The present invention relates to a locking device for locking an adaptor onto the nose of an excavator bucket. The locking device includes a locking member for engaging with the nose. A pin arrangement including two pins is inserted into opposite sides of the locking member, adaptor and nose. The adaptor can be locked onto the nose upon rotation of the pins. In both specific embodiments presented, fastening and unfastening of the device is a simple two-step process. Further, the adaptor load may be distributed in a balanced manner along the locking device whereby the locking elements together engage with the adaptor on opposite sides of the nose and the locking member engages with the nose.
A LOCKING DEVICE

TECHNICAL FIELD

The present invention relates to a locking device for locking an adaptor onto the nose of an excavator bucket.

The present invention also relates to a locking device for locking a first part relative to a second part.

BACKGROUND

The reference to any prior art in this specification is not, and should not be taken as an acknowledgement or any form of suggestion that the prior art forms part of the common general knowledge.

In heavy industrial excavating equipment such as buckets used on draglines, loaders including front-end loaders, dippers, backhoes, shovels and other such large earthmoving machines, it is a common problem that the metal teeth on the leading edge of the bucket become worn as the bucket is repeatedly forced through the ground during use. This wear can eventually render the teeth ineffectual requiring the teeth, or at least the point or tip of each worn tooth, to be replaced. Consequently, it is desirable to have an assembly where each tooth, or at least the point or tip thereof, can be readily replaced.

In practice, an adaptor is releasably fastened onto the nose of an excavator bucket and, in turn, a tooth is releasably fastened onto the adaptor. In these type of excavator assemblies, the adaptor is generally hollow to receive the nose of the bucket. In turn, the tooth is generally hollow to receive the front of the adaptor so that the tooth protrudes forwardly from the leading edge of the excavator bucket. Pins or other like fasteners can be used to fasten the parts together.
US 5,435,084 discloses a retention apparatus for securing a tooth onto the nose of an excavator bucket. The retention apparatus has a cylindrical body with an eccentric head affixed to the body. In use, the head can be rotated to lock the tooth onto the nose. The head is loaded by the outer tooth whereas the tail of the retention apparatus is not. In practice, this uneven load distribution along the retention apparatus may cause the retention apparatus to skew or the locked parts to vibrate in use. Embodiments of the present invention provide for improved load distribution.

The assembled parts of US 5,435,084 can be disassembled by axially driving the retention apparatus. However, the retention apparatus may become stuck or jammed in practice. Embodiments of the present invention provide an improved release mechanism for disassembling locked parts.

**SUMMARY OF THE INVENTION**

According to one aspect of the present invention, there is provided a locking device for locking an adaptor onto the nose of an excavator bucket, the locking device including:

- a locking member for engaging with the nose; and
- a pin arrangement including two pins for inserting into opposite sides of the locking member, adaptor and nose;

wherein the adaptor can be locked onto the nose upon rotation of the pins.

The adaptor may define a pair of lateral apertures in which respective pins can be engaged. The nose may define a lateral passage in which the locking member can be engaged. The locking member may have a generally egg-shaped or tapered profile.

Each pin may include a shaft and a head eccentrically terminating the shaft. The shaft may define a hexagonal passage. The head may be oval or egg-shaped, and define an opening in which a tightening tool can be mated. The pin arrangement may include a pair of like pin assemblies. Each pin assembly
may include one of the pins; a ratchet assembly through which a fastener passes and to facilitate rotation of the pin assembly in only one direction, and the fastener for fastening the pin assembly together. Each pin assembly may further include a limiter for limiting the extent to which the fastener can be unfastened. The limiter may include a collar and a retention clip for being clipped to the collar so as to retain the collar within the pin.

Each fastener may include a head defining a hexagonal opening in which a tightening tool can be mated, an intermediate portion extending from the head, and a free end of lesser diameter that the intermediate portion and extending from the intermediate portion. Each ratchet assembly includes a ratchet wheel which receives the fastener, and which can be displaced from the free end and onto the intermediate portion so as to engage with a detent.

The locking member may define a pair of passages for receiving respective detent assemblies. Each detent assembly may include a detent extending into the locking member, a plug sealing the passage and biasing means located between the plug and detent to bias the detent into the locking member.

