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US 60/542,896 (CON)  
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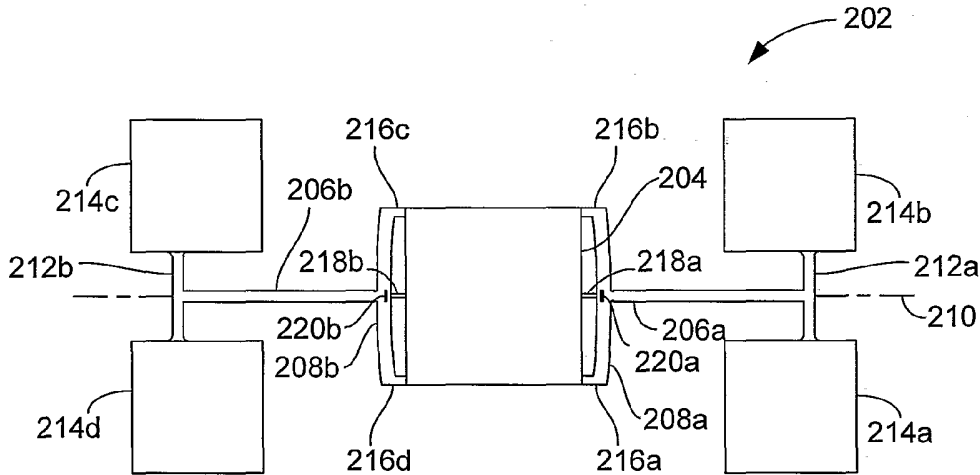
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(54) Title: METHOD AND APPARATUS FOR SCANNING A BEAM OF LIGHT



(57) Abstract: A resonant MEMS scanning system operates a MEMS scanner at its resonant frequency to maximize scan angle and minimize power consumption. A controller includes a phase locked loop, an amplitude servo control loop, and a resonant frequency servo control loop. A microprocessor controls the loops and provides override during conditions such as start-up. Resonant frequency is dynamically thermally trimmed, allowing the device to be operated at higher Q. The phase lock loop operates in a pre-lock condition to allow faster start-up. Resonant frequency is controlled open loop during idle and start-up. Drive voltage is set high during start-up to achieve a rapid rise in scan angle.

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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, IS, IT, LT, 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).

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# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US2005/004067

**A. CLASSIFICATION OF SUBJECT MATTER**  
G02B26/08 B81B3/00

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)  
G02B B81B

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, INSPEC, COMPENDEX

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2003/169055 A1 (KLEMENT MARTIN CHRISTOPHER) 11 September 2003 (2003-09-11) paragraph '0016!	1,14
X	paragraphs '0020! - '0023!, '0027!, '0038!	22-24, 26,27
X	US 2003/122066 A1 (DUNFIELD JOHN C) 3 July 2003 (2003-07-03)  paragraphs '0103!, '0107!, '0116!, '0129!, '0134!, '0143!, '0154! - '0157! figures 13,28	1,2,13, 14,17, 19-21
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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

2 December 2005

Date of mailing of the international search report

14.12.2005

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INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US2005/004067

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 243 186 B1 (MELVILLE CHARLES D) 5 June 2001 (2001-06-05)  column 7, lines 20-61 -----	1,3,4,6, 7,13-15, 25,27, 28,42-44
X	US 5 969 465 A (NEUKERMANS ET AL) 19 October 1999 (1999-10-19) column 5, lines 22-60 column 7, line 53 - column 8, line 43 -----	1,9-12, 14,16
X	US 2002/122217 A1 (NAKAJIMA TOMOHIRO) 5 September 2002 (2002-09-05) -----	1,5,13, 14,17, 18,29, 35,37 3,7
A	paragraphs '0092!, '0095!, '0098!, '0113!, '0114! -----	
A	US 6 360 035 B1 (HURST, JR. JERRY E ET AL) 19 March 2002 (2002-03-19) figures 24,26 -----	1,8
A	US 6 392 220 B1 (SLATER TIMOTHY G ET AL) 21 May 2002 (2002-05-21) column 4, lines 15-21 -----	29
A	US 2003/223679 A1 (MALA MOHIUDDIN ET AL) 4 December 2003 (2003-12-04) paragraph '0036! figure 12 -----	29

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US2005/004067

## 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.:  
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 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 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.

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

1. claims: 1-13,14-21

A method for driving a MEMS scanner comprising the transmission of a resonant frequency control signal.  
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2. claims: 22-28,42-44

A method for driving a MEMS scanner comprising outputting signals from servo loops.  
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3. claims: 29-41

A method for driving a MEMS scanner from the start up.  
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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US2005/004067

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2003169055 A1	11-09-2003	US 2004125198 A1	01-07-2004
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