(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
29 November 2007 (29.11.2007)

PCT

(10) International Publication Number
WO 2007/136353 A1

(51) International Patent Classification:
G06K 7/00 (2006.01) *G06K 19/00* (2006.01)
G01V 15/00 (2006.01)

(21) International Application Number:
PCT/SG2007/000146

(22) International Filing Date: 23 May 2007 (23.05.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
200603483-9 24 May 2006 (24.05.2006) SG

(71) Applicant and
(72) Inventor: **OH CHENG GUAN, Michael** [SG/SG]; Apt Blk 15, Bedok Reservoir Road #14-03, Singapore 478933 (SG).

(74) Agent: **LAWRENCE Y D HO & ASSOCIATES PTE LTD**; 30 Bideford Road #02-02, Thongsia Building, Singapore 229922 (SG).

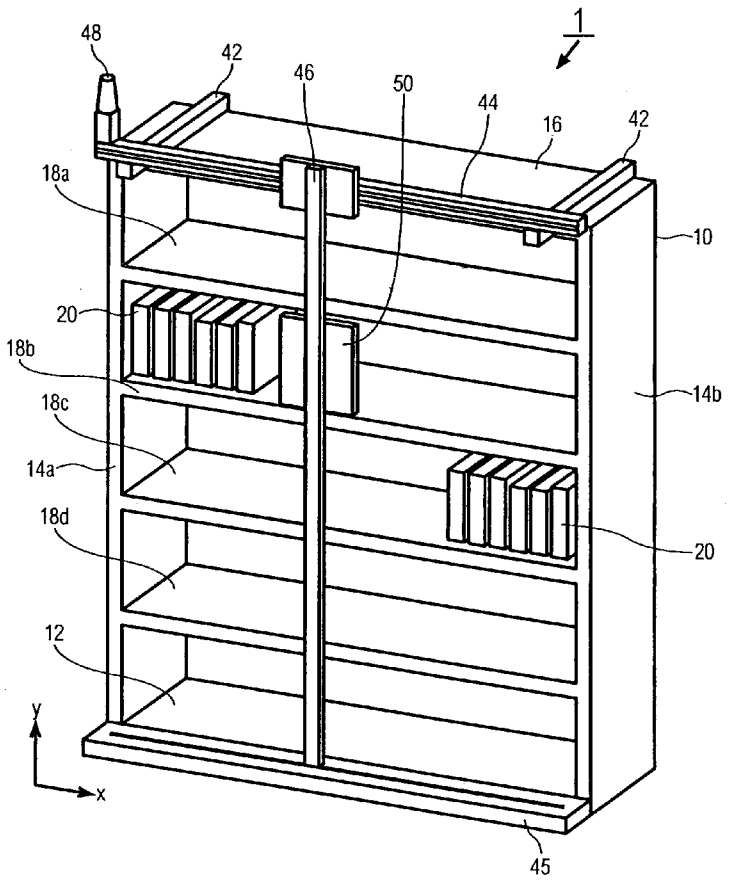
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, 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, 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, MT, 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*

[Continued on next page]

(54) **Title:** MOVABLE RFID READING DEVICE



(57) **Abstract:** The present invention provides a system for tracking RFID tagged articles arranged on a bookshelf or rack. The system comprises a conveyor means coupled to the bookshelf or rack. A RFID reading device is coupled to the conveyor means, where the conveyor means is configured to move the RFID reading device to interrogate the RFID tag on each of the plurality of articles. The system provides a more efficient method of tracking and controlling RFID tagged articles, and it overcomes the problems encountered in known systems using portable RFID scanner and Smart Shelf solutions.

WO 2007/136353 A1

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.

MOVABLE RFID READING DEVICE

Field of the Invention

[0001] The present invention generally relates to Radio Frequency Identification (RFID) technology for inventory systems, and more particularly to a movable RFID reading device for interrogating RFID tagged articles.

Background of the Invention

[0002] Radio Frequency Identification (RFID) technology is increasingly used in inventory management systems to track and control goods or articles. Generally, a RFID tag is attached to an article and it contains the information associated with the article. A RFID reader or scanner is then used to interrogate or scan the tags to capture the stored information of the tag attached to the article.

[0003] Commercial and public environments such as warehouses and libraries are known to implement RFID systems to maintain and control their large inventories of articles or books. However, there are certain limitations in those RFID systems. For example, the RFID systems could only capture the movement of inventoried articles at stations where RFID readers are installed, such as gantry points and check-in/check-out points. Thereafter, the management of the articles depends on the warehouse staff or librarians. In one instance, a particular article within a warehouse or library may be misplaced on the shelf and needs to be located. In another instance, the article must be located for inventory purposes. Typically, warehouse staff and librarians use a handheld portable RFID reader to manually locate the desired article.

[0004] WO 99/05660 discloses a library inventory control system where librarians use portable RFID scanners to perform inventory and verify that articles are placed on the proper shelf. These RFID scanners are coupled to a portable computer that stores the data collected by the RFID scanners. The drawbacks of this inventory control system are that the portable RFID scanner coupled to the computer is costly and cumbersome for the librarians to operate with. Furthermore, the manual inventorying process by librarians is laborious and inefficient. Also, additional manpower is required to perform a massive inventorying of the articles.

[0005] In the present market, some inventory management systems implement Smart Shelf solutions to overcome the drawbacks of manual inventorying process. Basically, the Smart Shelf has integrated antennas in every shelf that interrogates the RFID tagged articles places on the shelf. These integrated antennas are coupled to RFID readers to transmit the data associated from the tags to the RFID readers. Thus, the Smart Shelf performs automatic inventory of the articles and registers any misplaced articles. Although the Smart Shelf addresses the issue of automatic inventorying of articles, it does have certain drawbacks. For example, retrofitting the antennas and readers in each and every shelf is costly and cumbersome. Furthermore, the amount of RF signal generated by the antennas also creates problems such as magnetic field coupling between neighboring antennas, and "blind-spot" reading due to the polarization of tags. It is also difficult to customize the size of antennas to operate properly in different sizes of the shelf. Also, the maintenance of the enormous amount of RFID equipment in the Smart Shelf is costly.