The locking member may further define an internal hexagonal passage and each fastener may include a hexagonal nut for being received within the hexagonal passage. Each ratchet assembly further includes a ball thrust bearing located between the nut and ratchet wheel. Each ratchet assembly further includes a drive member with a hexagonal outer surface for being received within a hexagonal passage of the pin shaft. Each ratchet assembly further includes and O-ring for receiving the fastener shaft and a washer for receiving the O-ring. Each ratchet assembly further includes a compression ring for receiving the drive member and an O-ring for receiving the compression ring.

The locking device may include a pair of locking elements for engaging with the adaptor on opposite sides of the nose. The pin arrangement may move the locking elements relative to the locking member so that the locking elements engage with the adaptor and the locking member engages with the
nose to lock the adaptor onto the nose. The pin arrangement may rotate to translate the locking elements relative to the locking member. The load may be distributed in a balanced manner along the locking device whereby the locking elements together engage with the adaptor on opposite sides of the nose and the locking member engages with the nose. The locking member may not be loaded by the adaptor.

The adaptor may define a pair of lateral apertures in which respective locking elements can be engaged. Each locking element may be cam shaped. The nose may define a lateral passage in which the locking member can be engaged. The locking member may have a generally egg-shaped or tapered profile. The pin arrangement may pass through the locking elements and the locking member.

The pin arrangement may include a fastener for fastening the pins together so that the adaptor is at least loosely fastened onto the nose.

Each pin may include a shaft and a head eccentrically terminating the shaft. One of the pins may be a male pin and the other pin may be a female pin to facilitate complementary fastening of the pins together. The male pin may include a polygonal tail terminating the shaft and for being complementarily received within the shaft of the female pin. The polygonal tail may define an internal thread for engaging with the fastener. The male pin may define a polygonal recess for engaging with a tightening tool (e.g. pneumatic wrench) which, in turn, can rotate the pin arrangement to move the locking elements relative to the locking member.

The pin arrangement may include a ratchet gear assembly to facilitate rotation of the pin arrangement in only one direction. The locking member may define an internal barrier defining teeth. The ratchet gear assembly may include a pair of resilient washers for locating adjacent respective shafts, and a pair of ratchet gears for engaging between respective washers and the barrier. Each ratchet gear may define sawtooth teeth for engaging with the barrier teeth and to facilitate rotation of the pin arrangement in only one direction.
According to another aspect of the present invention, there is provided a
locking device for locking a first part relative to a second part, the locking
device including:

- a locking member for engaging with one of the parts; and
- a pin arrangement including two pins for inserting into opposite sides of
  the locking member, first part and second part;

wherein the first part can be locked relative to the second part upon
rotation of the pins.

The first part may be an adaptor and the second part may be the nose of an
excavator bucket. Alternatively, the first part may be an excavation tooth and
the second part may be an adaptor. Alternatively, the first part may be an
excavation tooth and the second part may be the nose. The locking member
may engage with only one of the parts.

According to another aspect of the present invention, there is provided a
method for locking a first part relative to a second part, the method including
the steps of:

- tightening at least one fastener of a pin arrangement within a locking
  member; and
- rotating pins of the pin arrangement to lock the first part relative to the
  second part.

**BRIEF DESCRIPTION OF THE DRAWINGS**

Preferred features, embodiments and variations of the invention may be
discerned from the following Detailed Description which provides sufficient
information for those skilled in the art to perform the invention. The Detailed
Description is not to be regarded as limiting the scope of the preceding
Summary of the Invention in any way. The Detailed Description will make
reference to a number of drawings as follows:
Figure 1 is an exploded perspective view of excavator bucket assembly including a locking device for locking an adaptor onto the nose of an excavator bucket in accordance with an embodiment of the present invention;

Figure 2a is a side view of the excavator bucket assembly of Figure 1;

Figure 2b is a plan sectional view of the excavator bucket assembly of Figure 2a;

Figure 3a is a sectional perspective view of an internal locking member of the locking device shown in Figure 1;

Figure 3b is an exploded perspective view of a pin arrangement of the locking device shown in Figure 1;

Figure 4a is a perspective view of the locking device shown in Figure 1 in an unlocked configuration;

Figure 4b is a perspective view of the locking device of Figure 4a in a locked configuration;

Figure 5a is a side view of the excavator bucket assembly of Figure 1 including the unlocked locking device of Figure 4a;

Figure 5b is a side view of the excavator bucket assembly of Figure 1 including the locked locking device of Figure 4b;

Figure 6 is an exploded perspective view of excavator bucket assembly including a locking device for locking an adaptor onto the nose of an excavator bucket in accordance with another embodiment of the present invention;

