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(71) Applicant: **Hangzhou XZB Tech Co. Ltd**
Hangzhou, Zhejiang 311121 (CN)

(72) Inventor: **XU, Na**
Hangzhou
Zhejiang 311121 (CN)

(74) Representative: **Dix, Lina**
Bronhofer Lukac Langlotz & Partner Rechtsanwälte
Sendlinger-Tor-Platz 5
80336 München (DE)

(54) METHOD FOR MACHINING AND SHAPING ROCKER ARM FRAME

(57) The present invention pertains to the field of engine fittings manufacturing, and specifically relates to a method for machining and shaping a rocker arm frame. The rocker arm frame includes an integrally-molded soleplate and side walls, wherein one end of the soleplate has an H-shaped curved crown, the other end has a ball socket, a bottom of the ball socket is provided with a small oil hole, and the side walls are each provided with a pin shaft hole. The method of machining and shaping comprises the following steps: A. blanking of a rocker arm frame profile, wherein a plate-shaped workpiece of the rocker arm frame is punched out by using a punch; B. pre-bending, wherein the plate-shaped workpiece is pre-bent to form a W-shaped curved crown part; and C. applying lateral extrusion to the W-shaped curved crown part to form a primary product of a rocker arm frame having the required H-shaped curved crown. The method solves the problem of severe local thinning in the course of shaping the side walls of the curved crown, and eliminates an interspace between the two side walls so that the two side walls can tightly fit with each other.

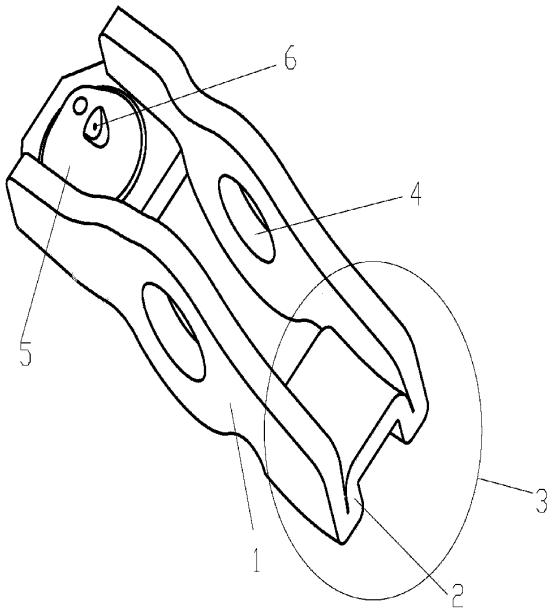

FIG. 1

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Description

FIELD OF THE INVENTION

[0001] The present invention pertains to the field of engine fittings manufacturing, and specifically relates to a method for machining and shaping a rocker arm frame.

BACKGROUND OF THE INVENTION

[0002] With the development of engine technologies, technologies for manufacturing a roller rocker arm, which is a major part of a valve rocker or a roller rocker arm, experience stages of casting forming, hot-forging forming, cold stamping forming and the like. At present, all advanced manufacturing technologies adopt a progressive die continuous cold stamping forming process. A roller rocker arm manufactured by using cold stamping forming is light in weight, high in intensity, good in conformity, and high in production efficiency, etc.

[0003] An existing rocker arm frame structure is as shown in FIG. 1: a curved crown structure of the rocker arm frame matching up with a valve is an "H" shape, during forming, side walls need to be bent by 180°. In a traditional forming process, a plate is first bent into a "U" shape, and then is extruded upward and folded into an "H" shape. This forming process has the following disadvantages: 1. side walls are severely locally stretched and thinned, which has a negative effect on the structural intensity and a risk of fatigue fracture; an interspace exists between two side walls which do not fit with each other, thus a rigidity is poorer, which may produce vibration and abnormal noise during working and thus having a negative effect on normal operation of an engine.

SUMMARY OF THE INVENTION

[0004] An objective of the present invention and creation is to provide a new technology for machining and shaping a rocker arm frame which is a constituent of a roller rocker arm of a valve mechanism having a hydraulic automatic compensation clearance. The present invention solves the problem of severe local thinning in the course of shaping the side walls of the curved crown, and eliminates an interspace between the two side walls so that the two side walls can tightly fit with each other.