[0006] Therefore, there is an imperative need to have a RFID system that can provide efficient reading of RFID tagged articles and overcome the above-discussed problems. This invention satisfies this need by disclosing RFID system with a movable RFID reader. Other advantages of this invention will be apparent with reference to the detailed description.

Summary of the Invention

[0007] The present invention provides RFID system that provides efficient tracking and controlling of RFID tagged articles arranged in a bookshelf, rack or the like.

[0008] Accordingly, in one aspect, the present invention provides a system for tracking a plurality of articles arranged sequentially, where each of the plurality of articles is attached with a Radio Frequency Identification (RFID) tag that stores the data associated with the article, the system comprising: a RFID reading device configured to interrogate the RFID tag on each of the plurality of articles; and a conveyor means coupled to the RFID reading device, wherein the conveyor means is configured for moving the RFID reading device to each of the plurality of articles, thereby allowing the RFID reading device to interrogate the RFID tag on each of the plurality of articles.

[0009] In another aspect, the present invention provides a method for tracking a plurality of articles arranged sequentially, where each of the plurality of articles is attached

with a Radio Frequency Identification (RFID) tag that stores the data associated with the article, the method comprising the steps of: providing a RFID reading device configured to interrogate the RFID tag on each of the plurality of articles; coupling a conveyor means to the RFID reading device; and driving the conveyor means to move the RFID reading device to each of the plurality of articles, thereby allowing the RFID device to interrogate the RFID tag on each of the plurality of articles.

Brief Description of the Drawings

[0010] Preferred embodiments according to the present invention will now be described with reference to the Figures, in which like reference numerals denote like elements.

[0011] FIG 1 is a perspective view showing a movable RFID reading device coupled to a bookshelf in accordance with one embodiment of the present invention.

[0012] FIG 2 is an elevation view of the movable RFID reading device coupled to the bookshelf in FIG 1.

[0013] FIG 3 is a block diagram illustrating the components of the RFID reading device according to one embodiment of the present invention.

[0014] FIG 4 is an elevation view of a plurality of movable RFID reading devices coupled to a bookshelf in accordance with an alternative embodiment of the present invention.

[0015] FIG 5 is an unassembled perspective view of the system and multiple bookshelves in accordance with an alternative embodiment of the present invention.

Detailed Description of the Invention

[0016] The present invention may be understood more readily by reference to the following detailed description of certain embodiments of the invention.

[0017] FIG 1 and 2 illustrate an inventory system **1** for a library bookshelf **10** and the like. While the present invention is described in a library environment, the scope of the invention includes other environments such as warehouses in which articles are stored in shelves or racks. In a library environment, tracking and controlling books is an extremely labor intensive and error-prone process. Books are often misplaced in the bookshelves and

require manual search and relocation. The system **1** provides a more efficient method of tracking and verifying books placed on a bookshelf **10** by a librarian or user. For illustration purposes, in all the Figures the x-axis represents the horizontal direction and the y-axis represents the vertical direction. However, it is contemplated that the x and y axes are not only limited to horizontal and vertical directions.

[0018] The bookshelf **10** is used for storing books, journals, audio-visual products, and the like. Specifically, the bookshelf **10** comprises a base **12**, a pair of side panels (**14a, 14b**), a top panel **16**, and a plurality of shelves (**18a, 18b, 18c, 18d**). The side panels (**14a, 14b**) are rigidly mounted on the horizontal base **12**, wherein the side panels (**14a, 14b**) extend vertically from the base **12** to the top panel **16**. The plurality of shelves (**18a, 18b, 18c, 18d**) are coupled to the side panels (**14a, 14b**), wherein the plurality of shelves (**18a, 18b, 18c, 18d**) extend horizontally from side panel **14a** to side panel **14b** to support upright books **20** arranged in the typical side-by-side manner. Each book **20** is attached with a Radio Frequency Identification (RFID) tag **22** (not shown) that contains the information associated with the book. The bookshelf **10** may be fabricated in wood, metal or any other suitable bookshelf materials.

[0019] In a first embodiment, the system **1** of comprises a conveyor means **44** that moves a RFID reading device **50** to scan books **20** arranged on the plurality of shelves (**18a, 18b, 18c, 18d**). In particular, the conveyor means **44** is supported by a plurality of support bars **42** mounted on the bookshelf top panel **16**, wherein the conveyor means **44** extends horizontally from side panel **14a** to side panel **14b**. The conveyor means **44** has a longitudinal member **46** that extends vertically from the bookshelf top panel **16** to the base **12**. Furthermore, the conveyor means **44** may be driven by a servo-motor **48**, or the like, to move the member **46** horizontally in x-directions. The conveyor means 44 can also be configured as a sliding rail that enables the member 46 to slide horizontally in x-directions. The RFID reading device **50** is coupled to the member **46**, and can be configured to slide vertically along the member **46** in y-directions. For example in FIG 2, the servo-motor **48** drives the conveyor means **44** to move the RFID reading device **50** across shelf **18b**. In particular, the RFID reading device **50** moves horizontally from position A to position B to interrogate all the tags **22** in the books **20** placed on shelf **18b**. Similarly, the RFID reading device **50** can be moved back from position B to position A. An optional rail **45** may be disposed at base **12** of the bookshelf **10**, wherein the rail **45** is configured to

receive the member **46**. The rail **45** is provided to ensure better stability of the horizontal movement of the member **46**. Furthermore, the RFID reading device **50** is slidable along member **46** to interrogate books **20** place on different shelves (**18a, 18b, 18c, 18d**). For example, the RFID reading device **50** slides vertically from position B to position C to interrogate books placed on shelf **18d**. The above example serves to explain the movement of the RFID reading device **50** and in no way meant to limit the scope of the present invention. It is apparent to one skilled in the art that the movement of the RFID reading device **50** is not limited to the above examples and can include a combination of horizontal and vertical movements as well.

