

(19) World Intellectual Property Organization
International Bureau



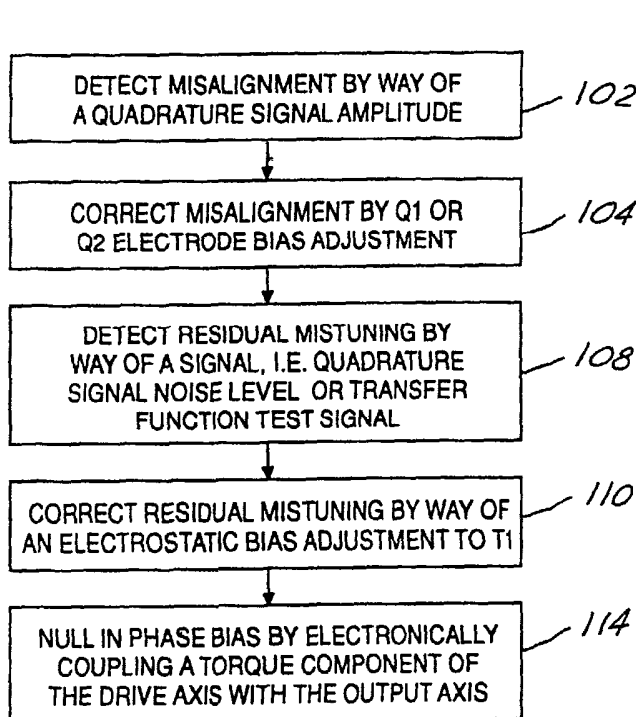
(43) International Publication Date
20 February 2003 (20.02.2003)

PCT

(10) International Publication Number
WO 2003/014669 A3

- (51) International Patent Classification⁷: G01C 19/56, 19/00, 25/00, G01P 3/14
 - (21) International Application Number: PCT/US2002/023224
 - (22) International Filing Date: 19 July 2002 (19.07.2002)
 - (25) Filing Language: English
 - (26) Publication Language: English
 - (30) Priority Data: 09/927,858 9 August 2001 (09.08.2001) US
 - (71) Applicant: THE BOEING COMPANY [US/US]; P.O. Box 3707, Mail Stop 13-08, Seattle, WA 98124-2207 (US).
 - (72) Inventors: CHALLONER, A., Dorian; 311 Carriage Place, Manhattan Beach, CA 90266 (US). GUTIERREZ, Roman, C.; 2921 Franklin Street, La Crescenta, CA 91214 (US). TANG, Tony, K.; 450 N. Brand Blvd. Ste. 600, Glendale, CA 91203 (US).
 - (74) Agent: GALBRAITH, Ann, K.; The Boeing Company, M/S 13-08, P.O. Box 3707, Seattle, WA 98124-2207 (US).
 - (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, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, 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, IE, IT, LU, MC, NL, PT, SE, SK, TR), OAPI patent (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: 25 March 2004
- 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: METHOD FOR ELECTROSTATICALLY ALIGNING AND TUNING A MICROGYROSCOPE



(57) Abstract: A micro-gyroscope (10) having closed loop operation by a control voltage (V_y), that is demodulated by an output signal of the sense electrodes (S1, S2), providing Coriolis torque rebalance to prevent displacement of the micro-gyroscope (10) on the output axis (y-axis). The present invention provides independent alignment and tuning of the micro-gyroscope by using separate sensors and actuators to detect and adjust alignment and tuning. A quadrature amplitude signal is used to detect misalignment, that is corrected to zero by an electrostatic bias adjustment. A quadrature signal noise level, or a transfer function test signal, is used to detect residual mistuning, that is corrected to zero by a second electrostatic bias adjustment.

WO 2003/014669 A3

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 02/23224

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 G01C19/56 G01C19/00 G01C25/00 G01P3/14

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 G01C G01P

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, COMPENDEX, INSPEC, IBM-TDB

C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 992 233 A (CLARK WILLIAM A) 30 November 1999 (1999-11-30)	1-4
Y	column 4, line 39 -column 14, line 24; figures 2,3,7A,7B,7C,12 ---	5-18
X	US 6 032 531 A (ROSHART TERRY V) 7 March 2000 (2000-03-07)	1
Y	column 3, line 48 -column 4, line 67 column 12, line 50 - line 60 column 17, line 44 - line 65 column 20, line 62 -column 21, line 5; figures 1-3,6-10 ---	5-18
Y	WO 97 45702 A (CALIFORNIA INST OF TECHN) 4 December 1997 (1997-12-04)	5-18
A	page 10, line 3 -page 25, line 12; figures 1,3 ---	1
-/--		

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 25 April 2003	Date of mailing of the international search report 17.06.03
---	---

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 Springer, O
--	--

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 02/23224

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6 164 134 A (CARGILLE DONALD R) 26 December 2000 (2000-12-26)	5-18
A	column 3, line 23 -column 4, line 26; figures 1,2	1
Y	----- GEIGER W ET AL: "New designs of micromachined vibrating rate gyroscopes with decoupled oscillation modes" 1997 INTERNATIONAL CONFERENCE ON SOLID-STATE SENSORS AND ACTUATORS. DIGEST OF TECHNICAL PAPERS. TRANSDUCERS 97. CHICAGO, IL, JUNE 16 - 19, 1997. SESSIONS 3A1 - 4D3. PAPERS NO. 3A1.01 - 4D3.14P, INTERNATIONAL CONFERENCE ON SOLID-STATE SENSORS AND ACTU, vol. 2, 16 June 1997 (1997-06-16), pages 1129-1132, XP010240677 ISBN: 0-7803-3829-4 page 1129, right-hand column, paragraph 2 -page 1130, right-hand column, paragraph 3; figures 1,3	5
Y	----- SONG H ET AL: "WAFER LEVEL VACUUM PACKAGED DE-COUPLED VERTICAL GYROSCOPE BY A NEW FABRICATION PROCESS" PROCEEDINGS OF THE IEEE 13TH. ANNUAL INTERNATIONAL CONFERENCE ON MICRO ELECTRO MECHANICAL SYSTEMS. MEMS 2000. MIYAZAKI, JAPAN, JAN. 23-27, 2000, IEEE INTERNATIONAL MICRO ELECTRO MECHANICAL SYSTEMS CONFERENCE, NEW YORK, NY: IEEE, US, 23 January 2000 (2000-01-23), pages 520-524, XP001045370 ISBN: 0-7803-5274-2 page 520, left-hand column, paragraph 4 -page 521, right-hand column, paragraph 1 page 524, left-hand column, paragraph 2; figures 2,9 -----	5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 02/23224

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:

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. Claim : 1 to 4 and 8 to 18

A method for aligning a micro-gyroscope having residual mechanical imbalance.

2. Claim : 5 to 7

A method of tuning the resonance frequency of a micro-gyroscope.

Continuation of Box 3.

Claims Nos.: 1-10, second set

The application came with two sets of claims. The second set of claims (claims 1 to 10) marked "For Foreign Filing" is a repetition of claims 8 to 18 of the first set of claims. Therefore, the second set of claims has not been searched.

The applicant's attention is drawn to the fact that claims, or parts of claims, relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure.

INTERNATIONAL SEARCH REPORT
 Information on patent family members

International Application No
 PCT/US 02/23224

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5992233	A	30-11-1999	AU 3474497 A	05-01-1998
			EP 0902876 A1	24-03-1999
			JP 2002515976 T	28-05-2002
			WO 9745699 A2	04-12-1997
			US 6296779 B1	02-10-2001
			US 6250156 B1	26-06-2001
			US 6067858 A	30-05-2000

US 6032531	A	07-03-2000	NONE	

WO 9745702	A	04-12-1997	US 5894090 A	13-04-1999
			AU 3288097 A	05-01-1998
			EP 0902875 A1	24-03-1999
			WO 9745702 A1	04-12-1997

US 6164134	A	26-12-2000	NONE	
