Abstract:
The invention concerns a rock bolt intended to be inserted and fixed in a drill hole (2) by being embedded in grout (4), and comprising an anchor rod (5) formed as an extended cylindrical solid part of ribbed steel type with radially protruding interaction means (20) intended to act as anchors in the grout, and which ribbed steel, demonstrating a threaded rear drawing part (12:1) intended to extend a certain distance out from the drill hole in order to interact with a contact element (13) that is located outside of the drill hole and intended to act against the area of rock material that surrounds the opening of the drill hole such that the rock bolt can be assigned a certain degree of prestress, an extended central part (12:2) constituting the principal part of the active part of the anchor rod in the grout and a forward end section (12:3) for anchoring the rock bolt in the interior of the drill hole. In order to increase the deformation capacity of the rock bolt the extended central part (12:2) is assigned at its cylindrical surface a barrier in the form of a cover (22) or a jacket (30) that limits a region of the interaction means (20) of the anchor rod (5), defined in advance, from contact with the grout (4) in the drill hole (2), whereby the extent along the longitudinal direction of the anchor rod of the barrier that is formed is limited with respect to the total length (L12:2) of the central part.
ROCK BOLT EMBEDDED IN GROUT

The present invention concerns a rock bolt of the type that is specified in the introduction to claim 1.

Bolting is the most common reinforcement of rock that is exposed to slow deformation or sudden fracture. Millions of rock bolts are consumed throughout the world every year. The fundamental requirement for rock bolts is that they should be cost-effective, thus that they should be cheap to manufacture while at the same time being able to support a heavy load and resist a large degree of strain before a bolt breaks.

When reinforcing rock with rock bolts of the type that it is intended should be embedded in grout, what is known as a "ribbed rock bolt" is normally used, which is a rod of solid steel that is provided at all parts with, as reinforcing rods for concrete are provided with, interaction means or anchors in the form of radially protruding ribs (fins or flanges) that extend in a transverse direction relative to the rod. The rock bolt is inserted into a drill hole drilled into the rock. The said drill hole has previously been filled with grout such that the ribbed rock bolt is surrounded by grout in the drill hole. The ribbed rock bolt is provided at the opening of the drill hole with an end fitting, normally in the form of a washer and nut, that is placed in contact with the area of rock that surrounds the opening of the drill hole and with which end fitting the rock bolt can be given a certain degree of prestress. This type of rock reinforcement is normally found in association with the construction of facilities in underground mines, tunnels or similar spaces in rock, and it acquires its principal load-carrying capacity through the adhesion that the grout entails.

A known and common rock bolt is the Kirunabulten™ (the Kiruna bolt) whose characteristic property is, in particular, its reliable anchoring mechanism. The said rock bolt is an excellent example of a rock bolt that satisfies a combination of the requirements described above and, it can be said to constitute, mainly, a combination of a ribbed rock bolt and a bolt that is mechanically fixed in the rock. This rock bolt is intended to be embedded in grout in a drill hole and demonstrates radially protruding ribs that, evenly distributed at mutual separations from each other along the length of the anchor rod, function as anchors in the grout. The anchor rod is provided with, in addition to the said ribs, an arrangement for its mechanical anchoring at the bottom of the drill hole. Due to the rock bolt being equipped with the said end anchoring arrangement, which functions by means of a wedge, the rock bolt has the advantage that it can be prestressed to a certain degree and thus it can support a load immediately after its installation. The rock bolt achieves its greatest load-carrying capacity when the grout subsequently has hardened. Even if the prior art rock bolt has proved to be well-functioning, there is always an interest in further improving its load-bearing ability with respect to its ability to absorb tensile and shear forces.
In particular, the achievement of a rock bolt with an improved resistance to deformation and the ability to withstand significant deformation along its length is desired. An improved resistance to deformation is particularly interesting for rock bolts that are used in rock with many cracks, where a rock bolt is locally placed under load at locations at which it traverses wide cracks between blocks. In order to use the ability of the rock bolt to absorb strain efficiently, the sections of a rock bolt that traverses cracks between blocks in the rock must allow a significant degree of deformation and extension. The term “extension” is used in this part to denote not only deformation within the elastic region but also within the plastic region, giving permanent deformation. What is important, however, is that the rock bolt is firmly anchored by the grout in the relevant block between the crack.