[0020] Besides providing a more efficient method of tracking and verifying books placed on the bookshelf **10**, the system **1** gives an additional advantage of easy implementation on existing bookshelves **10**. Furthermore, some libraries and warehouses have tall bookshelves **10** or racks for storing books **20** or articles. It is be difficult and maybe even hazardous for workers to reach these tall bookshelves **10** or racks. The present invention overcomes this problem by mounting the conveyor means **44** on the bookshelf **10**, thus providing the RFID reading device **50** with the versatility to interrogate books **20** or articles in tall bookshelves **10** or racks.

[0021] The reading cycle of the RFID reading device **50** from position A to B will now be described. As mentioned above, the conveyor means **44** moves the RFID reading device **50** across shelf **18b** horizontally to interrogate all the tags **22** in the books **20** placed on shelf **18b**. In particular, the RFID reading device **50** transmits an interrogation signal when moving across shelf **18b**. The speed of the servo-motor **48** can be pre-determined to ensure that the RFID reading device **50** performs proper interrogation of the tags **22** attached to each book **20**.

[0022] Referring to FIG 3, the RFID reading device **50** comprises an antenna **52**, a RFID reader **54** and a communication device **56**. The antenna **52**, RFID reader **54** and communication device **56** are preferably enclosed in a housing made of plastic materials or the like. The antenna **52** is electrically coupled to the RFID reader **54** for sending interrogation signals to the RFID tags **22** attached in the books **20**. The RFID reader **54** can be a high frequency (HF) reader, ultra-high frequency (UHF) reader, or any other known and unknown frequency readers. The RFID reader **54** may further be a combination of HF and UHF readers or a combination of any other known and unknown frequency

readers. In response to the interrogation signals, the tags **22** sends a response signal that contains the data associated with the books **20**. Each tag **22** is configured to send a unique response signal that contains the data of each book **20**. The RFID reader **54** detects the response signals via the antenna **52**, wherein the RFID reader **54** is configured to decode the response signals to retrieve the data associated with the books **20**. The reading cycle is complete when the RFID reading device **50** finishes interrogating all the tags **22** in the books **20** place along shelf **18b**.

[0023] Subsequently, the RFID reading device **59** slides vertically along member **46** to interrogate books **20** arranged on the other levels of shelf (**18a, 18c, 18d**). For example, it is shown in FIG 2 that the RFID reading device **50** slides from position B to position C. Then the same reading cycle of the RFID reading device **50** is repeated to interrogate tags **22** attached to books **20** arranged on shelf **18d**.

[0024] In addition, the RFID reader **54** is electrically coupled to the communication device **56** to send the data obtained during each reading cycle to a processing computer **60**. The communication device **56** can be a wireless communication device such as Bluetooth or Wireless Fidelity (WIFI). However, it is contemplated that the RFID reader **54** can also be electrically hard-wired to the computer **60**, wherein the RFID reader **54** transmits the data obtained during the reading cycle directly to the computer **60**. The computer **60** can be programmed to send command signals to activate the RFID reader **54**. Furthermore, the computer **60** is coupled to the servo-motor **48** to control the speed of the servo-motor **48** for driving the conveyor means **44**.

[0025] The computer **60** contains a database of the books **20** in the library. In particular, the computer **60** is coupled to all the RFID readers **54** in the library bookshelves **10** to receive the data from the RFID readers **54**. In use, the computer will compare the data received from each RFID reader **54** with the database to check whether there are missing or misplaced books **20** on a particular shelve **18**. The computer then generates a report to alert the library staff of any missing or misplaced books **20** in the bookshelves **10**. Librarians may then use this report to search for misplaced books **20** and relocate them on the correct bookshelves **10**.

[0026] As discussed above, the antenna **52**, RFID reader **54** and communication device **56** of the RFID reading device **50** are preferably enclosed in the same housing. In a second embodiment, the RFID reading device **50** only comprises the antenna **52**. The

RFID reader **54** and communication device **56** is housed in a separate compartment **47** that is disposed on top of the member **46**. By placing the RFID reader **54** and the communication device 56 in the separate compartment **47**, the overall weight of the RFID reading device **50** is reduced. Thus, the mobility of the RFID reading device **50** along the member **46** is improved.

[0027] In a third embodiment, a plurality of RFID reading devices are coupled to the member **46**. FIG 4 shows that the plurality of shelves (**18a, 18b, 18c, 18d**) and base **12** of the bookshelf **10** have corresponding RFID reading devices (**50a, 50b, 50c, 50d, 50e**). Each of the RFID reading devices (**50a, 50b, 50c, 50d, 50e**) comprises an internal antenna **52** for transmitting interrogation signals and receiving response signals. The antennas **52** in the plurality of RFID reading devices (**50a, 50b, 50c, 50d, 50e**) can be coupled to the RFID reader **54** via a multiplexer **58** (not shown). The RFID reader **54** and multiplexer **58** can be housed in the compartment **47**. As mentioned above, the RFID reader **54** is coupled to the communication device **56**, wherein the communication device **56** is also housed in the compartment **47**. An advantage of this embodiment is the use of a single RFID reader **54** coupled to the plurality of RFID reading devices (**50a, 50b, 50c, 50d, 50e**), which significantly reduces the cost of implementing and maintaining the RFID equipment.

