5130619	A	14-07-1992	DE 4107802 A1 02-07-1992

us 2002127114	A1	12-09-2002	EP 1226839 A1 31-07-2002

us 5522799	A	04-06-1996	JP 3320179 B2 03-09-2002
			JP 7171213 A 11-07-1995

us 6213723	B1	10-04-2001	NONE