Figure 7 is a sectional view of the excavator bucket assembly of Figure 6;
Figure 8 is a perspective view of the locking device shown in Figure 6 in an unlocked configuration;

Figure 9a is a side view of the excavator bucket assembly of Figure 6 including the unlocked locking device of Figure 8; and

Figure 9b is a side view of the excavator bucket assembly of Figure 9a with the locking device in a locked configuration.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Figures 1 and 2 show an excavator bucket assembly 2. Turning briefly to Figure 4, the excavator bucket assembly 2 includes a locking device 4 according to an embodiment of the present invention which can be configured in unlocked (Fig. 4a) and locked (Fig. 4b) configurations.

Returning to Figure 1, the locking device 4 locks an adaptor 6 onto the nose 8 of an excavator bucket in two straightforward steps. In a first step, a central pin arrangement 10 (see Fig. 3b) of the locking device 4 is assembled to pass through cam locking elements 12a, 12b and an internal locking member 14 to loosely fasten the adaptor 6 onto the nose 8. In a second step with particular reference to Figure 4, a tightening tool 16 can rotate the assembled pin arrangement 10. In turn, the pin arrangement 10 translates the cam locking elements 12a, 12b relative to the locking member 14 so that the locking elements 12a, 12b rearwardly engage with the adaptor 6 and the locking member 14 forwardly engages with the nose 8 to securely lock the adaptor 6 onto the nose 8.

The adaptor 6 is hollow and defines a pair of lateral apertures 16 in which respective cam locking elements 12 can be engaged. The nose 8 defines a lateral passage 18 in which the locking member 14, having a generally egg-shaped profile, can be engaged.
Turning to Figure 2b, it can be clearly seen that the locking device 4 includes the pair of cam locking elements 12a, 12b which rearwardly engage with the adaptor 6 on opposite sides of the nose 8. The elongate locking member 14 forwardly engages with the nose 8 between the cam locking elements 12a, 12b. The pin arrangement 10 passes through the cam locking elements 12a, 12b and the locking member 14. The load is symmetrically distributed along the locking device 4 whereby the cam locking elements 12a, 12b together engage with the adaptor 6 on opposite sides of the nose 8 and the locking member 14 engages with the nose 8. Advantageously, the locking member 14 is not loaded by the adaptor 6. The locking device 4 is described in detail below.

Referring to Figures 1 and 3b, the pin arrangement 10 includes a pair of pins 20a, 20b for inserting into opposite sides of the adaptor 6 and nose 8. As can best be seen in Figure 1, the pin arrangement 10 further includes a fastener 22 in the form of a threaded bolt for fastening the pins 20 together within the nose 8. As can best be seen in Figure 3b, each pin 20 includes a shaft 24 and a head 26 eccentrically terminating the shaft 24.

One of the pins 20a is a male pin and the other pin 20b is a female pin to facilitate complementary fastening of the pins 20 together. Elaborating further, the male pin 20a includes a hexagonal tail 28 terminating the shaft 24. The hexagonal tail 28 is complementarily received within a hexagonal passage defined in the shaft 24 of the female pin 20b so that relative rotation between the pins 20 is prevented. The hexagonal tail also defines an internal thread for engaging with the fastener 22.

As can best be seen in Figure 4a, the female pin 20b defines a recess 33 in which a head of the fastener 22 can be received. As can best be seen in Figure 4b, the male pin 20a defines a hexagonal recess 30 for engaging with the tightening tool 16 (e.g. standard or pneumatic wrench) which, in turn, can rotate the pin arrangement 10 to move the locking elements 12 relative to the locking member 14.
As can best be seen in Figure 3a, the locking member 14 has an internal barrier 32 defining ratchet teeth on opposite sides. Returning to Figure 3b, the pin arrangement 10 includes a ratchet gear assembly to facilitate rotation of the pin arrangement 10 in only one direction within the locking member 14. The ratchet gear assembly includes a pair of resilient rubber washers 34 for locating adjacent respective shafts 24, and a pair of ratchet gears 36 for engaging between respective washers 34 and the toothed barrier 32. In use, the rubber washers 34 compress the ratchet gears 36 into engagement with the toothed barrier 32.