A first and a second rock bolt are known from AU 2003262348 A1, each one of which is intended to be embedded in grout in a drill hole. The first rock bolt has been assigned a barrier in the form of a jacket that limits defined regions of the interaction means of the anchor rod from contact with the grout in the drill hole, while the second rock bolt has been assigned at a forward end part a chemically active end anchoring arrangement that comprises a rapidly hardening two-part resin mixture.

One purpose of the present invention, therefore, is to achieve a cost-effective, i.e. cheap, rock bolt that withstands deformation and that, despite the fact that it is of the type that is intended to be embedded in grout in a drill hole, can withstand a significant degree of deformation, i.e. a large strain and a large extension, and that can be prestressed and loaded immediately after its insertion into a drill hole. A second purpose is to provide a rock bolt that can be adapted immediately before it is deployed in a drill hole such that it functions in an optimal manner in a given rock bed in which the strain capacity of the rock bolt can be used more efficiently, which has not previously been the case when using rock bolts embedded in grout. Furthermore, it is a purpose to achieve a rock bolt that makes possible mechanical deployment from a magazine mounted on a machine.

These purposes of the invention are achieved through a rock bolt that demonstrates the features and characteristics that are specified in claim 1. Further advantages of the invention are made clear by the non-independent claims.

The invention will be described in more detail below with reference to the attached drawings and the subsequent description of an embodiment of the invention, in which:

- Figure 1 shows a side view of a rock bolt according to the invention, in a first embodiment and inserted into a drill hole in a rock wall, and surrounded by grout;
- Figure 2 shows a perspective view of the rock bolt in Figure 1;
- Figure 3 shows an X-ray view in perspective of an extracted and somewhat enlarged subpart of the rock bolt in Figure 1;
Figure 4 shows a side view of a rock bolt according to the invention in a second embodiment;

Figure 5 shows a rock bolt according to the invention in a third embodiment; and

Figure 6 shows an extracted part of the rock bolt that is shown in Figures 4 or 5.

Reference number 1 in Figure 1 denotes a rock bed with a drill hole 2 that has been drilled in the rock and that extends to a depth that is greater than the extent of the rock material that is to be reinforced. Reference number 3 generally denotes a rock bolt of length, for example, 3 meters that is surrounded in the drill hole 2 by grout 4 that may be, for example, cement grout. It is appropriate that the drill hole 2 be filled with grout 4 in advance through injection, before the rock bolt 3 is inserted into the drill hole.

The present rock bolt 3 is presented in more detail in Figure 2 and which rock bolt is, as is also the rock bolt described in the introduction, the Kirunabulten™, of combined ribbed and mechanical type, i.e. it comprises an anchor rod 5 that demonstrates an extended cylindrical solid shaft of ribbed steel with the possibility of anchoring it at the end in the bottom of the drill hole 2.

As is made most clear by Figure 1, the anchor rod 5 principally includes three parts, whereby reference number 12:1 is used to denote a short threaded rear drawing section intended to extend at least partially a certain distance out of the drill hole 2; reference number 12:2 is used to denote an extended central part that constitutes the principal part of the length of the rock bolt; and reference number 12:3 is used to denote a forward end part provided with an integral end anchoring arrangement 6 that forms a single unit with the anchor rod, and that is intended for the mechanical anchoring of the rock bolt to the rock bed 1 at the bottom of the drill hole 2. The said end anchoring arrangement 6 is in itself of a well-known type for this type of rock bolt and will therefore not be described in greater detail. It can, however, be mentioned that it is appropriate that the anchoring means be of the type in which the desired locking effect is obtained through the influence of a wedge. It should be understood that a rapidly hardening artificial resin or two-component plastic can be used as an alternative to the said mechanical anchoring arrangement 6, instead of conventional grout in the form of concrete at the front end of the rock bolt. Due to the rapidly hardening artificial resin, the rock bolt can be assigned a certain degree of prestress after as short a period as a few minutes after it has been inserted into the drill hole.