[0028] In a reading cycle, the servo-motor **48** drives the conveyor means **44** to move the plurality of RFID reading devices (**50a, 50b, 50c, 50d, 50e**) horizontally across the corresponding shelves (**18a, 18b, 18c, 18d**) and base **12** in x-directions. In this configuration, the plurality of RFID reading devices (**50a, 50b, 50c, 50d, 50e**) provides the efficiency of interrogating all the books **20** stacked in the bookshelf **10** in a single reading cycle. Preferably, the strength of the interrogation signals emanating from the plurality of RFID reading devices (**50a, 50b, 50c, 50d, 50e**) is pre-determined to provide effective interrogation without interference. For example, the RFID reading device **50a** transmits an interrogation signal that is strong enough to interrogate all the tags **22** on shelf **18a** but not the tags **22** on neighboring shelf **18b**. Furthermore, the interrogation signal emanating from the RFID reading device **50a** does not interfere with the interrogation signal emanating from the neighboring RFID reading device **50b**. Alternatively, the plurality of RFID reading devices (**50a, 50b, 50c, 50d, 50e**) are activated alternately to prevent interference of the interrogation signals emanating from the plurality of RFID reading devices. For example, RFID reading devices **50a**, **50c**, and **50e** are activated in one

reading cycle to interrogate the tags **22** on shelves **18a**, **18b** and base **12**. After the reading cycle is complete, RFID reading devices **50b** and **50d** are activated to interrogate the tags **22** on shelves **18b** and **18d**.

[0029] In a fourth embodiment, the system **1** is disposed between two bookshelves **10** and **11** as shown in FIG 5. Bookshelf **11** can either be the same make as bookshelf **10** or different make from bookshelf **10**. Here, the system **1** is the similar to the second embodiment described above. However, the RFID reading device houses two internal antennas **52a** and **52b** (not shown), wherein the antenna **52a** would be activated for bookshelf **10** and antenna **52b** would be activated for bookshelf **10**. In one reading cycle, only one of the antennas **52a** or **52b** would be activated to interrogate the corresponding bookshelf (10, 11). A shield is preferably disposed between the two antennas (**52a**, **52b**) to prevent any back-scatter interference between the two antennas (**52a**, **52b**) during operation. For example, when antenna **52a** is interrogating the tags at bookshelf **10**, the shield will prevent the antenna **52a** to receive signals from the tags **22** on bookshelf **11**.

[0030] Similar to the above discussion, the antennas (**52a**, **52b**) can be coupled to the RFID reader **54** via a multiplexer **58**. The RFID reader **54** and multiplexer **58** can be housed in the compartment **47**. The RFID reader **54** is also coupled to the communication device **56**, wherein the communication device **56** is also housed in the compartment **47**. Alternatively, the plurality of RFID reading devices as discussed above may be implemented in the present embodiment.

[0031] In addition, the support bars **42** are extended to mount the system **1** between the bookshelf **10** and bookshelf **11**. Also, the RFID reading device **50** is housed in a protective enclosure **50**. In the library environment, the RFID reading device **50** may be subject to public interference and vandalism. The protective enclosure **50** prevents library users from meddling with the system **1**, and particularly the RFID reading device **50**. The protective enclosure **50** may be made from plastic or other suitable materials that does not interfere with the RFID reading device **50**.

[0032] While the present invention has been described with reference to particular embodiments, it will be understood that the embodiments are illustrative and that the invention scope is not so limited. Alternative embodiments of the present invention will become apparent to those having ordinary skill in the art to which the present invention pertains. Such alternate embodiments are considered to be encompassed within the spirit

and scope of the present invention. Accordingly, the scope of the present invention is described by the appended claims and is supported by the foregoing description.

CLAIMS

What is claimed is:

1. A system for tracking a plurality of articles arranged sequentially, where each of the plurality of articles is attached with a Radio Frequency Identification (RFID) tag that stores the data associated with the article, the system comprising:

a RFID reading device configured to interrogate the RFID tag on each of the plurality of articles; and

a conveyor means coupled to the RFID reading device, wherein the conveyor means is configured for moving the RFID reading device to each of the plurality of articles, thereby allowing the RFID reading device to interrogate the RFID tag on each of the plurality of articles.

2. The system according to claim 1, wherein the plurality of articles are sequentially arranged in a plurality of shelves of a storage frame, wherein the conveyor means is coupled to the storage frame, and wherein the conveyor means comprises a member disposed on the on the plurality of shelves.

3. The system according to claim 2, wherein the RFID reading device is coupled to the member, wherein the conveyor means moves the member to allow the RFID reading device to interrogate the RFID tag on each of the plurality of articles sequentially arranged on one of the plurality of shelves.

4. The system according to claim 3, wherein the RFID reading device is movable along the member to interrogate the RFID tag on each of the plurality of articles on different shelves

5. The system according to claim 4, wherein the RFID reading device comprises a RFID antenna for sending an interrogation signal to the RFID tag to obtain a response signal from the RFID tag, wherein the response signal contains the data associated with the article.

6. The system according to claim 5, wherein the RFID antenna is coupled to a RFID reader, wherein the RFID reader decodes the response signal received by the RFID antenna to obtain the data associated with the article.

7. The system according to claim 6, wherein the RFID reader is coupled to a computer that processes the data associated with the article.

8. The system according to claim 7 further comprising a communication device coupled to the RFID reader, wherein the communication device is configured to transfer the data associated with the article to the computer.

9. The system according to claim 8, wherein the communication device can be a wireless communication device such as Bluetooth or Wireless Fidelity (WiFi).

10. The system according to claim 3, wherein the conveyor means can be a sliding rail, wherein the member is slidable along the sliding rail to allow the RFID reading device to interrogate the RFID tag on each of the plurality of articles sequentially arranged on one of the plurality of shelves.

