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- (71) **Applicant (for all designated States except US):** **THE CHINESE UNIVERSITY OF HONG KONG** [CN/CN]; Shatin, N.T., Hong Kong (CN).
- (72) **Inventor; and**
- (75) **Inventor/Applicant (for US only):** **FONG, Tik-Pui Daniel** [CN/CN]; Room 1506, 15/F Block H, Yu Chai House, Yu Chui Court, Shatin, New Territories, Hong Kong (CN).
- (74) **Agent:** **INSIGHT INTELLECTUAL PROPERTY LIMITED**; 19 A, 19B, Tower A, InDo Building, No. 48A Zhichun Road, Haidian District, Beijing 100098 (CN).
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(54) **Title:** FINGER PROSTHESIS

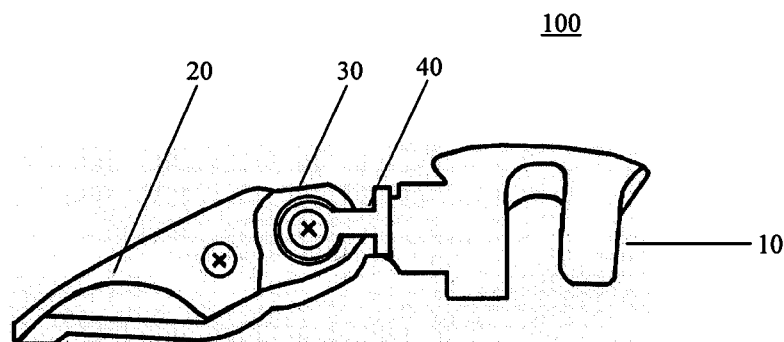


Fig 1

(57) **Abstract:** A finger prosthesis (100) is provided. The finger prosthesis (100) comprises a tip (20) for simulating different functions of a finger and a ring (10) for attaching the prosthesis to a stump. The finger prosthesis further comprises a joint (30) coupled between the tip (20) and the ring (10), wherein the joint (30) comprises an interlocking mechanism configured to allow the joint (30) to rotate at lockable intervals so as to lock the tip (20) into different positions during a flexion period of the finger prosthesis (100).

FINGER PROSTHESIS

Cross Reference of Related Applications

[0001] This application claims the benefit of U.S. provisional patent application No. 61/499,695 filed on June 22, 2011, which is explicitly incorporated by reference in its entirety as part of this application.

Background

[0002] Hand function is very important to human's daily life. Finger loss leads to weakened hand function, medical burden, diminished working capability and inferior quality of life. "X-finger", the world's first active-function artificial finger, has been invented for patients to regain the finger function. Such finger allows users to perform flexion and extension actively. However, due to the completed structure, this kind of finger is expensive and is often not affordable to most people, especially to those low-income factory workers who lost their fingers due to occupational accidents. The current proposal aims to design an inexpensive artificial finger.

Summary

[0003] In one aspect of the present application, a finger prosthesis is provided. The finger prosthesis comprises a tip for simulating different functions of a finger and a ring for attaching the prosthesis to a stump. The finger prosthesis further comprises a joint coupled between the tip and the ring, wherein the joint comprises an interlocking mechanism configured to allow the joint to rotate at lockable intervals so as to lock the tip into different positions during a flexion period of the finger prosthesis.

[0004] In another aspect of the present application, there is provided a finger prosthesis comprising: a tip for simulating different functions of a finger; and a ring for attaching the prosthesis to a stump. The finger prosthesis further comprises a joint coupled between the tip and the ring, wherein the joint comprises a shifting part with a first engaging end; and a rotating wheel with a second engaging end, wherein the second engaging end is capable of being interlocked with the first engaging end by a plurality of intervals.

[0005] According to one embodiment, the rotating part may be provided with a rebounding mechanism configured to make the rotating wheel to return to a start position at the end of the intervals.

