

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
12 September 2002 (12.09.2002)

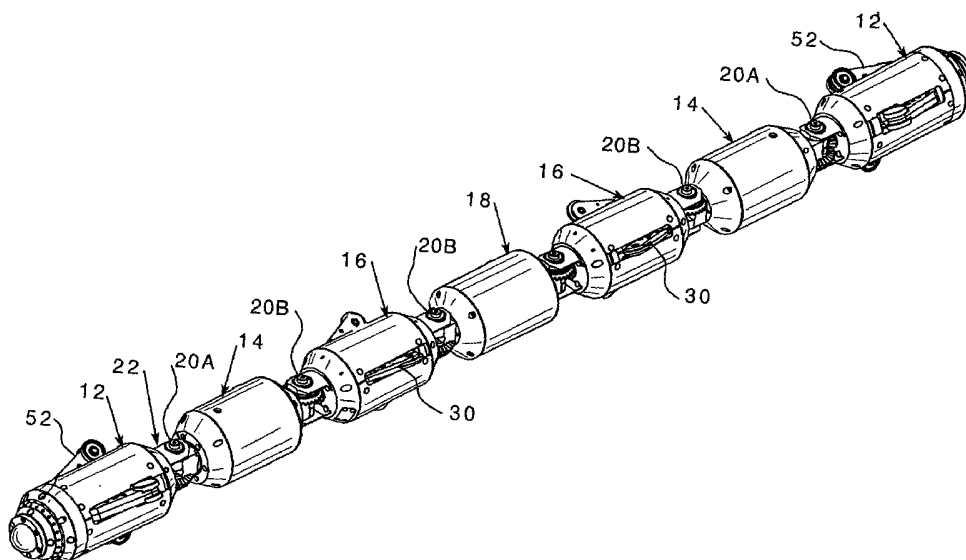
PCT

(10) International Publication Number
WO 02/070943 A3

- (51) International Patent Classification⁷: **F16L 55/32**, G01M 3/00, G01N 27/90, 29/26
- (74) Agents: **ETHRIDGE, Christine, R.** et al.; Kirkpatrick & Lockhart LLP, Henry W. Oliver Building, 535 Smithfield Street, Pittsburgh, PA 15222-2312 (US).
- (21) International Application Number: PCT/US02/09054
- (22) International Filing Date: 7 March 2002 (07.03.2002)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data: 60/273,845 7 March 2001 (07.03.2001) US
- (71) Applicant: **CARNEGIE MELLON UNIVERSITY** [US/US]; 5000 Forbes Avenue, Pittsburgh, PA 15213 (US).
- (72) Inventors: **SCHEMPF, Hagen**; 109 Pheasant Drive, Pittsburgh, PA 15238 (US). **MUTSCHLER, Edward**; 560 Fair Vista Court, Wexford, PA 15090 (US). **GOLTSBERG, Vitaly**; 2945 Perrysville Avenue, Pittsburgh, PA 15214 (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, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).
- Published: — with international search report

[Continued on next page]

(54) Title: GAS MAIN ROBOTIC INSPECTION SYSTEM



(57) Abstract: The present invention provides a long-range, untethered, live, in-pipe inspection system that includes a self-propelled train having a plurality of modules; joint members for interconnecting adjacent modules, data collection components, and wireless communication components for transmitting collected data and receiving control messages. The module-train includes, generally, at least one, and preferably two drive modules (12), at least one power module (14) and an electronics module (18). The train may additionally include at least one support module (16), which may be interposed between the power and electronics modules. In one embodiment of the invention, there are two drive modules (12), one at each terminal end of the train, two power modules (14), one adjacent to each drive module, two support modules (16), one adjacent to each power module, and one central electronics and computing module (18).



WO 02/070943 A3



(88) Date of publication of the international search report:
1 May 2003

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.

(15) Information about Correction:

Previous Correction:

see PCT Gazette No. 05/2003 of 30 January 2003, Section II

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 02/09054

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 F16L55/32 G01M3/00 G01N27/90 G01N29/26

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 F16L G01M G01N

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category ° | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|--|-----------------------|
| X | US 6 107 795 A (SMART ANDREW) 22 August 2000 (2000-08-22) figures column 1, line 14 - line 17 column 3, line 53 - line 59 --- | 1-110 |
| X | US 5 172 639 A (FONTANA RICHARD R ET AL) 22 December 1992 (1992-12-22) column 4, line 6 - line 58; figures 1-4 --- | 1-110 |
| X | WO 98 12418 A (INTELLIGENT INSPECTION CORP CO) 26 March 1998 (1998-03-26) figures 1-3 page 14, line 1 - page 15, line 27 --- | 1-110 |
| A | EP 0 105 418 A (HITZEL RAINER) 18 April 1984 (1984-04-18) page 14, line 28 - line 31; figure 1 --- | 1-110 |
| | -/-- | |