11. The system according to claim 2, wherein a plurality of RFID reading devices is mounted on the member, wherein the conveyor means moves the member to allow the plurality of RFID reading devices to interrogate the RFID tag on each of the plurality of articles sequentially arranged on the plurality of shelves.

12. The system according to claim 11, wherein each of the plurality of RFID reading devices comprises a RFID antenna for sending an interrogation signal to the RFID tag to obtain a response signal from the RFID tag, wherein the response signal contains the data associated with the article.

13. The system according to claim 12, wherein the RFID antenna in each of the plurality of RFID reading devices is coupled to a RFID reader, wherein the RFID reader decodes the response signal received by the RFID antenna to obtain the data associated with the article.

14. The system according to claim 13, wherein RFID antenna in each of the plurality of RFID reading devices is coupled to a RFID reader via a multiplexer.

15. The system according to claim 14, wherein the RFID reader is coupled to a computer that processes the data associated with the article.

16. The system according to claim 14 further comprising a communication device coupled to the RFID reader, wherein the communication device is configured to transfer the data associated with the article to the computer.

17. The system according to claim 16, wherein the communication device can be a wireless communication device such as Bluetooth or Wireless Fidelity (WiFi).

18. The system according to claim 11, wherein the conveyor means can be a sliding rail, wherein the member is slidable along the sliding rail to allow the plurality of RFID reading devices to interrogate the RFID tag on each of the plurality of articles sequentially arranged on the plurality of shelves.

19. A method for tracking a plurality of articles arranged sequentially, where each of the plurality of articles is attached with a Radio Frequency Identification (RFID) tag that stores the data associated with the article, the method comprising the steps of:

providing a RFID reading device configured to interrogate the RFID tag on each of the plurality of articles;

coupling a conveyor means to the RFID reading device; and

driving the conveyor means to move the RFID reading device to each of the plurality of articles, thereby allowing the RFID device to interrogate the RFID tag on each of the plurality of articles.

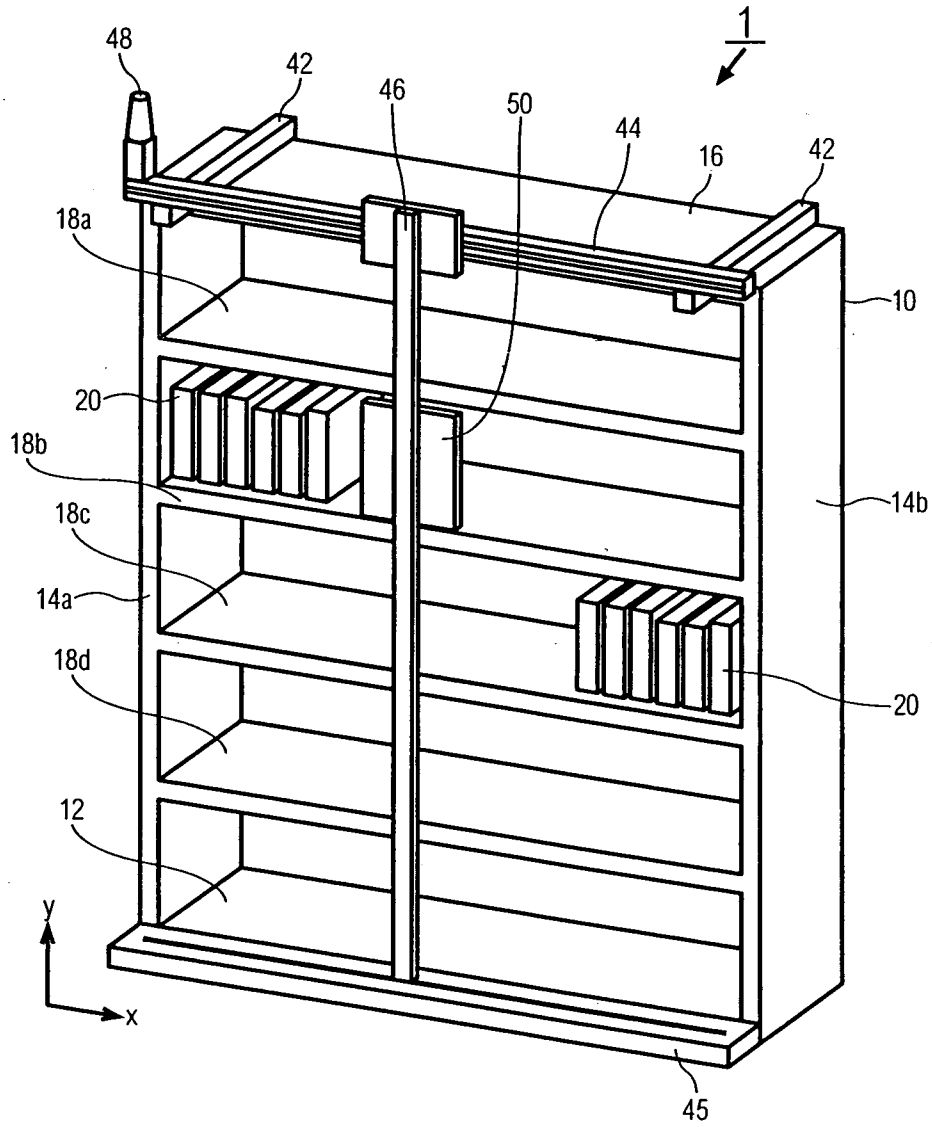


FIG. 1

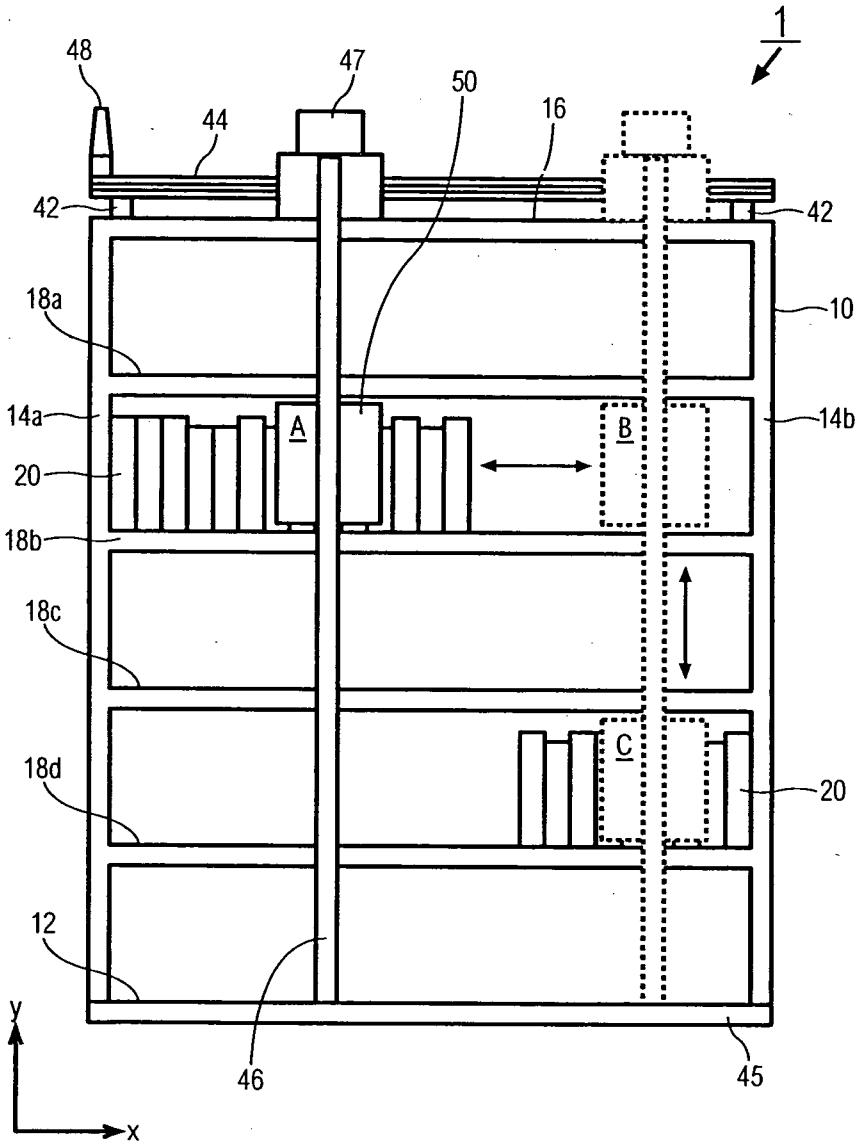

1
48
47
50
16
44
42
42
18a
10
14a
A
B
14b
20
18b
18c
C
18d
20
12
46
45
y
x

FIG. 2

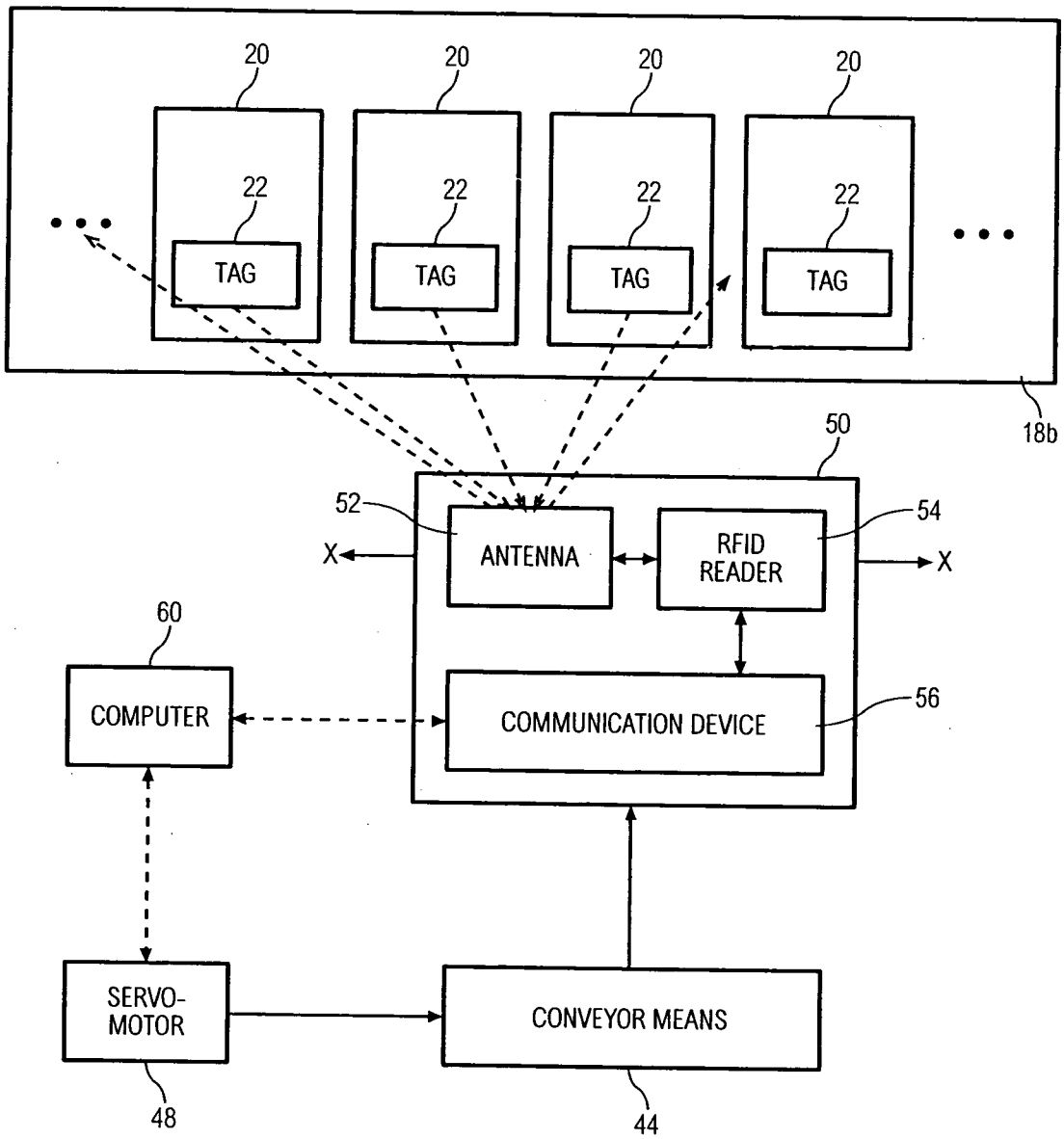

20
20
20
20
22
22
22
22
TAG
TAG
TAG
TAG
18b
50
52
54
X
ANTENNA
RFID READER
X
60
COMPUTER
COMMUNICATION DEVICE
56
SERVO-MOTOR
CONVEYOR MEANS
48
44

FIG. 3

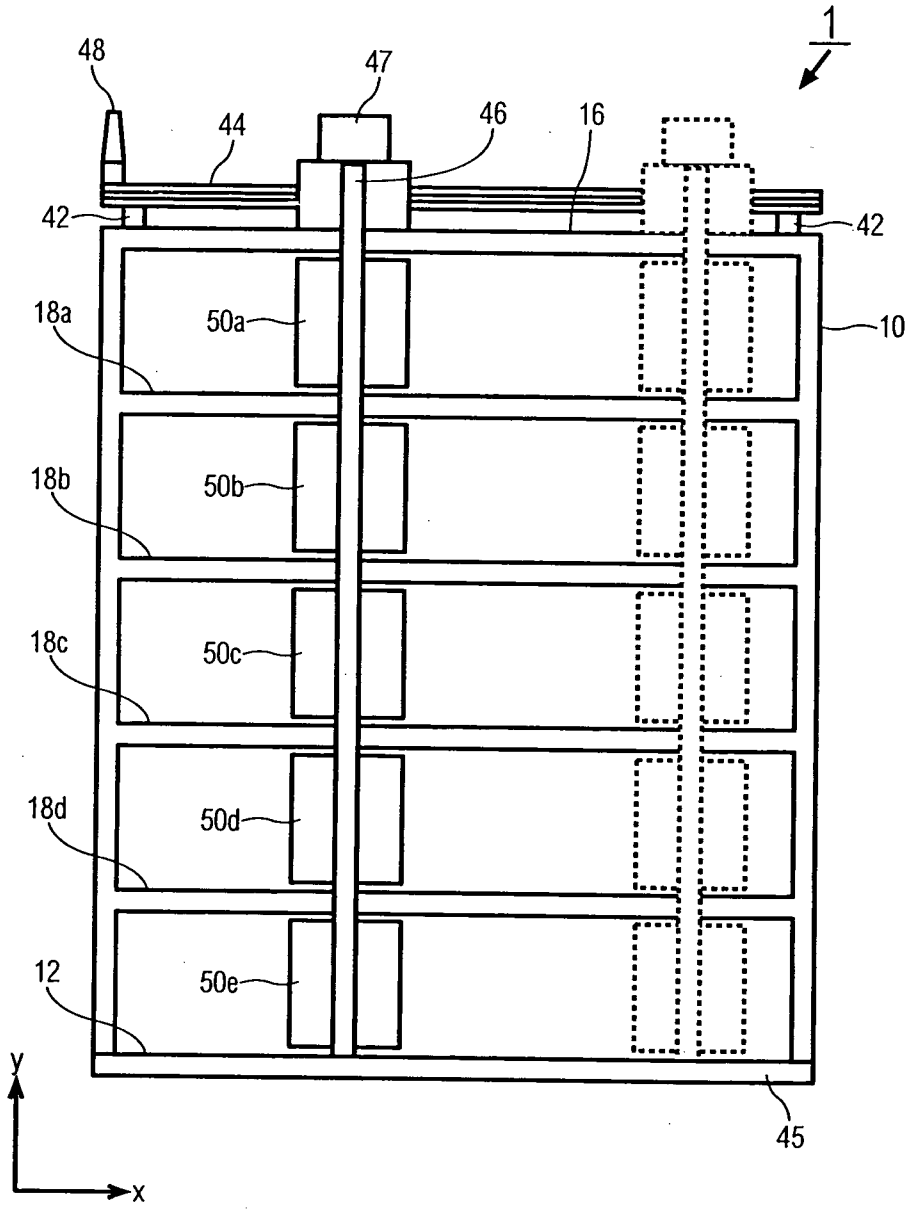

1
48
47
44
46
16
42
42
18a
50a
10
18b
50b
18c
50c
18d
50d
12
50e
y
x
45

FIG. 4

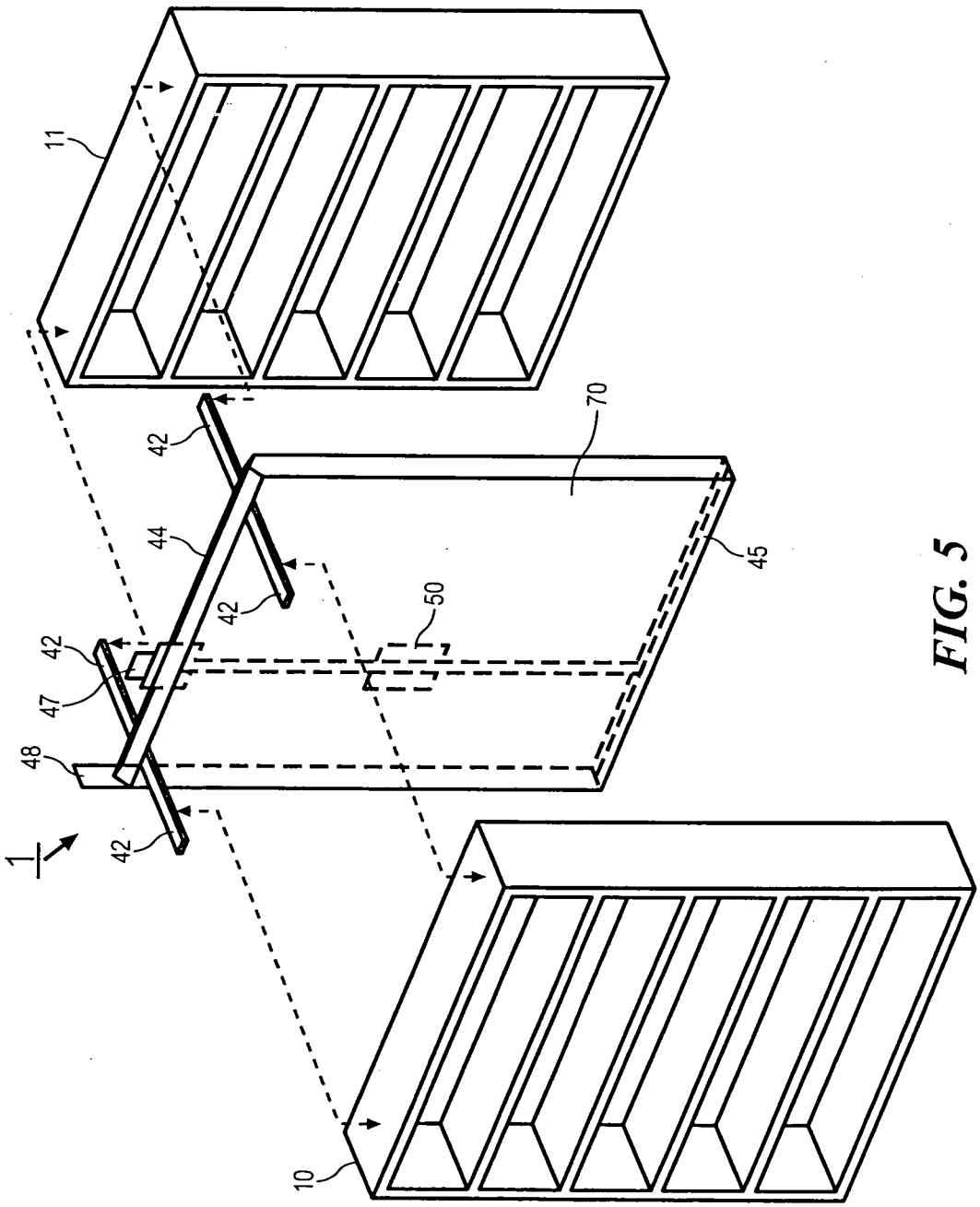


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SG2007/000146

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

G06K 7/00 (2006.01) ***G01V 15/00*** (2006.01) ***G06K 19/00*** (2006.01)

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)

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 practicable, search terms used)
DWPI, Patent Lens, Esp@cenet, PCT Gazette "labels, tags, barcodes, rfid, scan, track etc."

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6600418 B2 (FRANCIS et al.) 29 July 2003 Entire document.	1,19
X	US 2006/0092014 A1 (ONDERKO et al.) 4 May 2006 Paragraph 45 and figure 1.	1,19
P,X	WO 2006/104636 A1 (VARIAN, INC.) 5 October 2006 Figure 1, paragraph 38, 40, 41 and 47 to 49.	1,19
X	AU 200127689 B2 (3M INNOVATIVE PROPERTIES COMPANY) 24 July 2001 Figure 6 and page 1 lines 9 to 16.	1,19

[X] Further documents are listed in the continuation of Box C [X] 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 application or patent 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	Date of mailing of the international search report
03 August 2007	9 - AUG 2007
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer **P. THONG** AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : (02) 6283 2128

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SG2007/000146

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 2005/0246248 A1 (VESUNA) 3 November 2005 Entire document.	1,19
Y	US 6535790 B2 (NAKANO et al.) 18 March 2003 Entire document.	1,19
Y	WO 2003/061366 A2 (MEADWESTVACO CORPORATION) 31 July 2003 Paragraph 27 in particular.	1,19

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/SG2007/000146

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	2005246248	EP	1756763	WO	2005109280		
US	6535790	DE	10108288	JP	2001233405	US	2001020197
WO	2006104636	US	2006213964	US	2006283945		
US	2006092014	EP	1805688	US	7221269	US	2006290472
		WO	2006049659				
US	6600418	AR	031656	AU	59116/01	CA	2431878
		CN	1479908	EP	1342207	MX	PA03005035
		NZ	526107	US	2002070862	WO	0248955
WO	03061366	AU	2003209188	CA	2473136	CA	2474254
		CN	1639913	CN	1643731	EP	1468473
		EP	1470613	EP	1793326	MX	PA04006667
		MX	PA04007066	RU	2004124049	RU	2004125583
		US	7084769	US	2003174099	US	2003216969
		US	2006232382	US	2006238307	WO	03061060
AU	200127689	WO	2001/052179	US	7161470	EP	1247249

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX