(54) Title: NEEDLE HUB AND DISPOSAL DEVICE FOR SINGLE-USE NEEDLE ASSEMBLIES

(57) Abstract: Described is a needle hub (1) comprising a proximal end (1.1.4) adapted to engage a medicament delivery device (2), a distal end (1.1.1) having an opening (1.1.1.1), a shoulder (1.1.5) disposed between the proximal end (1.1.4) and the distal end (1.1.1), 5 and a needle assembly engagement mechanism (Fi) coupled to the shoulder (1.1.5) and adapted to releasably engage a needle assembly (3). The needle assembly engagement mechanism (Fi) includes two or more resilient arms (1.1.2) adapted to releasably engage a retainer element (3.3) on the needle assembly (3).

FIG 1
Declarations under Rule 4.17:

— of inventorship (Rule 4.17(iv))
Needle Hub and Disposal Device for Single-Use Needle Assemblies

Technical Field

The invention relates to a needle hub for single-use needles and a disposal device for used single-use needle assemblies.

Background of the Invention

Patients suffering from diseases like diabetes have to frequently self-administer injections. Injection devices like auto-injectors or pen injectors have been developed to facilitate self-administering injections. Typically, such injection devices are fitted with a sterile, disposable needle assembly for each injection to minimize the risk of infections.

A conventional needle assembly consists of a hub for engaging the injection device, a double-tipped needle coupled to the hub, and a spring-biased needle shield for hiding the needle from view and covering an injection end of the needle after the injection. The conventional needle assembly also includes a protective cap to maintain sterility of the needle and prevent against inadvertent actuation. Conventional needle assemblies are often packaged loosely in boxes. Thus, a patient is required to carry a box of the needle assemblies (and a sharps disposal unit) when travelling. Similarly, loosely packing the needle assemblies does not optimally use packing space available. Thus, there is a need for a single-use needle assembly.

Further, a conventional needle assembly typically engages the injection device by threads, requiring the patient to manually engage and disengage the needle assembly and the injection device. However, it may present an injury risk if the patient is required to manually remove a single-use needle, and in any event, it may be difficult for the patient (especially if the patient has dexterity or vision problems) to manipulate the single-use needle. Thus, there is a need for a disposal device for single-use needles.

Summary of the Invention
It is an object of the present invention to provide a needle hub for single-use needle assemblies.

It is a further object of the present invention to provide a disposal device for single-use needle assemblies that minimizes the risk of accidental needle stick injuries.

In an exemplary embodiment, a needle hub according to the present invention comprises a proximal end adapted to engage a medicament delivery device, a distal end having an opening, a shoulder disposed between the proximal end and the distal end, and a needle assembly engagement mechanism coupled to the shoulder and adapted to releasably engage a needle assembly. The needle assembly engagement mechanism includes two or more resilient arms adapted to releasably engage a retainer element on the needle assembly. In an exemplary embodiment, the proximal end includes a screw thread.

In an exemplary embodiment, the arms include notches adapted to engage the retainer element when the arms are in a non-deflected position.

In an exemplary embodiment, a channel having a first diameter is disposed between the arms. An aperture having a second diameter is formed at a distal end of the arms, wherein the second diameter is greater than the first diameter.

In an exemplary embodiment, the needle hub further comprises a spring disposed between the arms and grounded proximally on the shoulder. The spring is grounded distally on the notches when the arms are in the non-deflected position.

In an exemplary embodiment, the needle hub further comprises a needle having a distal tip and a proximal tip. The retainer element is disposed on the needle. The retainer element has a distal part with a third diameter and a proximal part with a fourth diameter. The third diameter is greater than the fourth diameter. The third diameter is substantially equal to the second diameter and the fourth diameter is substantially equal...
to the first diameter. The fourth diameter is less than a diameter of the spring. When
the needle assembly is retained in the needle hub, the retainer element abuts the distal
part of the retainer element abuts the notches.

In an exemplary embodiment, a needle assembly disposal device according to the
present invention comprises a housing having a cavity therein, an interface disposed on
the housing and having an opening adapted to receive the needle hub, a stem adapted
to engage the arms, and a flexible membrane disposed adjacent a base of the stem.
The membrane has an expandable aperture. The interface includes alignment features
adapted to align the needle hub with the stem.

In an exemplary embodiment, the needle assembly disposal device further comprises a
spring applying a biasing force to the stem. The spring is grounded distally on the
housing and proximally on a connector coupled to the stem.