As is made most clear by Figures 1 and 2, the rock bolt 3 has a forward end anchor arrangement 6 that includes a wedge 7 intended to interact with the bottom of the drill hole 2. A contact element 13 is arranged externally, with an inlet into the said drill hole 2. The contact element 13 comprises a contact washer 14 provided with a hole and a tension nut 15 that interacts with the thread 16 that is arranged at the short drawing part 12:1 of the anchor rod 5. The anchor rod 5 is intended to be surrounded by grout 4 in the drill hole 2 and is for
this reason of the form of a conventional ribbed steel rod, i.e. it is designed to have along the complete length of its cylindrical surface interaction means in the form of transverse ribs 20 that, distributed at distances from each other, form local anchors in the grout 4.

The anchoring arrangement 6 located at the forward end of the anchor rod 5 is shown in more detail in Figure 2 and, as is made clear, the anchoring arrangement is designed as a continuous and integral part of the rock bolt through the end part 12:3 of the rock bolt having been slitted or sawn into four equal subparts 8 or segments, in a form known as a "Y-split" in which the segments diverge from the anchor rod in a manner that resembles the tail of a fish. The wedge 7 has been inserted between the four said subparts. The wedge 7 is arranged such that it achieves, in interaction with the walls and bottom of the drill hole 2, an anchoring effect in which the wedge drives the subparts 8 to expand in a transverse direction out from the anchor rod 5 towards the wall of the drill hole. This expansion effect is obtained as a result of the rock bolt 3 being inserted into the drill hole 2 and being pressed down to the bottom of the drill hole with force. During the tightening of the tension nut 15 against the contact washer 14, the force of contact of the anchoring arrangement 8 with the wall of the drill hole 2 increases, and thus the prestress of the rock bolt 3 in the drill hole 2 increases at the same time.

With reference to Figures 2 and 3 in particular, the present invention is shown in more detail, whereby as a component of the task of improving the resistance to deformation of the rock bolt 3 the extended central part 12:2 is arranged with a cover 22 at a longitudinal section of its cylindrical surface, preferably a cover of a formable elastomer, alternatively of a curable epoxy polymer whose external surface or periphery has been designed to form a surrounding jacket 30, essentially in the form of a cylinder, at the extended central part 12:2. The jacket 30 surrounds the anchor rod 5 and has been given such a layer thickness that it exceeds the diameter of the anchor rod, measured at the ribs 20, by only a small amount. The latter fact will become particularly evident from a careful study of Figure 3. As a consequence of this, the jacket 30 formed in this manner will not increase the diameter of the anchor rod more than necessary where it effectively limits, as a barrier, the ribs 20 that protrude radially from the anchor rod 5 from contact with the grout 4 along a section of length L30 of the complete length denoted L12:2 of the central part 12:2. Due to the jacket 30, certain parts of the anchor rod 5 do not come into contact with the grout 4 or concrete, which means that the strain properties of the anchor rod 5 are significantly improved along these parts, and the resulting ability of the rock bolt to absorb deformations in the rock increases. The extension that arises on deformation of the anchor rod 5 when a large load is applied will thus arise principally at the interface between the anchor rod 5 and the jacket 30, along the central part 12:2.
It would be possible that the cover 22 be constituted by, for example, a layer or a film of any suitable material that achieves a jacket 30 with an essentially smooth cylindrical outer surface of the type described above. The motion that arises between the anchor rod 5 and the cylindrical jacket 30 during extension of the central part 12:2 of the rod 3 when a large load is applied is illustrated by the double-headed arrow in Figure 3.

It would be possible in an alternative design that the cover 22 be applied as a curable formable plastic mass, for which it would be appropriate that the layer thickness on the anchor rod 5 be so selected that the mass at least fills the space between adjacent ribs 20 of the ribbed rod 5 along the section of length L30, in order in this way to form the jacket 30. It is appropriate that the cover 22 be a urethane plastic of thermoplastic or of curable plastic type, for example a curable epoxy polymer. The cover 22 may be arranged as soft foam, stiff foam or hard foam such as foamed urethane plastic, polyurethane elastomer or polyurethane rubber. Alternatively, the cover 22 may be arranged as a series of alternating sections with jacket body segments 30 separated from each other Thus, the central part 12:2 of the anchor rod 5 can demonstrate along its length L12:2 a series of repeated length sections L30:1-L30:n separated from each other and having cover sections 30:1-30:n of some elastomer (as shown in Figure 5).

