

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
31 December 2003 (31.12.2003)

PCT

(10) International Publication Number
WO 2004/001228 A3

(51) International Patent Classification⁷: **F04B 53/16**,
11/00, 53/14

(21) International Application Number:
PCT/CH2003/000394

(22) International Filing Date: 18 June 2003 (18.06.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
02405509.7 19 June 2002 (19.06.2002) EP

(71) Applicant and

(72) Inventor: **GYGER, Fritz** [CH/CH]; Reckholderweg 4c,
CH-3645 Thun-Gwatt (CH).

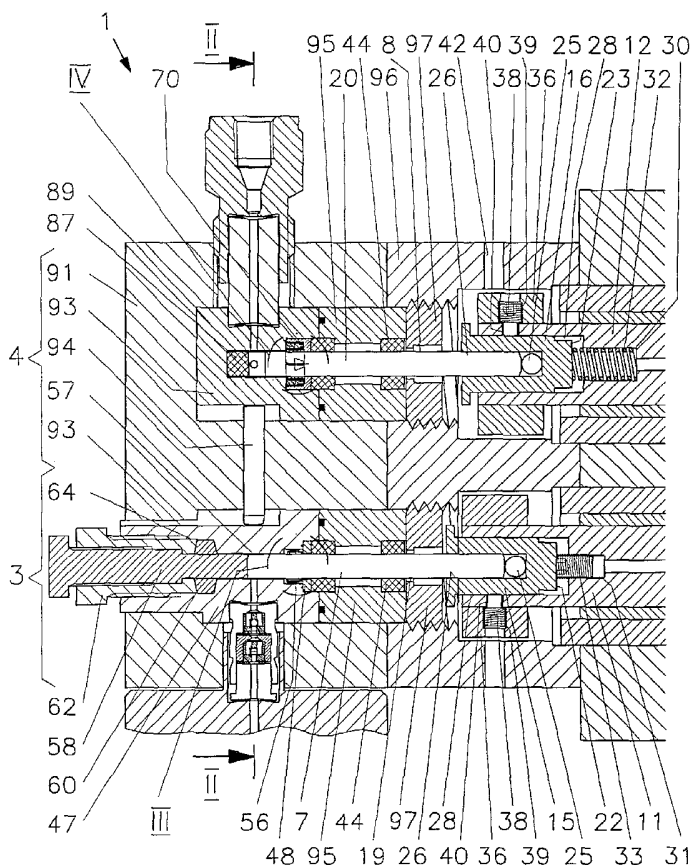
(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

(74) Agent: **AMMANN PATENT ATTORNEYS LTD.** Published:
BERNE; Schwarztorstrasse 31, CH-3001 Bern (CH). — with international search report

[Continued on next page]

(54) Title: HIGH-PRESSURE SMALL VOLUME PUMP



(57) Abstract: An improved high-pressure pump (1) for an accurate, largely pulsation-free flow of the working medium, more particularly an HPLC pump, includes one or a plurality of the following measures: reduced dead space due to adapted seals (48, 70); reduced dead space thanks to a device (15, 16; 32; 36, 38) for adjusting the length of the displacement piston; adjustable dead space and therefore adjusting capability of the pulsation freedom through a displacement chamber provided with an adjustable opposed piston (58); and seals compensating construction tolerances by a combination of a cambered sealing surface and a conical sealing surface.



— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

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.

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

4 March 2004

INTERNATIONAL SEARCH REPORT

International Application No

PCT/CH 03/00394

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 F04B53/16 F04B11/00 F04B53/14

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 F04B

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	EP 0 898 077 A (HYDRAIR LTD) 24 February 1999 (1999-02-24)	1
A	abstract page 3, line 14 -page 6, line 17 figures 1,2	2,3
X	US 3 981 620 A (ABRAHAMS LOUIS ET AL) 21 September 1976 (1976-09-21)	3,23
Y	abstract	20
A	column 6, line 16 - line 63 figures 4,5	1,4,5,13
Y	DE 43 08 467 A (FUNKE HERBERT DR) 5 May 1994 (1994-05-05)	20
A	cited in the application abstract column 1, line 1 - line 47 figures 1,2,6	1,3
	--- -/--	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in 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

9 December 2003

Date of mailing of the international search report

19. 12. 2003

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

Kolby, L

INTERNATIONAL SEARCH REPORT

International Application No

PCT/CH 03/00394

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 706 970 A (RAMIREZ PEDRO) 17 November 1987 (1987-11-17) abstract column 3, line 4 -column 4, line 15 figures ---	1-4
A	US 4 592 558 A (HOPKINS JOHN F) 3 June 1986 (1986-06-03) abstract column 2, line 49 -column 4, line 67; figures ---	1-4
A	US 5 799 953 A (HENDERSON GARY L) 1 September 1998 (1998-09-01) abstract column 2, line 66 -column 5, line 25; figures ---	1-4
X	US 2 733 664 A (MILTON ROY COMPANY) 7 February 1956 (1956-02-07) column 2, line 31 -column 4, line 61; figures 1,2,9 ---	5,6
A	US 2 346 964 A (HARPER LYNDUS E) 18 April 1944 (1944-04-18) page 1, column 2, line 43 -page 4, column 2, line 70 figures ---	1,3,11, 13,16, 21,23
X	EP 0 677 659 A (CRYOMEC AG) 18 October 1995 (1995-10-18) abstract column 2, line 49 -column 4, line 25 figure 1 ---	5,6,13, 14 16,17
A	US 2 841 092 A (BARRON JOHN T ET AL) 1 July 1958 (1958-07-01) column 2, line 6 -column 4, line 48 figure 1 ---	5,6
A	US 4 045 343 A (ACHENER PIERRE Y ET AL) 30 August 1977 (1977-08-30) abstract column 9, line 4 -column 10, line 52 column 12, line 26 -column 13, line 2; figures 2,3 -----	1,3,7, 11,21,23
A		1,5,9, 13,16
A		1,3,13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CH 03/00394

Box I Observations where certain claims were found unsearchable (Continuation of item 1 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 II Observations where unity of invention is lacking (Continuation of item 2 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 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: 1-4,20,23

Hochdruckpumpe mit Federelement im Dichtelement

2. Claims: 5-10,11,12,21,22

Hochdruckpumpe mit Kolbenjustiereinrichtung
Hochdruckpumpe mit Gegenkolben

3. Claims: 13-19

Hochdruckpumpe mit lösbarer Anschlussanordnung

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/CH 03/00394

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0898077	A	24-02-1999	EP 0898077 A1	24-02-1999
US 3981620	A	21-09-1976	US 3855129 A	17-12-1974
			CA 991950 A1	29-06-1976
			DE 2311016 A1	20-09-1973
			DE 2366193 C2	11-10-1984
			FR 2175029 A1	19-10-1973
			GB 1429854 A	31-03-1976
			JP 49047908 A	09-05-1974
			JP 61032620 B	28-07-1986
			US 3958898 A	25-05-1976
DE 4308467	A	05-05-1994	DE 4308467 A1	05-05-1994
			AT 178975 T	15-04-1999
			AU 5368494 A	24-05-1994
			WO 9410445 A1	11-05-1994
			DE 59309519 D1	20-05-1999
			EP 0682749 A1	22-11-1995
			US 5653876 A	05-08-1997
US 4706970	A	17-11-1987	NONE	
US 4592558	A	03-06-1986	NONE	
US 5799953	A	01-09-1998	NONE	
US 2733664	A	07-02-1956	NONE	
US 2346964	A	18-04-1944	NONE	
EP 0677659	A	18-10-1995	CH 688919 A5	29-05-1998
			DE 59508873 D1	04-01-2001
			EP 0677659 A2	18-10-1995
US 2841092	A	01-07-1958	NONE	
US 4045343	A	30-08-1977	CA 1077739 A1	20-05-1980
			DE 2649593 A1	12-05-1977
			FR 2331021 A1	03-06-1977
			GB 1516760 A	05-07-1978
			JP 1005254 B	30-01-1989
			JP 1531049 C	15-11-1989
			JP 52060187 A	18-05-1977