In an exemplary embodiment, the needle assembly disposal device further comprises a
deflector disposed within the housing and aligned with the stem.

Further scope of applicability of the present invention will become apparent from the
detailed description given hereinafter. However, it should be understood that the
detailed description and specific examples, while indicating preferred embodiments of
the invention, are given by way of illustration only, since various changes and
modifications within the spirit and scope of the invention will become apparent to those
skilled in the art from this detailed description.

Brief Description of the Drawings

The present invention will become more fully understood from the detailed description
given hereinbelow and the accompanying drawings which are given by way of
illustration only, and thus, are not limitive of the present invention, and wherein:
Figure 1 shows schematically a sectional view of an exemplary embodiment of a needle hub according to the present invention.

Figure 2 shows schematically a top view of an exemplary embodiment of a needle hub according to the present invention.

Figure 3 shows schematically a sectional view of a part of an exemplary embodiment of a needle assembly disposal device according to the present invention.

Figure 4 shows a sectional view of a part of an exemplary embodiment of a needle assembly disposal device according to the present invention.

Figure 5 shows a sectional view of a part of another exemplary embodiment of a needle assembly disposal device according to the present invention.

Corresponding parts are marked with the same reference symbols in all figures.

Detailed Description

Figures 1 and 2 show an exemplary embodiment of a needle hub 1 according to the present invention. The needle hub 1 includes a housing 1.1 which is adapted to engage a medicament delivery device 2. The delivery device 2 may a pen injector, an autoinjector, a syringe, etc. In another exemplary embodiment, the needle hub 1 may be formed integrally with the delivery device 2.

The needle hub 1 is adapted to engage a needle assembly 3 which holds a needle 3.1. In an exemplary embodiment, the needle assembly 3 is a single-use needle assembly which is coupled to the needle hub 1 before use and removed from the needle hub 1 after use. In an exemplary embodiment, the needle assembly 3 includes a retainer element 3.3 which is adapted to engage the needle hub 1. The retainer element 3.3 may include a distal part 3.3.1 having a substantially conical shape and a proximal
part 3.3.2 having a substantially cylindrical shape. In an exemplary embodiment, the distal part 3.3.1 has a larger diameter than the proximal part 3.3.2. Those of skill in the art will understand that the retainer element 3.3 may have different sizes and geometries.

In an exemplary embodiment, the housing 1.1 is a hollow cylinder comprising a distal end 1.1.1 and a proximal end 1.1.4, and a shoulder 1.1.5 formed therebetween. The distal end 1.1.1 includes an opening 1.1.1.1 through which a distal tip 3.1.1 of the needle 3.1 protrudes when the needle assembly 3 is coupled to the needle hub 1. The proximal end 1.1.4 includes a coupling arrangement for engaging the delivery device 2. For example, the coupling arrangement may be a screw thread 1.1.6 which is adapted to engage a corresponding screw thread 2.1 on the delivery device 2. In other exemplary embodiments, the coupling arrangement may include a bayonet coupling, a snap-fit, a friction fit, etc. A proximal tip 3.1.2 of the needle 3.1 is adapted to be inserted into a cartridge or container containing the medicament in the delivery device 2 when the needle hub 1 is coupled to the delivery device 2. When the needle hub 1.1 is coupled to the delivery device 2, the shoulder 1.1.5 may abut a distal end of the delivery device 2.

In an exemplary embodiment, the needle hub 1 includes a needle assembly engagement mechanism F1 adapted to releasably engage the needle assembly 3. The needle assembly engagement mechanism F1 includes two or more resilient arms 1.1.2 disposed on the housing 1.1 and extending in a distal direction D from the shoulder 1.1.5. In a first (non-deflected state), distal ends of the arms 1.1.2 form an aperture 1.1.2.1 adapted to receive the needle assembly 3. When engaging the needle assembly 3 to the needle hub 1, the needle assembly 3 is pushed into engagement with the arms 1.1.2, and the retainer element 3.3 causes the arms 1.1.2 to deflect radially. When the retainer element 3.3 reaches notches formed in the arms 1.1.2, the arms 1.1.2 return to their non-deflected position and engage the needle assembly 3. For example, as shown in Figure 1, the notches abut the distal part 3.3.1 of the retainer element 3.3.
In an exemplary embodiment, the needle hub 1 further includes a spring 1.2 adapted to apply a biasing force to the needle assembly 3 when it is coupled to the needle hub 1. The spring 1.2 may be disposed in a channel 1.1.3 between the arms 1.1.2. In an exemplary embodiment, a diameter of the channel 1.1.3 is less than a diameter of the aperture 1.1.2.1 to facilitate insertion of the needle assembly 3 into the needle hub 1. The spring 1.2 may be grounded distally on the notches in the arms 1.1.2 and proximally on a bearing surface 1.1.5.1 on the shoulder 1.1.5. As shown in Figure 1, the bearing surface 1.1.5.1 includes a through hole for allowing the proximal tip 3.1.2 of the needle 3.1 to pass through when the needle assembly 3 is coupled to the needle hub 1.