It would be possible in another design, that the cover 22 be constituted by a film, for example a shrink-on film, that can be formed by the application of heat to tightly surround and thus cover the ribs 20 of the anchor rod 5 along a certain section of length L30. Due to the fact that the central part 12:2 is at certain parts along its complete length L12:2 assigned the said cover 22, the anchor rod 5 is permitted, along each section of length L30 of a jacket body 30 that is formed from the cover, to absorb tensile forces efficiently through the central section 12:2 being allowed to extend within the grout 4. Due to the fact that each such section of the anchor rod 5 can be freely extended, the rock bolt can absorb tensile stress in the anchor rod that is caused by local rock deformations.

The cover 22 is illustrated in Figure 1 applied such that it forms a jacket body 30 with a length L30, extending across a crack 18 that limits two separate blocks in the rock 1. As has been described above, also a portion of the threaded drawing part 12:1 that is present inside the drill hole 2 is surrounded by the grout 4. In order to act in a manner that absorbs force, the rear part 12:1 and the front part 12:3 of the anchor rod 5 are fixed in the grout 4 of the drill hole 2 by means of the freely exposed transverse ribs 20 of the anchor rod 5. It should be understood that in practice a part of the rear drawing part 12:1 of the anchor rod 5, which part constitutes the thread 16, is embedded in grout and that is located inside the drill hole 2, fixed at the rock by the grout 4. This is done in order to minimise the risk that the rock bolt is torn off at the threads 16, as a result of, among other things, the notching effect that arises in the thread. The central part 12:2 is freed from the grout 4 in order to allow
the rock bolt to be freely stressed in this region. It is intended that the front end section 12:3 act to anchor the end in the grout 4.

It should be understood that the rock bolt 3 can be prefabricated and provided in advance with the cover 22 during a manufacturing stage in the factory, or the rock bolt can be provided with the cover 22, and thus with a formed jacket 30, on site, immediately before the rock bolt is to be inserted into a drill hole 2. The advantage of the latter procedure, namely the possibility of applying the cover 22 as late as possible in the manufacturing stages of the rock bolt 3 or immediately before the rock bolt is inserted into a drill hole 2, is that it makes it possible to adapt each individual rock bolt or each batch of rock bolts for a specific purpose, and for the structure of the type of rock bed that it is intended that they reinforce. It would thus be possible for the rock bolt 3 to be manufactured as a stock item in a particularly simple standard design of ribbed rod without a cover 22, whereby the rock bolt can be easily adapted for each specific field of use, type of rock or pattern of crack formation in the rock that has been determined in advance, through being equipped with a cover 22 of a suitable length in regions along the length of the anchor rod.

With reference to Figures 4-6, the present rock bolt is shown in a second embodiment whereby the jacket 30 comprises a relatively stiff plastic or metal tube instead of the formable cover 22 described above. The jacket 30 designed as a tube is fixed in place on the anchor rod 5 and surrounds it tightly, and it has been given such a location on the extended central part 12:2 and has been given such a length L30 relative to the total length L 12:2 of the central part 12:2 that two sections with freely exposed anchors 20 are formed on the central part 12:2. To be more precise, a first section 12:2a of the anchor rod 5 is formed with freely exposed anchors 20 in association with the forward end section 12:3, and a second section 12:2b is formed with freely exposed anchors 20 in association with the rear drawing section 12:1. The length L 12:2a of the free first section 12:2a constitutes a limited part of the total length of the rock bolt, which it is appropriate has been selected in the interval 10-30% of the total length of the rock bolt. It is appropriate that also the length L 12:2b of the free second section 12:2b constitute a limited part of the total length of the rock bolt, and it is advantageous that this be selected in the interval 5-20% of the total length of the rock bolt. A rock bolt 3 is in this way obtained that is fixed anchored in the rock 1 at the bottom and mouth of the drill hole after mounting, while it is free from contact with grout along its length between these locations, and this means that the rock bolt embedded in grout will be freely deformable along the greater part of its total length. In order to further reduce the tendency to adhere in selected regions of the grout, it is appropriate that the plastic tube be given an essentially smooth outer surface. It is, furthermore, advantageous that the plastic tube be manufactured from a greasy plastic, such as, for example, polythene, polypropene or teflon.
Figure 5 shows an example of a rock bolt according to the invention where the central part 12:2 comprises a number of segments 30:1-30:n that form a barrier, separated from each other, with one or several free sections 12:2c, 12:2d of stretches of central part located between them, each one of which demonstrates the lack of a barrier 22, 30. It is preferred that this type of rock bolt be used during the production of relatively long bolts, i.e. bolts of lengths from 5 meters upwards.

A rock bolt with a large capacity to absorb deformation can, through the invention, be formed from the starting point of a cheap standard product, namely a ribbed steel rod. This is principally achieved through the anchor rod 5 that is formed from the ribbed steel being isolated from the grout in sections by being provided with a protective surrounding jacket 30 in suitable sections along its length, particularly along sections of the anchor rod 5 that cross cracks in the rock. The cover 22 thus forms a cylindrical jacket 30 in which sections of the extended central part 12:2 of the rock bolt can slide or move in a rock bolt that otherwise is fixed embedded at the ends 12:1, 12:3 that are exposed to grout. The rock bolt can act to absorb loads to a greater extent as a result of this, since it can be freely extended at critical sections.

The invention is not limited to what has been described above and shown in the drawings: it can be changed and modified in several different ways within the scope of the innovative concept defined by the attached patent claims.
CLAiMS

1. A rock bolt intended to be inserted and fixed in a drill hole (2) by being embedded in grout (4), and comprising an anchor rod (5) with an extended cylindrical solid part of ribbed steel type with radially protruding interaction means (20) intended to act as anchors in the grout, and which ribbed steel, demonstrating a threaded rear drawing part (12:1) intended to extend a certain distance out from the drill hole in order to interact with a contact element (13) that is located outside of the drill hole and intended to act against the rock material that surrounds the opening of the drill hole such that the rock bolt can be assigned a certain degree of prestress, an extended central part (12:2) constituting the principal part of the active part of the anchor rod in the grout and a forward end section (12:3), characterised in that the anchor rod (5) at its front end section (12:3) is provided with a mechanically acting end anchoring arrangement (6) comprising a wedge (7) and arranged to lock in a manner that retains the anchor rod in the drill hole, after the insertion of the rock bolt, through interaction between the wedge and the interior of the drill hole (2), and in that the extended central part (12:2) is assigned at its cylindrical surface a barrier in the form of a cover (22) or a jacket (30) that limits a region of the interaction means (20), defined in advance, from contact with the grout (4) in the drill hole (2).

2. The rock bolt according to claim 1, whereby the barrier (22, 30) is arranged to run continuously around the anchor rod (5) of the central part (12:2).

3. The rock bolt according to any one of claims 1-2, whereby the central part (12:2) has a first free section (12:2a) of a length (L12:2a) of the central part that, adjacent to the forward end section (12:3), demonstrates a lack of barrier (22, 30).

4. The rock bolt according to any one of claims 1-3, whereby the central part (12:2) has a second free section (12:2b) of a length (L12:2b) of the central part that, adjacent to the rear drawing section (12:1), and demonstrates a lack of barrier (22, 30).

5. The rock bolt according to any one of claims 1-4, whereby the central part (12:2) comprises a number of segments (30:1-30:n), separated from each other and forming barriers, with one or several free sections (12:2c, 12:2d) of central part located between them, each one of which demonstrates the lack of a barrier (22, 30).
6. The rock bolt according to claim 3, whereby the length \((L_{1:2:2a})\) of the free first section \((1:2:2a)\) comprises 10-30% of the total length of the rock bolt.

7. The rock bolt according to claim 4, whereby the length \((L_{1:2:2b})\) of the free second section \((1:2:2b)\) comprises 5-20% of the total length of the rock bolt.

8. A rock bolt according to any one of claims 1-7, whereby the barrier \((22, 30)\) comprises tube or a sheath of plastic or metal with an essentially smooth outer surface that surrounds the radially protruding interaction means \((20)\) of the anchor rod \((5)\).

9. The rock bolt according to claim 8, whereby the tube that is manufactured from plastic comprises a polymeric material of the type known as "greasy" plastic.

10. The rock bolt according to claim 9, whereby the greasy plastic has been selected from one of the following plastic materials: polyethene, polypropene, and teflon.

11. The rock bolt according to any of claims 1-7, whereby the barrier \((22, 30)\) comprises an elastomeric polymeric material, or a curable epoxy polymer, and that the barrier is formed as a cover \((22)\) that surrounds the anchor rod \((5)\), such as a film or foil of the said material.

12. The rock bolt according to claim 11, whereby the polymeric material is present in the form of a layer of curable foam material that surrounds the anchor rod \((5)\).

13. The rock bolt according to claim 11, whereby the polymeric material comprises a curable mass that fills the space between the interaction means \((20)\) of the anchor rod \((5)\).

14. The rock bolt according to any one of the preceding claims 1-13, whereby the end section \((1:2:3)\) of the rock bolt is slitted into subparts \((8)\) or segments that diverge from the anchor rod in a manner similar to that of a fishtail, and between which subparts the wedge \((7)\) has been inserted.
### A. CLASSIFICATION OF SUBJECT MATTER

**IPC:** see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

### B. MINIMUM DOCUMENTATION SEARCHED

**IPC:** E21 D

### 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>A</td>
<td>AU 2003262348 A1 (IND ROLL FORMERS PTY LTD), 3 June 2004 (2004-06-03); whole document</td>
<td>1.14</td>
</tr>
<tr>
<td>A</td>
<td>WO 03042501 A1 (GRINAKER LTA LTD ET AL), 22 May 2003 (2003-05-22); whole document</td>
<td>1.14</td>
</tr>
<tr>
<td>A</td>
<td>WO 2008079021 A1 (NTNU TECHNOLOGY TRANSFER AS ET AL), 3 July 2008 (2008-07-03); whole document</td>
<td>1.14</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
  - "&" document member of the same patent family

**Date of actual completion of the international search:** 02-09-2011

**Date of mailing of the international search report:** 22-09-2011

**Name and mailing address of the ISA/SE**

Patent- och registreringsverket  
Box 5055  
S-1 02 42, STOCKHOLM  
Facsimile No. +46 8 666 02 86

**Authorized officer**  
Chris ter Backnert  
Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 2009)
Continuation of: second sheet
International Patent Classification (IPC)

E21D 21/00 (2006.01)

Download your patent documents at www.prv.se
The cited patent documents can be downloaded:
• From "Cited documents" found under our online services at www.prv.se
  (English version)
• From "Anforda dokument" found under "e-tjanster" at www.prv.se
  (Swedish version)
Use the application number as username. The password is RUPKLSLLSM.

Paper copies can be ordered at a cost of 50 SEK per copy from PRV InterPat (telephone number 08-782 28 85).

Cited literature, if any, will be enclosed in paper form.
### INFORMATION ON PATENT FAMILY MEMBERS

**PCT/SE201 1/050659**

<table>
<thead>
<tr>
<th>Country</th>
<th>Application No.</th>
<th>Date of Priority</th>
<th>Date of Filing</th>
<th>Date of Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>AU</td>
<td>2003262348 A 1</td>
<td>03/06/2004</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>US</td>
<td>20040136789 A 1</td>
<td>15/07/2004</td>
<td>CA 2432835 C</td>
<td>08/02/201 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CA 2723330 A 1</td>
<td>21/1 2/2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>US 7037046 B2</td>
<td>02/05/2006</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ZA 200304823 A</td>
<td>13/02/2004</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CA 2466283 A 1</td>
<td>22/05/2003</td>
</tr>
<tr>
<td>WO</td>
<td>2008079021 A 1</td>
<td>03/07/2008</td>
<td>AT 455933 T</td>
<td>15/02/201 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>AU 2007338947 A 1</td>
<td>03/07/2008</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CA 2682332 C</td>
<td>23/03/201 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CN 101720379 A</td>
<td>02/06/201 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>DE 602007004521 D1</td>
<td>11/03/201 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ES 2340341 T3</td>
<td>01/06/201 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>JP 2010513763 A</td>
<td>30/04/201 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>KR 20090117701 A</td>
<td>12/1 1/2009</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NO 20110667 A</td>
<td>23/06/2008</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>RU 2407894 C 1</td>
<td>27/1 2/201 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SE 0602799 L</td>
<td>23/06/2008</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SE 532203 C 2</td>
<td>10/1 1/2009</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>US 20100021245 A 1</td>
<td>28/01/201 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ZA 200904448 A</td>
<td>29/09/201 0</td>
</tr>
</tbody>
</table>

---

Form PCT/ISA/210 (patent family annex) (July 2009)