 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

26 November 2002

Date of mailing of the international search report

11.12.02

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

Untermann, N

INTERNATIONAL SEARCH REPORT

Inte al Application No

PCT/US 02/09054

| 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 5 388 528 A (PELRINE RONALD E ET AL) 14 February 1995 (1995-02-14) figures 1,12 column 3, line 32 - line 52 column 6, line 18 - line 25 column 10, line 47 - line 66 ---- | 111-115 |
| X | FR 2 667 519 A (INSPECTRONIC) 10 April 1992 (1992-04-10) figure page 6, line 5 - line 22 ---- | 111-115 |
| A | DE 200 02 929 U (DREIER GERHARD) 5 October 2000 (2000-10-05) page 1, paragraph 7; figure 2 ---- | 111-115 |
| A | DE 196 24 275 A (SIEMENS AG) 9 January 1997 (1997-01-09) column 2, line 56 -column 3, line 4; figure ----- | 111 |

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 02/09054

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: 1-110

a system for inspection of selective conditions in a pipeline in general

2. Claims: 111-115

a system for inspection of selective conditions in a gas pipeline relating to an imaging system

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 02/09054

| Patent document cited in search report | | Publication date | Patent family member(s) | Publication date |
|--|---|------------------|-------------------------|------------------|
| US 6107795 | A | 22-08-2000 | GB 2301187 A | 27-11-1996 |
| | | | CA 2173193 A1 | 23-11-1996 |
| | | | CA 2221379 A1 | 28-11-1996 |
| | | | CA 2341321 A1 | 28-11-1996 |
| | | | DE 69619678 D1 | 11-04-2002 |
| | | | DE 69619678 T2 | 26-09-2002 |
| | | | EP 0840869 A1 | 13-05-1998 |
| | | | WO 9637727 A1 | 28-11-1996 |
| | | | GB 2301414 A ,B | 04-12-1996 |
| | | | GB 2329025 A ,B | 10-03-1999 |
| | | | GB 2334318 A ,B | 18-08-1999 |
| | | | HK 1015154 A1 | 22-09-2000 |
| | | | JP 10509236 T | 08-09-1998 |
| | | | US 6084402 A | 04-07-2000 |
| | | | US 5878783 A | 09-03-1999 |
| | | | US 6031371 A | 29-02-2000 |
| US 5172639 | A | 22-12-1992 | AU 1743892 A | 02-11-1992 |
| | | | WO 9217359 A1 | 15-10-1992 |
| WO 9812418 | A | 26-03-1998 | US 5947213 A | 07-09-1999 |
| | | | AU 738284 B2 | 13-09-2001 |
| | | | AU 4589597 A | 14-04-1998 |
| | | | BR 9706796 A | 04-01-2000 |
| | | | CA 2238334 A1 | 26-03-1998 |
| | | | EP 0862682 A2 | 09-09-1998 |
| | | | NO 982336 A | 22-07-1998 |
| | | | WO 9812418 A2 | 26-03-1998 |
| | | | US 6378627 B1 | 30-04-2002 |
| | | | US 6026911 A | 22-02-2000 |
| | | | US 6431270 B1 | 13-08-2002 |
| | | | US 6112809 A | 05-09-2000 |
| EP 0105418 | A | 18-04-1984 | DE 3236947 A1 | 12-04-1984 |
| | | | AT 27665 T | 15-06-1987 |
| | | | DE 3371955 D1 | 09-07-1987 |
| | | | EP 0105418 A1 | 18-04-1984 |
| US 5388528 | A | 14-02-1995 | US 5284096 A | 08-02-1994 |
| | | | DE 69203671 D1 | 31-08-1995 |
| | | | DE 69203671 T2 | 25-01-1996 |
| | | | EP 0526900 A1 | 10-02-1993 |
| | | | JP 3158187 B2 | 23-04-2001 |
| | | | JP 5185931 A | 27-07-1993 |
| FR 2667519 | A | 10-04-1992 | FR 2667519 A1 | 10-04-1992 |
| DE 20002929 | U | 05-10-2000 | DE 20002929 U1 | 05-10-2000 |
| DE 19624275 | A | 09-01-1997 | DE 29509906 U1 | 17-10-1996 |
| | | | DE 29509907 U1 | 17-10-1996 |
| | | | DE 19624275 A1 | 09-01-1997 |