When the needle assembly 3 is coupled to the needle hub 1, the retainer element 3.3 may engage and compress the spring 1.2. For example, the proximal part 3.3.2 of the retainer element 3.3 may fit axially within coils of the spring 1.2, and the distal part 3.3.1 may bear on the spring 1.2. Thus, when the needle assembly 3 is coupled to the needle hub 1, as shown in Figure 1, the spring 1.2 may apply a biasing force in the distal direction on the needle assembly 3.

In another exemplary embodiment, the spring 1.2 may be part of the needle assembly 3. For example, the proximal part 3.3.2 of the retainer element 3.3 may be formed as the spring 1.2, e.g. one moulded part, especially injection-moulded part made from polypropylene.

Figure 4 shows an exemplary embodiment of a needle assembly disposal device 4 according to the present invention. The disposal device 4 is formed as a container having a housing 4.1. The housing 4.1 includes an interface 4.2 adapted to disengage the needle assembly 3 from the needle hub 1. In an exemplary embodiment, the interface 4.2 includes an opening 4.3 adapted to receive the needle hub 1. The interface 4.2 may further include alignment features adapted to abut an outer surface of the housing 1.1 of the needle hub 1 so that the needle hub 1 and the needle assembly 3 are properly oriented on the disposal device 4.
When the needle hub 1 is inserted into the opening 4.3, the distal tip 3.1 of the needle 3.1 passes through a stem 4.4 disposed over an opening to a cavity 4.6 in the disposal device 4. A base of the stem 4.4 may at least partially covered by a flexible membrane 4.5 having an expandable aperture initially sized to receive the needle 3.1 but expandable to receive the retainer element 3.3.

As the needle hub 1 is further inserted into the opening 4.3, the stem 4.4 is inserted into aperture 1.1.2.1 and then the channel 1.1.3 between the arms 1.1.2, causing the arms 1.1.2 to deflect radially. As the arms 1.1.2 deflect, the notches release the retainer element 3.3, and the biasing force of the spring 1.2 pushes the needle assembly 3 in the distal direction relative to the needle hub 1. The force of the spring 1.2 pushes the needle assembly 3 through the membrane 4.5 and into the cavity 4.6. The retainer element 3.3 may cause the membrane 4.5 to deflect in the distal direction, stretching and expanding the aperture in the membrane 4.5 and allowing the retainer element 3.3 to pass through. Once the retainer element 3.3 has passed through the aperture in the membrane 4.5, the aperture may return to its initial size and prevent the needle assembly 3 from through the membrane in the proximal direction because the membrane 4.5 cannot deflect in the proximal direction (it will abut the housing 4.1).

Figure 5 shows another exemplary embodiment of a needle assembly disposal device 5 according to the present invention. The disposal device 5 is formed as a container having a housing 5.1. The housing 5.1 includes an interface adapted to disengage the needle assembly 3 from the needle hub 1. In an exemplary embodiment, the interface includes an opening 5.3 adapted to receive the needle hub 1. The interface may further include alignment features adapted to abut an outer surface of the housing 1.1 of the needle hub 1 so that the needle hub 1 and the needle assembly 3 are properly oriented on the disposal device 5.

When the needle hub 1 is inserted into the opening 5.3, the distal tip 3.1 of the needle 3 passes through a stem 5.4 disposed over an opening to a cavity 5.6 in the disposal device 5. A base of the stem 5.4 may be at least partially covered by a flexible membrane 5.5 having an expandable aperture initially sized to receive the stem 5.4.
In this exemplary embodiment, the stem 5.4 may be coupled to the housing 5.1 via a spring 5.7 which is ground distally on the housing 5.1 and proximally on a connector 5.9 which is coupled to the stem 5.4. The spring 5.7 may be disposed in a cavity 5.8 formed on a surface of the housing 5.1. The spring 5.7 may apply a force on the connector 5.9 to bias the stem 5.4 in the proximal direction.

As the needle hub 1 is further inserted into the opening 5.3, the distal end 1.1.1 of the housing 1.1 abuts the connector 5.9, pushing the stem 5.4 in the distal direction and compressing the spring 5.7. When the stem 5.4 abuts the housing 5.1, the stem 5.4 is inserted into aperture 1.1.2.1 and then the channel 1.1.3 between the arms 1.1.2, causing the arms 1.1.2 to deflect radially. As the arms 1.1.2 deflect, the notches release the retainer element 3.3, and the biasing force of the spring 1.2 pushes the needle assembly 3 in the distal direction relative to the needle hub 1. The force of the spring 1.2 pushes the needle assembly 3 through the stem 5.4 and into the cavity 5.6. The stem 5.4 may cause the membrane 5.5 to deflect in the distal direction, stretching and expanding the aperture in the membrane 5.5 and allowing the stem 5.4 to pass through. Once the needle hub 1 has been removed from the disposal device 5, the stem 5.4 may return to an extended position under the biasing force of the spring 5.7, and the aperture in the membrane 5.5 may return to its initial size and prevent the needle assembly 3 from through the membrane in the proximal direction because the membrane 5.5 cannot deflect in the proximal direction (it will abut the housing 5.1).

Those of skill in the art will understand that the needle assembly disposal devices 4, 5 allow a removal of used needle assemblies 3 safely and easily from the needle hub 1 and reliably stow them away to protect users from needle sticks or accidental re-use of used needles 3.1 by which a transfer of diseases such as Hepatitis or HIV is possible.

Figure 3 show an exemplary embodiment of a deflector that may be utilized within a housing 4.1, 5.1 of a needle assembly disposal device 4, 5. The deflector may be a conical protrusion which is disposed underneath the interface 4.2. After the needle assembly 3 disengages the needle hub 1, the distal tip 3.1.1 of the needle 3.1 impacts
the deflector and causes the needle assembly 3 to be disposed at an angle in the disposal device 4, 5. Thus, the deflector may prevent used needle assemblies in the disposal device from blocking other used needle assemblies from being disposed in the disposal device.

Those of skill in the art will understand that modifications (additions and/or removals) of various components of the apparatuses, methods and/or systems and embodiments described herein may be made without departing from the full scope and spirit of the present invention, which encompass such modifications and any and all equivalents thereof.
Claims

1. A needle hub (1) comprising:
   a proximal end (1.1.4) adapted to engage a medicament delivery device (2);  
   a distal end (1.1.1) having an opening (1.1.1.1);  
   a shoulder (1.1.5) disposed between the proximal end (1.1.4) and the distal end (1.1.1); and  
   a needle assembly engagement mechanism (F1) coupled to the shoulder (1.1.5) and adapted to releasably engage a needle assembly (3), the needle assembly engagement mechanism (F1) including two or more resilient arms (1.1.2) adapted to releasably engage a retainer element (3.3) on the needle assembly (3).

2. The needle hub (1) according to claim 1, wherein the proximal end (1.1.4) includes a screw thread (1.1.6).

3. The needle hub (1) according to any one of the preceding claims, wherein the arms (1.1.2) include notches adapted to engage the retainer element (3.3) when the arms (1.1.2) are in a non-deflected position.

4. The needle hub (1) according to any one of the preceding claims, wherein a channel (1.1.3) having a first diameter is disposed between the arms (1.1.2).

5. The needle hub (1) according to claim 4, wherein an aperture (1.1.2.1) having a second diameter is formed at a distal end of the arms (1.1.2), wherein the second diameter is greater than the first diameter.

6. The needle hub (1) according to any one of the preceding claims, further comprising:  
   a spring (1.2) disposed between the arms (1.1.2) and grounded proximally on the shoulder (1.1.5).
7. The needle hub (1) according to claims 3 and 6, wherein the spring (1.2) is grounded distally on the notches when the arms (1.1.2) are in the non-deflected position.

8. A needle assembly (3) for use with the needle hub (1) according to any of the preceding claims, the needle assembly (3) comprising:
   a needle (3.1) having a distal tip (3.1.1) and a proximal tip (3.1.2);
   wherein the retainer element (3.3) is disposed on the needle (3.1),
   wherein the retainer element (3.3) has a distal part (3.3.1) with a third diameter and a proximal part (3.3.2) with a fourth diameter, wherein the third diameter is greater than the fourth diameter.

9. The needle assembly (3) according to claims 5 and 8, wherein the third diameter is substantially equal to the second diameter and the fourth diameter is substantially equal to the first diameter.

10. The needle assembly (3) according to claims 5, 7 and 8, wherein the fourth diameter is less than a diameter of the spring (1.2).

11. The needle assembly (3) according to claims 3 and 8, wherein, when the needle assembly (3) is retained in the needle hub (1), the retainer element (3.3) abuts the distal part (3.3.1) of the retainer element (3.3) abuts the notches.

12. A needle assembly disposal device (4, 5) for use with the needle hub (1) according to any of claims 1 through 7, the disposal device (4, 5) comprising:
   a housing (4.1, 5.1) having a cavity therein;
   an interface (4.2) disposed on the housing (4.1, 5.1) and having an opening (4.3, 5.3) adapted to receive the needle hub (1);
   a stem (4.4, 5.4) adapted to engage the arms (1.1.2); and
   a flexible membrane (4.5, 5.5) disposed adjacent a base of the stem (4.4, 5.4),
   the membrane having an expandable aperture.
13. The needle assembly disposal device (4, 5) according to claims 4 and 12, wherein the interface (4.2) includes alignment features adapted to align the needle hub (1) with the stem (4.4, 5.4).

14. The needle assembly disposal device (5) according to claim 12, further comprising:
   a spring (5.7) applying a biasing force to the stem (5.4), the spring (5.7) grounded distally on the housing (5.1) and proximally on a connector (5.9) coupled to the stem (5.4).

15. The needle assembly disposal device (4, 5) according to claim 12, further comprising:
   a deflector disposed within the housing (4.1, 5.1) and aligned with the stem (4.4, 5.4).
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

INV. A61M5/32

ADD.

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)

A61M

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)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>wo 01/93924 AI (MDC INVEST HOLDINGS INC [US]; HALSHE THOR R [US]; MCWETHY ROBERT T [U]) 13 December 2001  (2001-12-13) abstract; figures 1-5, 3</td>
<td>1</td>
</tr>
<tr>
<td>Y</td>
<td>EP 0 787 501 A2 (TERUMO CORP [JP]) 6 August 1997 (1997-08-06) abstract; figures 9-11</td>
<td>2-15</td>
</tr>
<tr>
<td>Y</td>
<td>US 2008/255514 AI (CRAPSEY ANDREW CHASE [US]) 16 October 2008 (2008-10-16) abstract; figures 5-11</td>
<td>2-15</td>
</tr>
<tr>
<td>Y</td>
<td>wo 2004/030539 AI (GREINER BIO ONE GMBH [AT]; KONRAD FRANZ [AT]) 15 April 1 2004 (2004-04-15) abstract; figure 11</td>
<td>2-15</td>
</tr>
</tbody>
</table>

Further documents are listed in the continuation of Box C. 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

*A* document member of the same patent family

Date of the actual completion of the international search

17 January 2013

Date of mailing of the international search report

24/01/2013

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016

Authorized officer

Ehrsam, Fernand

Form PCT/ISA/210 (second sheet) (April 2006)
<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td>WO 0193924 A1</td>
<td>13-12-2001</td>
<td>AU 6972801 A</td>
<td>17-12-2001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BR 0111470 A</td>
<td>25-02-2004</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CA 2412308 A1</td>
<td>13-12-2001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CN 1447703 A</td>
<td>08-10-2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CN 1966099 A</td>
<td>23-05-2007</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DE 60126085 T2</td>
<td>16-08-2007</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ES 2280381 T3</td>
<td>16-09-2007</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP 4833488 B2</td>
<td>07-12-2011</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP 2003534878 A</td>
<td>25-11-2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MX PA02012016 A</td>
<td>19-08-2004</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US RE431411 E1</td>
<td>24-01-2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 6524276 B1</td>
<td>25-02-2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 2003105432 A1</td>
<td>05-06-2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WO 0193924 A1</td>
<td>13-12-2001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 0787501 A2</td>
<td>06-08-1997</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DE 69720570 DI</td>
<td>15-05-2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DE 69720570 T2</td>
<td>27-11-2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 0787501 A2</td>
<td>06-08-1997</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 2008255514 A1</td>
<td>16-10-2008</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>WO 2004030539 A1</td>
<td>15-04-2004</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AT 413648 B</td>
<td>15-04-2006</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AU 2003265711 A1</td>
<td>23-04-2004</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CA 2500654 A1</td>
<td>15-04-2004</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 1549215 A1</td>
<td>06-07-2005</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 2005288607 A1</td>
<td>29-12-2005</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WO 2004030539 A1</td>
<td>15-04-2004</td>
</tr>
</tbody>
</table>