[0005] In order to achieve the above objective, the present invention adopts the following technical scheme.

[0006] A method for machining and shaping a rocker arm frame, where the rocker arm frame includes an integrally-molded soleplate and side walls, one end of the soleplate has an H-shaped curved crown, the other end has a ball socket, a bottom of the ball socket is provided with a small oil hole, and the side walls are each provided with a pin shaft hole. The method of machining and shaping includes the following steps:

A. blanking of a rocker arm frame profile, where a plate-shaped workpiece of the rocker arm frame is punched out by using a punch;

B. pre-bending, where the plate-shaped workpiece is pre-bent to form a W-shaped curved crown part; and

C. applying lateral extrusion to the W-shaped curved crown part to form a primary product of a rocker arm frame having the required H-shaped curved crown.

[0007] The method of machining and shaping includes the following steps:

a. punching a guide pin hole, where a raw material steel belt is placed in a progressive die device and is punched a guide pin hole;

b. blanking of a rocker arm frame profile, where a plate-shaped workpiece of the rocker arm frame is punched out by using a punch;

c. pre-bending, where the plate-shaped workpiece is pre-bent to form a W-shaped curved crown part;

d. applying lateral extrusion to the W-shaped curved crown part to form a primary product of a rocker arm frame having the required H-shaped curved crown;

e. extrusion forming a cambered surface of the ball socket and the curved crown simultaneously at one go to ensure a location degree of the cambered surface of the ball socket and the curved crown;

f. side punching the pin shaft hole;

g. blanking;

h. thermal processing; and

i. laser puncturing, the small oil hole inside the ball socket is processed by using a laser punching device.

[0008] The method of machining and shaping includes a step for laser puncturing the small oil hole.

[0009] The step for laser puncturing is after the step of thermal processing.

[0010] Before the step of pre-bending there is provided with a step of rolling groove, at a W-shaped bent part there is provided a rolling groove.

[0011] The curved crown part is first bent into a "W" shape, and then lateral extrusion is applied to the side walls so that the curved crown part is formed into an "H" shape.

[0012] An objective of the present invention and creation is to provide a new technology for machining the small oil hole, improve the production efficiency of the

rocker arm frame and eliminate the risk of clogging of the small oil hole.

[0013] The bottom of the ball socket of the rocker arm frame is provided with the small oil hole, when an engine is working, high-pressure lubricating oil transferred from an oil pump is ejected from the small oil hole to lubricate a cam and a roller transmission pair on the roller rocker arm, and a bore diameter of the oil hole generally is smaller than 0.5mm. In the prior art, blanking on a progressive die needs multiple workstations to be implemented, a mold structure is complex, requirements for mold material and machining precision are high, a punch pin is easy to be broken during work and short in service life, it is time-consuming and laborious to replace a punch pin, thereby having a negative effect on tact time and machining efficiency of the whole progressive die. In addition, there is a risk of clogging of the small oil hole in subsequent manufacturing procedures such as thermal processing and roll polishing of the small oil hole of the rocker arm frame.

[0014] The small oil hole of the rocker arm frame of the present invention does not adopt a blanking process. Instead, the small oil hole is placed in the rocker arm frame for forming and thermal processing, and then is machined by a laser punching device.

[0015] Compared with the existing forming process technology, the forming process of the present invention has the following beneficial effects:

1. Two side walls are uniform in wall thickness without obvious local thinned part, and thus are good in intensity.

2. 180° bent parts of the side walls are extruded into "H" shapes by two side slide blocks, and the two formed side walls can tightly fit with each other and have good structural rigidity.

3. A workpiece is pre-bent into a "W" shape, and then is formed into an "H" shape by applying lateral extrusion. Compared with a process where a workpiece is pre-bent into a "U" shape and then is forcibly extruded upward and folded into an "H" shape, a mould is subjected to a small force and has a long service life.

4. By using the machining process of laser puncturing, a structure of the progressive die is simplified, a fault rate and number of mould replacement times are reduced, the production efficiency of the progressive die is improved, and the risk of clogging of the small oil hole caused by other working procedures is eliminated.

5. A diameter of the small oil hole on the rocker arm frame has a great effect on oil supply pressure loss of an oil pump. Therefore, it is expected that the oil hole is made as small as possible. However, it is relatively difficult to punch a small hole smaller than 0.3mm by using a mould, but it is very easy and convenient to machine a small hole smaller than 0.3mm by using laser puncturing with a higher production efficiency and lower cost.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

FIG. 1 is a schematic three-dimensional structural diagram of an isometric axis of a rocker arm frame.

FIG. 2 is a schematic diagram showing that a curved crown part is pre-bent into a "U" shape and then is extruded upward and folded into an "H" shape.

FIG. 3 is a schematic diagram showing that a curved crown part is pre-bent into a "W" shape and then is sideways extruded into an "H" shape.

FIG. 4 is a schematic cross-sectional view of a rocker arm frame.

FIG. 5 is a schematic diagram of a second embodiment of the technology of the rocker arm frame.

FIG. 6 is a schematic diagram of a transformation of the second embodiment of the technology of the rocker arm frame.

[0017] 1 side wall I; 2 side wall II; 3 curved crown; 4 pin shaft hole; 5 ball socket; 6 small oil hole; 7 two side walls tightly fitting with each other; 8 two side walls having thicknesses; 9 flat upper rolling groove; 10 arc lower rolling groove; 11 arc upper rolling groove; 12 V-shaped lower rolling groove; 20 thinner side wall II in the prior art; 30 curved crown in the prior art; 70 interspace; 80 intersection portion; 100 U-shaped workpiece; 101 workpiece in the present invention; 300 curved crown section in the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0018] The following further describes the embodiments of the present invention with reference to the accompanying drawings: the process for continuously forming a rocker arm frame by using a steel belt on a progressive die mainly has the following processing steps: punching a guide pin hole; blanking of a rocker arm frame profile; pre-bending into a "W" shape; sideways extruding into an "H" shape; extrusion forming a cambered surface of a ball socket and a curved crown simultaneously at one go; side punching a pin shaft hole; and blanking, etc. As shown in FIG. 2, in a traditional forming process, a curved crown part is pre-bent into a U-shaped workpiece 100, then the side wall I 1 is pressed down by an upper mould, and the workpiece is extruded

upward and stretched into an "H" shape. Limited by a size L, when the workpiece is extruded upward, the intersection portion 80 of the side wall II 20 and the curved crown 30 is severely locally stretched and thinned, which greatly reduces the intensity and leads to a risk of fatigue fracture during work. Additionally, the formed side wall I and the side wall II do not fit with each other, a larger gap or interspace 70 exists, a rigidity is poorer, which has a negative effect on the structural rigidity of the rocker arm frame, and vibration and abnormal noise may be produced when an engine is working.

[0019] The forming process of the present invention is as shown in FIG. 3, in the forming process, the side wall I 1 and the side wall II 2 deform relatively uniform without being obviously stretched and thinned. After being sideways extruded into an "H" shape, the side wall I1 and the side wall II 2 tightly fit with each other, and the curved crown 3 is good in rigidity. Therefore, the intensity and the rigidity of the whole rocker arm frame are superior to those of the traditional forming process, as shown in FIG. 3, two side walls tightly fit with each other 7, and two side walls have uniform thicknesses 8.

[0020] As shown in FIG. 4, the process adopts a laser puncturing method to machine the small oil hole 6 of the rocker arm frame, which is carried out after the working procedures of forming of the rocker arm frame, roll polishing for debarring, thermal processing, shot blasting and so on. After the laser puncturing, ultrasonic cleaning is performed, there is no risk of clogging of the small oil hole, and the bore diameter of the small oil hole may be smaller than 0.2mm, and the machining efficiency is higher and may reach about 60 pieces per minute, whereas a traditional progressive die process tact is about 30 pieces per minute. Upper punching of a small oil hole is performed by using a traditional progressive die, the bore diameter of the small oil hole is more than 0.3mm, and it needs multiple workstations to punch the small oil hole out. A mould of punching is a complex wedge slide block structure, requirements for mould material and machining precision are very high, the punch pin is short in service life and easily goes wrong, a frequency in replacing a mould is high, and a rejection rate of the rocker arm frame is high. After the rocker arm frame is formed, working procedures of roll polishing, thermal processing and shot blasting or the like may clog the small oil hole, and thus a working procedure is added to check whether the oil hole is clogged or not when the final product is finished. By comparison, the new laser puncturing process replaces traditional oil hole machining processes because it has the advantages of higher production efficiency and lower cost.

[0021] The foregoing embodiment is only an embodiment of a processing technology of the rocker arm frame. The present invention may also have multiple shift processes. For example, as shown in FIG. 5 and FIG. 6, before the rocker arm frame is pre-bent into a "W" shape, the step of rolling groove is added, and other forming processes are the same as Embodiment I.

[0022] The depth of the rolling groove is smaller than one third of the thickness of the plate. Too deep rolling groove may have a negative effect on the whole mechanical stability, whereas too shallow rolling groove may not reach a desired effect.

[0023] A shape of a rolling groove I is a plane or an arc surface, and the shape of a rolling groove II is an arc surface or an inverted V. Settings of the foregoing shapes of the rolling grooves are more beneficial to bending.

[0024] Adding the processing step of a rolling groove has the following advantages: 1. reducing bending forming force; 2. making good symmetry during bending; 3. reducing overlap of a bent part; 4. reducing forming force when it is pre-bent into a "W" shape and sideways extruded into an "H" shape, which is advantageous to prolonging the service life of a mould.

Claims

1. A method for machining and shaping a rocker arm frame, wherein the rocker arm frame comprises an integrally-molded ball socket, a curved crown and two symmetrical side walls, one end of the two side walls is connected to the H-shaped curved crown, the other end is connected to the ball socket, a bottom of the ball socket is provided with a small oil hole, and the side walls are each provided with a pin shaft hole; wherein the method of machining and shaping comprises the following steps:

   blanking of a rocker arm frame profile, wherein a plate-shaped workpiece of the rocker arm frame is punched out by using a punch;
   pre-bending, wherein the plate-shaped workpiece is pre-bent to form a W-shaped workpiece; and
   lateral extrusion, applying lateral extrusion to the W-shaped workpiece to form a primary product of a rocker arm frame having the required H-shaped curved crown.

2. The method for machining and shaping a rocker arm frame according to claim 1, wherein the method of machining and shaping comprises following steps:

   a. punching a guide pin hole, wherein a raw material steel belt is placed in a progressive die device and is punched a guide pin hole out;
   b. blanking of a rocker arm frame profile, wherein a plate-shaped workpiece of the rocker arm frame is punched out by using a punch;
   c. pre-bending, wherein the plate-shaped workpiece is pre-bent to form a W-shaped curved crown part;
   d. applying lateral extrusion to the W-shaped curved crown part to form a primary product of a rocker arm frame having the required H-

shaped curved crown;
e. extrusion forming a cambered surface of the ball socket and the curved crown simultaneously at one go to ensure a location degree of the cambered surface of the ball socket and the curved crown;
f. side punching the pin shaft hole;
g. blanking;
h. thermal processing; and
i. laser puncturing, the small oil hole inside the ball socket is processed by using a laser punching device.

3. The method for machining and shaping a rocker arm frame according to claim 1, wherein the method of machining and shaping comprises a step for laser puncturing the small oil hole.

4. The method for machining and shaping a rocker arm frame according to claim 3, wherein the step for laser puncturing is after the step of thermal processing.

5. The method for machining and shaping a rocker arm frame according to claim 1 or 2, wherein before the step of pre-bending there is provided with a step of rolling groove, at a bent part of the W-shaped workpiece there is provided a rolling groove.

6. The method for machining and shaping a rocker arm frame according to claim 5, wherein a depth of the rolling groove is smaller than one third of a thickness of the plate.

7. The method for machining and shaping a rocker arm frame according to claim 5, wherein a shape of a rolling groove I is a plane or an arc surface, and the shape of a rolling groove II is an arc surface or an inverted V.

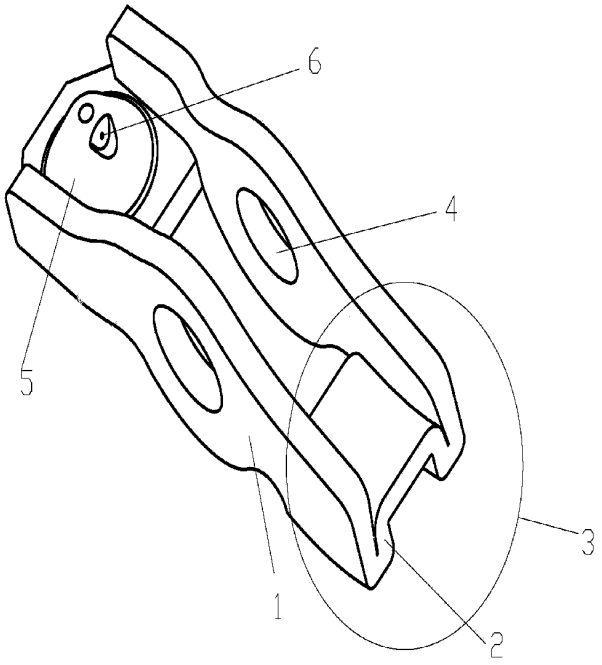

FIG. 1

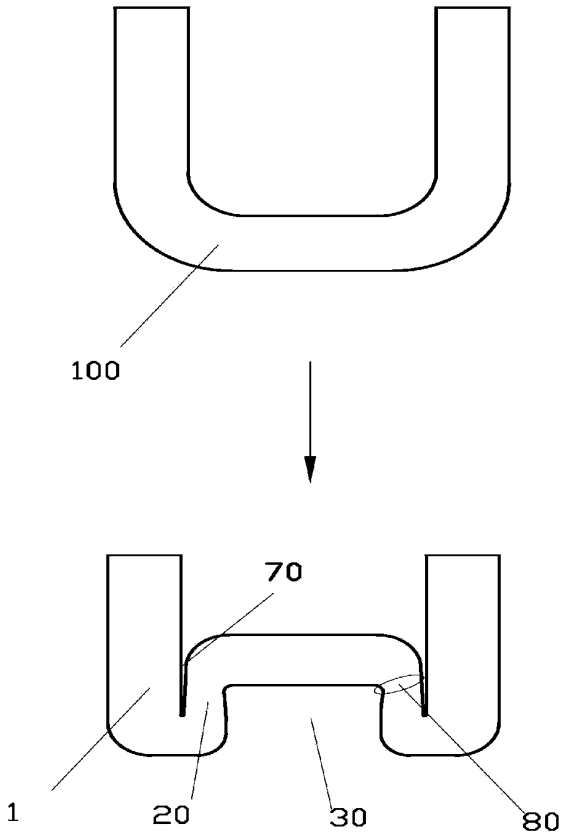

FIG. 2

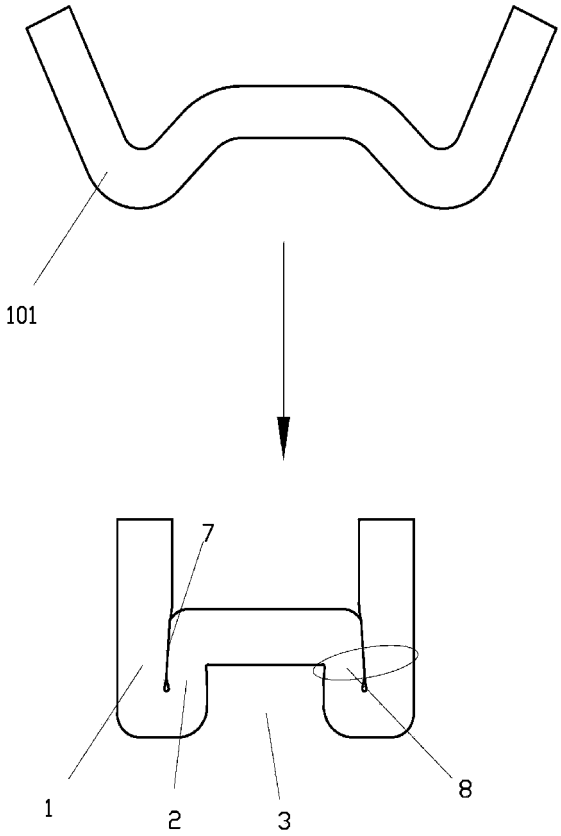

FIG. 3

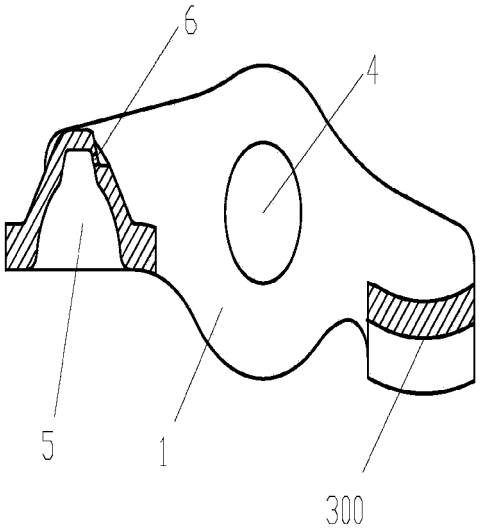

FIG. 4

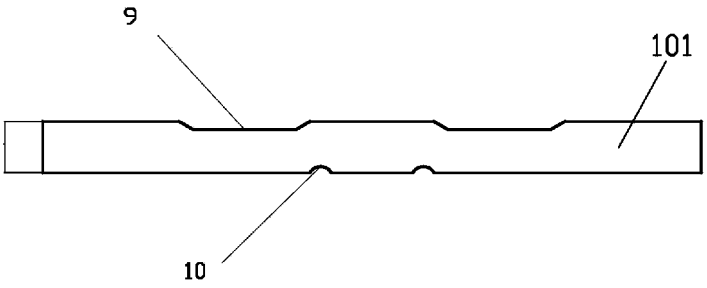

FIG. 5

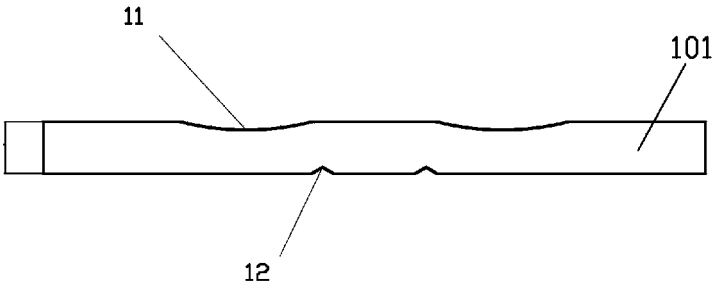

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2013/091167

A. CLASSIFICATION OF SUBJECT MATTER

B21D 53/84 (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)

B21D; B23P

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, CNPAT, CNKI: rocker, machining, punch, bending, press, extrude, crown

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2001047179 A (NSK LTD.), 20 February 2001 (20.02.2001), description, columns 1-11, and figures 1-13	1-7
A	JP 2001198641 A (OTICS CORP. et al.), 24 July 2001 (24.07.2001), the whole document	1-7
A	CN 1509216 A (TOHO INDUSTRIAL CO., LTD. et al.), 30 June 2004 (30.06.2004), the whole document	1-7
A	CN 101247905 A (NAKANISHI METAL WORKS CO., LTD. et al.), 20 August 2008 (20.08.2008), the whole document	1-7

☐ 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	Date of mailing of the international search report
02 June 2014 (02.06.2014)	**08 July 2014 (08.07.2014)**
Name and mailing address of the ISA/CN: State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No.: (86-10) 62019451	Authorized officer **ZHANG, Wei** Telephone No.: (86-10) **62085300**

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2013/091167

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
JP 2001047179 A	20 February 2001	None	
JP 2001198641 A	24 July 2001	None	
CN 1509216 A	30 June 2004	EP 1380368 A1	14 January 2004
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