[0006] In another aspect of the present application, there is provided a finger prosthesis comprising: a tip for simulating different functions of a finger; a ring for attaching the prosthesis to a stump; and a joint coupled between the tip and the ring. The joint comprises:

- a shifting part with a first plurality of gears; and

- a rotating wheel with a second plurality of gears, wherein the shifting part is capable of being interlocked with the rotating wheel through the first and second gears by a plurality of intervals;

- a capacity for receiving the shifting part;

- a support located in the capacity for supporting one side of the shifting part to provide a spring-like nature that allows little displacement of the shifting part;

- wherein the rotating wheel is provided with a first protuberance and a second protuberance located two sides of the second gears, and wherein, during an interlocked stage, the shifting part is located with one side of the capacity, at the end of the intervals, the first protuberance exerts a force on an end of the shifting part so that the shifting part is shifted to the other side of the capacity, allowing the rotating wheel to return to a start position.

Brief description of Drawings

[0007] Fig. 1 illustrates the finger prosthesis according to one embodiment of the present application.

[0008] Fig. 2 is a decomposition view for the finger prosthesis as shown in Fig. 1.

[0009] Fig. 3 illustrates the inner configurations of the joint according to one embodiment of the present application.

[0010] Fig. 4(a)-(e) illustrate the operation principle of the joint.

[0011] Fig. 5 illustrates flexion operation of the finger prosthesis according to one embodiment of the present application.

[0012] Fig. 6 illustrates six lockable intervals of the joint according to one embodiment of the present application.

Detailed Description

[0013] Fig. 1 illustrates the finger prosthesis 100 according to one embodiment of the present application. As shown, the finger prosthesis 100 comprises a ring 10 for attaching the prosthesis to a stump (not shown), and a tip 20 configured to simulate different functions of a finger. There is a joint 30 coupled between the tip 20 and the ring 10. Inside the joint 30, there is configured with an interlocking mechanism for allowing the joint to rotate at lockable intervals (for example, there may be six intervals) so as to lock the tip 20 into different positions during a flexion period of the finger prosthesis 100.

[0014] According to one embodiment, the ring 10 has a non-invasive ring like structure to attach the prosthesis 100 to the stump of the metacarpal bone surrounding with muscles and soft tissue. The ring 10 may be made of soft metal, for example sliver, that allows easy and fine adjustment with manual strength.

[0015] As shown in Fig. 2, the tip 20 may comprise an posterior portion 201 and a anterior portion 202 opposite to the posterior portion 201. The portions 201 and 202 may be made from silver metal and silicon, respectively. In order to better apply friction to the held object, silicon was used to form the posterior portion 201 of the tip, since it can be shaped easily by molding and is slightly deformable to maximize the contact area while holding object. The anterior portion 202 of the tip was made of silver plate which simulates the nail function in real finger for fine motion.

[0016] The joint 30 may be connected to the ring 10 through a connector 40. The connector 40 may also function to adjust the length of the finger prosthesis 100. That is, the more length the connector 40 has, the more length the finger prosthesis 100 will have.

[0017] In one embodiment, the interlocking mechanism in the joint 30 may comprise a rebounded type progressive hinge lock which is bent easily in one direction and locked against an opposite force. The rebounded type progressive hinge lock is often used in chairs, seats and sofas for adjusting the back support angle. The rebounded type progressive hinge lock may comprise a shifting part with a first engaging end, and a rotating part with a second engaging end. The second engaging end is capable of being interlocked with the first engaging end by a plurality of intervals of the flexion period. The rotating part may be further provided with a rebounding mechanism, which makes

the rotating part to return to the start position smoothly at the end of the sixth intervals. A more specific example of the interlocking mechanism is given as below in reference to Fig. 3.

[0018] Fig.3 illustrates the elements inside the joint 30 with the interlocking mechanism according to a specific example of the present application. In this example, the interlocking mechanism may comprise a shifting part 301, a rotating wheel 302 and a supporting part 303.

[0019] As shown in Fig. 3, there is provided a capacity 304 in the joint 30 for receiving the shifting part 301. During the flexion period, the shifting part 301 and the rotating wheel 302 may be interlocked by gears 3011 and 3012 at, for example, six intervals, and the shifting part is backed with the supporting part 303, which provides a spring-like nature that allows little displacement of the shifting part. The supporting part 303 may be of a thin sheet, for example, a thin aluminum sheet.