Each ratchet gear 36 has a central hexagonal aperture which complementarily engages with the tail 28 of the male pin 20a to impede movement of the gears 36 relative to the pins 20. Each ratchet gear 36 also defines sawtooth teeth for engaging with the teeth of the barrier 32 to facilitate rotation of the pin arrangement 10 in only one direction. In this manner, the pin arrangement 10 can be incrementally tightened and will not be inadvertently released though vibration in use so as to unlock the adaptor 6 from the nose 8.

In order to release the adaptor 6 from the nose 8, the fastener 22 must first be un-tightened, which releases the ratchet gears 36 compressed between the washers 34 from engagement with the barrier 32, before the pin arrangement 10 can then be un-tightened so as to unlock the adaptor 6 from the nose 8. The pin arrangement 10 can then be readily removed from the loosely fastened adaptor 6 and nose 8 without becoming jammed.

A method for locking the adaptor 6 onto the nose 8 of the excavator bucket is now described.

Initially, the method involves placing the adaptor 6 over the nose 8. The locking elements 12 are positioned within apertures 16 of the adaptor 6 on opposite sides of the nose 8. The method also involves positioning the locking member 14 within the nose 8 between the locking elements 12.
The pin arrangement 10 is assembled to pass through the locking elements 12 and the locking member 14 to loosely fasten the adaptor 6 onto the nose 8. Elaborating further, the pair of pins are inserted into opposite sides of the adaptor 6 and nose 8. The ratchet gear assembly is arranged on the male pin 20a of the pin arrangement 10 to facilitate rotation of the pin arrangement in only one direction. The pins 20 are fastened together with the fastener 22 so that the adaptor 6 is loosely fastened onto the nose 8 as shown in Figure 5a.

Next, the method involves rotating the pin arrangement 10 with the tool 16 to move the locking elements 12 relative to the locking member 14 so that the locking elements 12 rearwardly engage with the adaptor 6 and the locking member 14 forwardly engages with the nose 8 to firmly lock 6 the adaptor 6 onto the nose 8 as shown in Figure 5b.

As previously discussed, the adaptor 6 can be released from the nose 8 by first un-tightening the fastener 22, which releases the ratchet gears 36 from engagement with the barrier 32, and then rotating the pin arrangement 10 in a reverse direction (i.e. the opposite direction to the tightening direction) so as to unlock the adaptor 6 from the nose 8.

Figure 6 shows another excavator bucket assembly 102. Turning briefly to Figure 8, the excavator bucket assembly 102 includes a locking device 104 according to another embodiment of the present invention which can be configured in unlocked (Fig. 8, 9a) and locked (Fig. 9b) configurations.

Referring to Figure 7, the locking device 104 locks an adaptor 106 onto the nose 108 of an excavator bucket in two straightforward steps. In a first step, a central pin arrangement 110 is passed through the adaptor 106 and nose 108, and a pair of opposed ratchet assemblies which facilitate rotation of the pin arrangement 110 in only one direction are engaged within a locking member 114 of the locking device 104. In a second step with particular reference to Figures 8 and 9, a tightening tool 116 can rotate the assembled pin arrangement 110. In turn, the pin arrangement 110 rearwardly engages with
the adaptor 106 and the locking member 114 forwardly engages with the nose 108 to securely lock the adaptor 106 onto the nose 108.

As shown in Figure 6, the adaptor 106 is hollow and defines a pair of lateral apertures 116 in which respective pin assemblies 150 of the pin arrangement 110 can be engaged. The nose 108 defines a lateral passage 118 in which the locking member 114, having a generally egg-shaped profile, can be engaged.

The pin arrangement 110 includes a pair of like pin assemblies 150a, 150b which are separated. Each pin assembly 150 includes a pin 120, a ratchet assembly through which a fastener 122 passes and to facilitate rotation of the pin assembly 150 in only one direction, and the fastener 122 for fastening the pin assembly 150 together. Each pin assembly 150 further includes a limiter 152 for limiting the extent to which the fastener 122 can be unfastened (or untightened). Each limiter 152 includes a collar 154 and a resilient retention clip 156 for being clipped to the collar 154 so as to retain the collar 154 within the pin 120. As can best be seen in Figure 7, the retention clip 156 sits within an internal groove of the pin 120.

Returning to Figure 6, each pin 120 includes a shaft 124 and a head 126 eccentrically terminating the shaft 124. The shaft 124 defines a hexagonal passage 158. The head 126 is oval or egg-shaped, and defines an opening or recess 133 in which a tightening tool 116 can be complementarily mated. The adaptor 106 can be locked onto the nose 108 upon respective rotation of the pins 120 with the tightening tool 116.

Each fastener 122 includes a head 160 defining a hexagonal opening 162 in which another tightening tool (not shown) can be complementarily mated, an intermediate portion 164 extending from the head 160, and a threaded free end 166 of lesser diameter that the intermediate portion 164 and extending from the intermediate portion 164. Each ratchet assembly includes a toothed ratchet wheel 136 which receives the fastener 122, and which can be
displaced from the free end 166 and onto the intermediate portion 164 so as to engage with a detent 132.

As can best be seen in Figure 8, the locking member 114 defines a pair of passages 168a, 168b for receiving respective detent assemblies. Returning to Figure 6, each detent assembly includes a detent 132 extending into the hollow of the locking member 114, a plug 170 sealing the passage 168 and biasing means 172 (e.g. spring) located between the plug 170 and detent 132 to bias the detent 132 into the locking member 114.

As can best be seen in Figure 7, the locking member 114 further defines an internal hexagonal passage 174 and each fastener 122 includes a hexagonal nut 176 for being complementarily received within the hexagonal passage 174. Each ratchet assembly further includes a ball thrust bearing 134 located between the nut 176 and ratchet wheel 136. Each ratchet assembly further includes a drive member 178 with a hexagonal outer surface for being complementarily received within the hexagonal passage 158 of the pin shaft 124.

Each ratchet assembly further includes and O-ring 180 for receiving the fastener intermediate portion 164 and a washer 182 for receiving the O-ring 180. The O-ring 180 and washer 182 are located between the fastener head 160 and the pin 120. Each ratchet assembly further includes a resilient compression ring 184 for receiving the drive member 178 and an O-ring 186 for receiving the compression ring 184. The O-ring 186 and compression ring 184 are sandwiched between the pin 120 and drive member 178.

A method for locking the adaptor 106 onto the nose 108 is now briefly described.

Each pin assembly 150 is self contained and, initially, the fastener 122 is unfastened so that the fastener head 160 abuts the limiter collar 154 as shown in Figure 7.
The pin assemblies 150a, 150b, including pins 120a, 120b, are inserted into opposite sides of the locking member 114, adaptor 106 and nose 108. In this manner, each fastener nut 176 is engaged in the central hexagonal passage 174 of the locking member 114.

Each fastener 122 is tightened or further fastened with a rotating tightening tool so that the ratchet wheel 136 is displaced from the fastener free end 166 and onto the intermediate portion 164 so as to engage with a detent 132. Elaborating further, the ratchet wheel 136 expands when passing onto the intermediate portion 164 of greater diameter.

The tightening tool 116 can then be used to rotate the pins 120 of the pin arrangement 110 so that the locking device changes from the unlocked configuration of Figure 9a to the locked configuration of Figure 9b. In this manner, the pins 120 rearwardly engage with the adaptor 106 and the locking member 114 forwardly engages with the nose 108 to securely lock the adaptor 106 onto the nose 108. The ratchet assembly impedes the unlocking of the adaptor 106 from the nose 108.

The load is distributed in a balanced manner along the locking device 104 whereby pins 120 together engage with the adaptor 106 on opposite sides of the nose 108 and the locking member 114 engages with the nose 108.

The adaptor 106 can be released from the nose 108 by first un-tightening the fastener 122, which releases the ratchet wheel 136 from engagement with the detent 132, and then rotating the pin arrangement 110 in a reverse direction (i.e. the opposite direction to the tightening direction) so as to unlock the adaptor 106 from the nose 108. The pin arrangement 110 can then be readily removed from the adaptor 6 and nose 8 without becoming jammed.

A person skilled in the art will appreciate that many embodiments and variations can be made without departing from the ambit of the present invention.
A preferred embodiment relates to a locking device 4 for locking a first part onto a second part, whereby the first part is an adaptor 6 and the second part is the nose 8 of an excavator bucket. In an alternative embodiment, the first part is an excavation tooth and the second part is the adaptor 6. In yet another embodiment, the first part is an excavation tooth and the second part is the nose 8.

In a preferred embodiment, the locking member 14 formed a tight fit within the passage 18 and the locking elements 12 could move within the oversized apertures 16. In an alternative embodiment, the locking member 14 may loosely fit and move within the passage 18 and the locking elements 12 may form a tight fit with the apertures 16. In yet an alternative embodiment, the locking member 14 may loosely fit and move within the passage 18 and the locking elements 12 may move within oversized apertures 16. In all of these embodiments, the locking member moves relative to the locking elements so that the locking elements engage with the adaptor and the locking member engages with the nose to lock the adaptor onto the nose.