[0020] In addition, the rotating wheel 302 is further provided with two protuberances 3013 and 3014, which cooperate with the other elements of the interlocking mechanism to function as the rebounding mechanism, which will be discussed below.

[0021] Referring to Fig 4 (a), the shifting part 301 and the rotating wheel 302 may be interlocked by gears 3011 and 3012. As the connector 40 rotates according to the direction of arrow, which in turn makes the rotating wheel 302 to rotate in the same direction, the other side of the shifting part 301 is backed with the supporting part 303. In the Figs. 4(c) and (d), at the end of the intervals, the protuberance 3013 of the rotating wheel 302 exerts force on the end of the shifting part 301 and then the shifting part 301 would be shifted to the other side of the capacity 304, allowing the rotating wheel 302 to return to the start position smoothly. In Fig. 4 (e), as the rotating wheel 302 further rotates, the protuberance 3014 of the rotating wheel would push the shifting part 301 back to the “locking” position. In one embodiment, all moving parts in the joint may be made of stainless steel for longer duration while aluminum was chosen for other parts for weight reduction.

[0022] Fig. 5 illustrates the different flexion status of the prosthesis according to one embodiment of the present application. Fig. 6 illustrates the relationship between each

flexion status and the joint. In this embodiment, there are six intervals during the flexion. As shown, the joint starts working from zero flexion and then flexion is performed by assistance of another hand, with 15 degrees increment, until a 90-degree flexion is reached. At each of the intervals, the joint is locked to prevent extension of finger. This makes the thumb opposition nature of human hand for amputee become possible. When the flexion angle exceeds 90-degree, it rebounds and returns to starting position. In addition, the flexion is done by assistance of another hand or any rigid surface. At each of the angles, the shifting part and the rotating part gets locked by the gears to prevent extension, thus providing a rigid support for hand grip. To reset the device to full extension, just flex it to 90 degrees and it gets rebounded to the original position.

[0023] The finger prosthesis allows user to regain flexion and extension movement of finger. The prosthesis can restore the opposition function of patient with multiple digit amputation. By applying enough prosthesis on the involved hand, it is possible for them to pick up large heavy object.

[0024] While the present application has been illustrated by the above description and embodiments or implementations, it is not intended to restrict or in any way limit the scope of the appended claims hereto.

What is claimed is:

1. A finger prosthesis comprising:
a tip for simulating different functions of a finger;
a ring for attaching the prosthesis to a stump; and
a joint coupled between the tip and the ring, wherein the joint comprises an interlocking mechanism configured to allow the joint to rotate at lockable intervals so as to lock the tip into different positions during a flexion period of the finger prosthesis.
2. A prosthesis of claim 1, wherein the interlocking mechanism comprises a rebounded type progressive hinge lock, which is capable of being bent in a first direction and locked against an force with a second direction, the second direction being substantively opposite to the first direction.
3. A prosthesis of claim 2, wherein the rebounded type progressive hinge lock comprises:
a shifting part with a first engaging end; and
a rotating part with a second engaging end, wherein the second engaging end is capable of being interlocked with the first engaging end by a plurality of intervals.
4. A prosthesis of claim 3, wherein each of the first and second engaging ends comprises a plurality of gears, and the second engaging end is capable of being interlocked with the first engaging end through the gears.
5. A prosthesis of claim 3, wherein the rotating part is provided with a rebounding mechanism configured to make the rotating part to return to a start position at the end of the intervals.
6. A prosthesis of claim 5, wherein rebounding mechanism comprises two protuberances on the rotating part.
7. A prosthesis of claim 3, wherein the joint comprises a capacity for receiving the shifting part.

8. A prosthesis of claim 7, wherein during an interlocked stage, the shifting part is located in one side of the capacity.

9. A prosthesis of claim 8, wherein, at the end of the intervals, the rebounding mechanism exerts a force on an end of the shifting part so that the shifting part is shifted to the other side of the capacity, allowing the rotating part to return to a start position.

10. A prosthesis of claim 7, wherein there is provided a support part in the capacity for supporting one side of the shifting part to provide a spring-like nature that allows little displacement of the shifting part.

11. A prosthesis of claim 10, wherein the support part comprises a sheet-like shape.

12. A prosthesis of claim 3, wherein the shifting part and rotating part are configured to cooperate to make the two parts interlocked by 6 intervals.

13. A prosthesis of claim 1, wherein the ring comprises a non-invasive ring like structure to attach the prosthesis to the stump.

14. A prosthesis of claim 1, wherein the tip comprises an anterior portion and a posterior portion opposite to the anterior portion, the anterior portion and the posterior portion are made from silver metal and silicon, respectively, in order to simulate different functions of the finger.

15. A finger prosthesis comprising:

a tip for simulating different functions of a finger;

a ring for attaching the prosthesis to a stump; and

a joint coupled between the tip and the ring, wherein the joint comprises:

a shifting part with a first engaging end; and

a rotating wheel with a second engaging end, wherein the second engaging end is capable of being interlocked with the first engaging end by a plurality of intervals.

16. A prosthesis of claim 15, wherein the rotating wheel is provided with a rebounding mechanism configured to make the rotating wheel to return to a start position at the end of the intervals.

17. A finger prosthesis comprising:

a tip for simulating different functions of a finger;

a ring for attaching the prosthesis to a stump; and

a joint coupled between the tip and the ring, wherein the joint comprises:

a shifting part with a first plurality of gears; and

a rotating wheel with a second plurality of gears, wherein the shifting part is capable of being interlocked with the rotating wheel through the first and second gears by a plurality of intervals;

a capacity for receiving the shifting part;

a support located in the capacity for supporting one side of the shifting part to provide a spring-like nature that allows little displacement of the shifting part;

wherein the rotating wheel is provided with a first protuberance and a second protuberance located two sides of the second gears,

wherein, during an interlocked stage, the shifting part is located in one side of the capacity, at the end of the plurality of intervals, the first protuberance exerts a force on an end of the shifting part so that the shifting part is shifted to the other side of the capacity, allowing the rotating wheel to return to a start position.

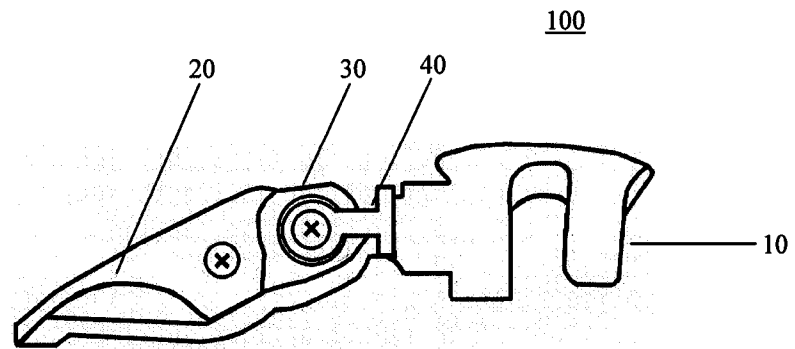


Fig 1

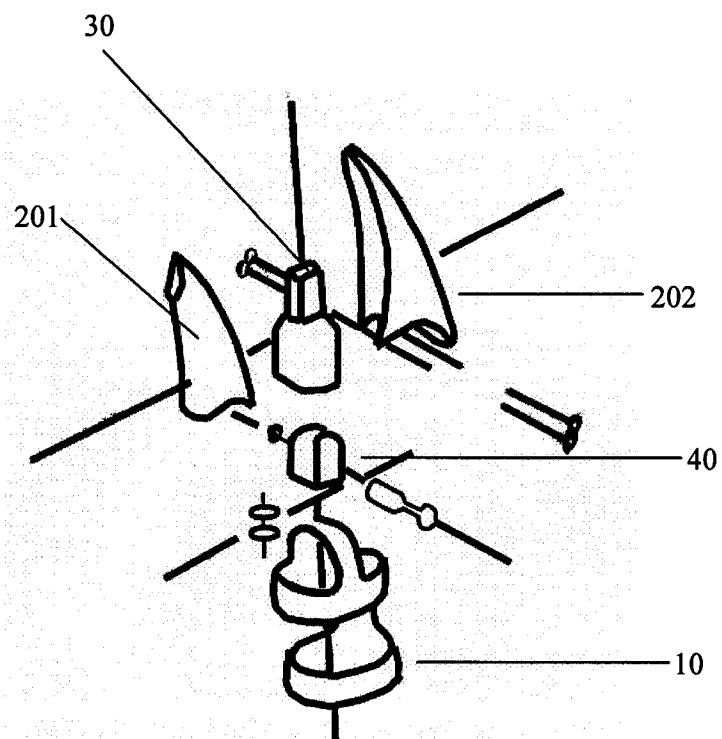


Fig 2

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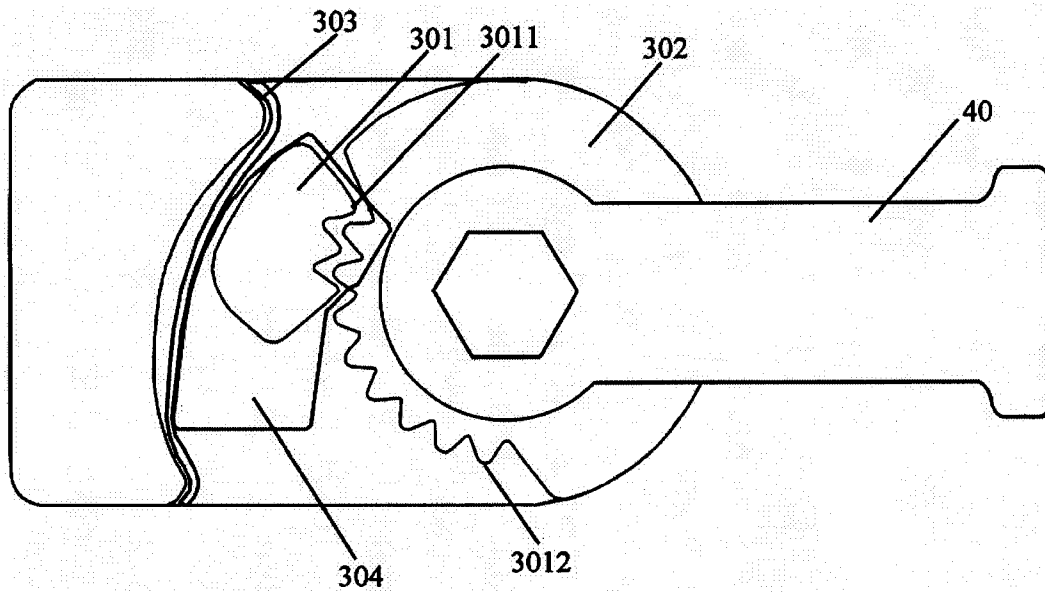


Fig 3

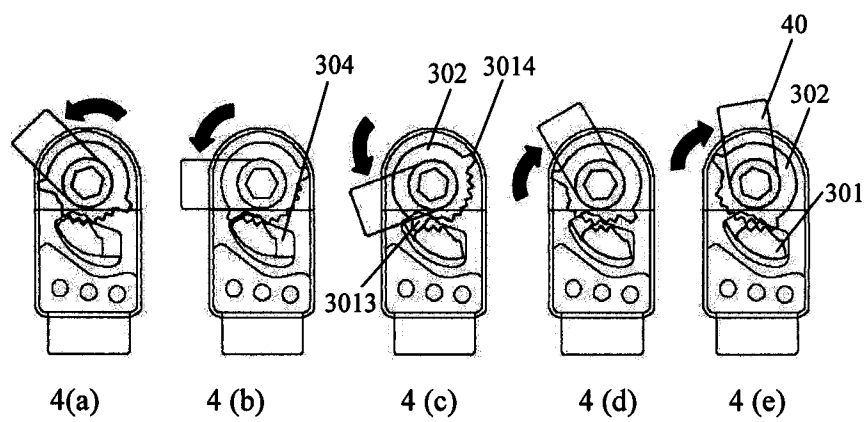


Fig 4

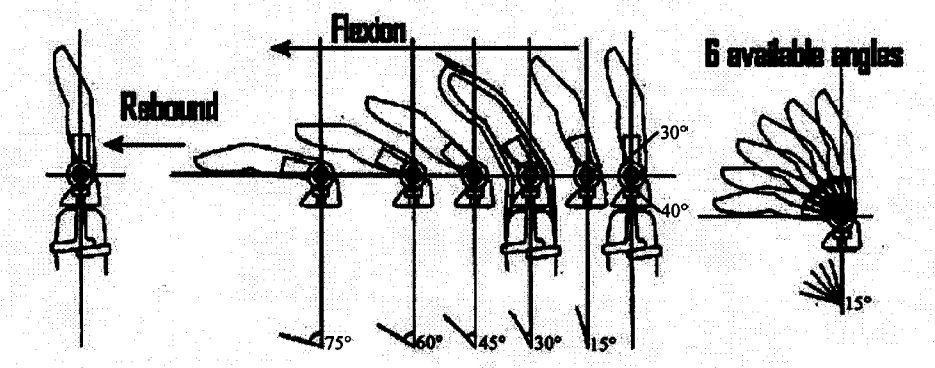


Fig 5

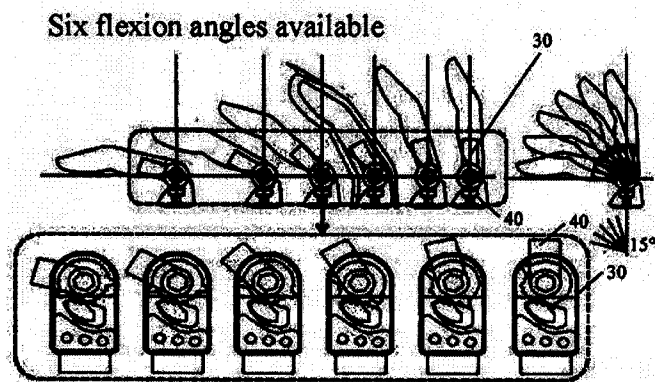


Fig 6

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2012/077350

A. CLASSIFICATION OF SUBJECT MATTER

A61F2/54 (2006.01) i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: A61F2/-; EC: A61F2/58H4

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)

CNKI, CNPAT, WPI, EPODOC: Finger?, Digit?, Prosthetic, Prosthesis, Artificial, Joint, Pivot+, Lock+, Rebound+, Gear+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN101147707A (LI, Minghao) 26 Mar. 2008 (26.03.2008) figure 1, page 2 line 4 to page 3 line 7 in the description)	1,13,14
A	CN1832711A (DIDRICK, Daniel) 13 Sept. 2006 (13.09.2006) the whole document	1-17
A	CN201299671Y (QUE, Yutao) 02 Sept. 2009 (02.09.2009) the whole document	1-17
A	GB108872 (ROBINSON, Enos) 30 Aug. 1917 (30.08.1917) the whole document	1-17
A	GB123180 (ROBINSON, Enos) 20 Feb. 1919 (20.02.1919) the whole document	1-17
A	US1285617 (CARON, Louis G) 26 Nov. 1918 (26.11.1918) the whole document	1-17
A	US2598593 (INTERNATIONAL BUSINESS MACHINES CORP.) 27 May 1952 (27.05.1952) the whole document	1-17

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:	“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
“A” document defining the general state of the art which is not considered to be of particular relevance	“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
“E” earlier application or patent but published on or after the international filing date	“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
“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)	“&” document member of the same patent family
“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	

Date of the actual completion of the international search 27 Aug. 2012 (27.08.2012)	Date of mailing of the international search report 04 Oct. 2012 (04.10.2012)
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer KONG Xiangyun Telephone No. (86-10)82245076

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2012/077350

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN101147707A	26. 03. 2008	NONE	
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US2598593	27.05.1952	NONE	