In compliance with the statute, the invention has been described in language more or less specific to structural or methodical features. It is to be understood that the invention is not limited to specific features shown or described since the means herein described comprises preferred forms of putting the invention into effect. The invention is, therefore, claimed in any of its forms or modifications within the proper scope of the appended claims appropriately interpreted by those skilled in the art.
The claims defining the invention are as follows:

1. A locking device for locking an adaptor onto the nose of an excavator bucket, the locking device including:
   a locking member for engaging with the nose; and
   a pin arrangement including two pins for inserting into opposite sides of the locking member, adaptor and nose;
   wherein the adaptor can be locked onto the nose upon rotation of the pins.

2. A locking device as claimed in claim 1, further including an arrangement for facilitating rotation of the pins in one direction only when the adaptor is locked onto the nose.

3. A locking device as claimed in claim 2, wherein the adaptor can be unlocked from the nose by disabling said arrangement and then rotating the pins in an opposite direction to said one direction.

4. A locking device as claimed in claim 1, wherein the pin arrangement loosely fastens the adaptor onto the nose, prior to locking the adaptor onto the nose upon rotation of the pins.

5. A locking device as claimed in claim 1, wherein the locking member engages with the inside of the nose when the adaptor is locked onto the nose.

6. A locking device as claimed in claim 1, wherein the pin arrangement engages with the adaptor when the adaptor is locked onto the nose.

7. A locking device as claimed in claim 6, wherein the pin arrangement engages with the adaptor on either side of the nose.

8. A locking device as claimed in claim 1, wherein the adaptor defines a pair of lateral apertures through which respective pins are inserted and the nose defines a lateral passage in which the locking member is received.
9. A locking device as claimed in claim 1, wherein the locking member has a generally egg-shaped or tapered profile.

10. A locking device as claimed in claim 1, wherein each pin includes a shaft and a head eccentrically terminating the shaft.

11. A locking device for locking a first part relative to a second part, the locking device including:
   a locking member for engaging with one of the parts; and
   a pin arrangement including two pins for inserting into opposite sides of the locking member, first part and second part;
   wherein the first part can be locked relative to the second part upon rotation of the pins.

12. A locking device as claimed in claim 11, further including an arrangement for facilitating rotation of the pins in one direction only when the first part is locked relative to the second part.

13. A locking device as claimed in claim 12, wherein the first part can be unlocked relative to the second part by disabling said arrangement and then rotating the pins in an opposite direction to said one direction.

14. A locking device as claimed in claim 10, wherein the pin arrangement loosely fastens the first part relative to the second part, prior to locking the first part relative to the second part upon rotation of the pins.

15. A locking device as claimed in claim 10, wherein the locking member engages with the inside of the one part when the first part is locked relative to the second part.

16. A locking device as claimed in claim 10, wherein the pin arrangement engages with the other part when the first part is locked relative to the second part.
17. A locking device as claimed in claim 16, wherein the pin arrangement engages with the other part on either side of the one part.

18. A locking device as claimed in claim 1, wherein the one part defines a lateral passage in which the locking member is received the other part defines a pair of lateral apertures through which respective pins are inserted.

19. A locking device as claimed in claim 1, wherein the locking member has a generally egg-shaped or tapered profile, and each pin includes a shaft and a head eccentrically terminating the shaft.

20. A method for locking a first part relative to a second part, the method including the steps of:
   - tightening at least one fastener of a pin arrangement within a locking member; and
   - rotating pins of the pin arrangement to lock the first part relative to the second part.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.
E02F9/28 (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)
EPODOC & WPI; IPC & ECLA E02F9/28: key words: LOCK, PIN & like terms

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>
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<tbody>
<tr>
<td>X</td>
<td>US 7,681,344 B2 (RUANG) 23 March 2010 Figures 1-3; Column 5, line 6 to column 7, line 4; Column 8, lines 41-54</td>
<td>1-20</td>
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<tr>
<td>X</td>
<td>US 7,603,799 B2 (CAMPOMANES) 20 October 2009 Figures; Column 5, line 42 to column 6, line 20</td>
<td>1-8, 11-18, 20</td>
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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 the actual completion of the international search
23 January 2012

Date of mailing of the international search report
24 JANUARY 2012

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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.

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<td>US 200726 1278</td>
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Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX