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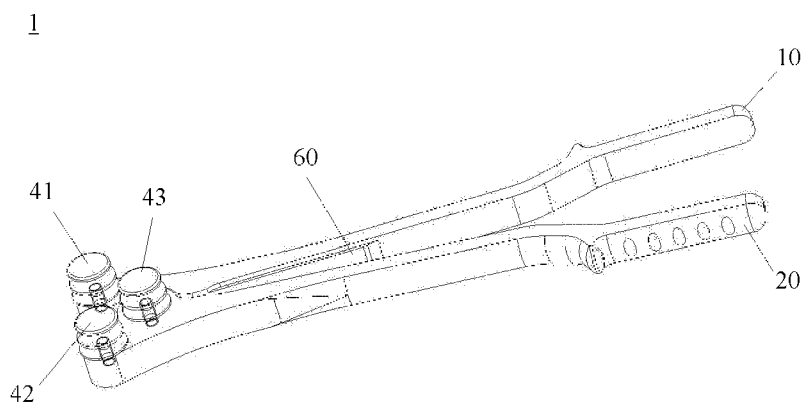


Fig.3

(57) Abstract: A bender (1) comprises a first operation arm (10) comprising a roller end and an operation end, a second operation arm (20) comprising a roller end and an operation end, and the first operation arm (10) and the second operation arm (20) connect together at a pivot (30) and are pivotable around the pivot (30). A first roller (41) is mounted on the roller end of the first operation end. A second roller (42) is mounted on the roller end of the second operation end. A third roller (43) is mounted on the pivot (30), wherein a roller head (45) of the third roller (43) at least comprises a first portion (451) of a first diameter and a second portion (452) of a second diameter. The first diameter is larger than the second diameter, so that the roller head (45) is formed in a stepped shape. The bender (1) provides two or more steps of bending, so that it can be operated conveniently.



BENDER

FIELD OF THE INVENTION

The present invention relates to a surgical instrument, particularly relates to a bender for bending a fixing rod/fixing plate used in a bone surgery.

BACKGROUND OF THE INVENTION

Bone structure is susceptible to a variety of weakness or diseases, including bone broken, fractures, degeneration, dislocation and the like. Treating methods and devices are developed for curing or at least alleviating the suffering of the patient. Taking the spinal as an example, when problems such as dislocation of the vertebrae, extradiscal occur, the diseased vertebrae are corrected through surgery. During surgery, two adjacent vertebrae are generally fused together by means of an elongated fixing rod/fixing plate, so as to stabilize the vertebrae.

In some cases, the fixing rod/fixing plate used during surgery need to be bent, for accommodating the anatomy of the patient.

Fig.1 shows a prior art bend 100, and schematically shows the operation of the bend 100. When the fixing rod/fixing plate is bent, two benders 100 are used, fixing two ends of the fixing rod/fixing plate, respectively. Thus, two hands are necessary for implementing the bending. Thus, it can be seen that the operation of the bender 100 shown in Fig.1 is complex.

In order to facilitate in operation, another kind of prior art bender 200 is developed, as shown in Fig.2. The bender 200 has two operation arms 210 connected to each other at a pivot, and the arms are rotatable around the pivot. An arcuate seat 220 is provided at the pivot, for providing bending shape for the fixing rod/fixing plate. One end of each operation arm 210 is provided with a roller 230, respectively. The rollers 230 cooperate with the arcuate seat 220 to bend the fixing rod/fixing plate into a desired shape.

Compared with the bender 100 shown in Fig.1, the bender 200 shown in Fig.2 can be

handled by one hand, so its operation is relatively simple. However, there is still problem that may be occurred during operating the bender 200. Especially, when the surgeon using the bender 200 has a relative smaller hand, it may be difficult for him/her to hold the two operation arms 210 of the bender 200 by one hand, thus, still need two hands to operate the bender, or need other's help. Thus, in some cases, the operation of the bender 200 is still not very convenient.

Therefore, there is a need for a novel bender with simple structure and easy to be operated.

SUMMARY OF THE INVENTION

The present invention is made in view of the above mentioned technical problem in the art. And, the object of the present invention is providing a bender with simple structure and can be easily operated.

The above object of the present invention is achieved by a bender comprising: a first operation arm comprising a roller end and an operation end, a first roller is mounted on the roller end of the first operation end; a second operation arm comprising a roller end and an operation end, a second roller is mounted on the roller end of the second operation end, and the first operation arm and the second operation arm connect together at a pivot and are pivotable around the pivot, a third roller is mounted on the pivot; wherein a roller head of the third roller at least comprises a first portion of a first diameter and a second portion of a second diameter, the first diameter is larger than the second diameter, so that the roller head is formed in a stepped shape.

In the bender of the present invention, the roller head of at least the third roller is formed in a stepped shape, which includes at least two portions, thus the fixing rod/fixing plate may be bent in two or more steps by the portions of the rollers with different diameters of the third roller. Thus, in each bending, the distance between the operation ends of the operation arms may be relative smaller, so that the operation is facilitated.

Further, similar to the third roller, the roller head of at least one of the first roller and the

second roller is also formed in a stepped shape.

The roller is mounted onto the operation arm as follows: a first roller mounting aperture is formed at the roller end of the first operation arm, a shank of the first roller extends into the first roller mounting aperture from one side of the first roller mounting aperture, and a first screw extends into the first roller mounting aperture from another side of the first roller mounting aperture, and is screwed in a threaded bore formed in the shank of the first roller. The second and the third rollers may be mounted onto the roller end of the second operation arm and the pivot by the same or similar way.

Preferably, a biasing device is provided between the first operation arm and the second operation arm, the biasing device is located between the operation ends of the first and second operation arms and the pivot, and applies a biasing force on the first operation arm and the second operation arm, so that the operation end of the first operation arm is spaced apart from the operation end of the second operation arm.

One possible structure of the biasing device may be formed of two elastic sheets, the two elastic sheets connect to each other at one end thereof, and the other end of the two elastic sheets connect respectively to the first operation arm and the second operation arm.

Another possible structure of the biasing device is a compression spring, the ends of the compression spring connect respectively to the first operation arm and the second operation arm.

The present invention further relates to a method for bending a fixing rod/fixing plate by means of the bender as mentioned above. The method includes the following steps in sequence:

- a. maintaining the first operation arm and the second operation arm in a status that the operation ends thereof are spaced apart from each other;
- b. positioning the fixing rod/fixing plate between the first and second rollers and the third rollers, and abutting the fixing rod/fixing plate against the second portion of the third roller;
- c. applying an external force on the operation ends of the first operation arm and the

second operation arm, so that the operation ends of the first operation arm and the second operation arm move towards each other;

d. removing the external force, and restore the operation ends of the first operation arm and the second operation arm to the status of being spaced apart from each other;

e. repositioning the fixing rod/fixing plate, so that the fixing rod/fixing plate abuts against the first portion of the third roller; and

f. applying an external force on the operation ends of the first operation arm and the second operation arm, so that the operation ends of the first operation arm and the second operation arm move towards each other once again.

In case that the roller head of at least one of the first roller and the second roller is also formed in a stepped shape, in step b, the fixing rod/fixing plate further abuts against a portion with smaller diameter of the roller head of at least one of the first roller and the second roller.

Also, in case that the roller head of at least one of the first roller and the second roller is also formed in a stepped shape, in step e, the fixing rod/fixing plate further abuts against a portion with larger diameter of the roller head of at least one of the first roller and the second roller.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig.1 shows a perspective view of a prior art bender, which shows how the bender is operated.

Fig.2 shows a plane view of a prior art bender in another form.

Fig.3 shows a perspective view of a bender of the present invention.

Fig.4 shows a perspective view of the bender of Fig.3, which is partially exploded.

Fig.5 shows a perspective view of a roller used in the bender of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The embodiment of the present invention will be described in detail with reference to the

drawings. The following embodiment described with reference to the drawings is just the preferred one, and does not mean to limit the scope of the present invention. Based on the present disclosure, the present invention is susceptible to various modification, variation and equivalent replacement, all of which fall in the protective scope of the present invention.

Fig.3 shows a perspective view of a bender 1 of the present invention, and Fig.4 shows the bender 1 partially exploded.

As shown in Fig.3, the bender 1 includes a pair of operation arms, i.e. the first operation arm 10 and the second operation arm 20. The first operation arm 10 and the second operation arm 20 are pivotably connected together at a pivot 30, and are rotatable about the pivot 30. The pivot 30 can be formed by any way known in the art. For example, tabs may be formed on the first operation arm 10 and the second operation arm 20, respectively, the tabs on the operation arms are formed by holes, through which a bolt may pass, thus connecting the tabs on the two operation arms together. Therefore, the first operation arm 10 and the second operation arm 20 is pivotably about the bolt.

A first roller 41 is mounted on one end of the first operation arm 10. Similarly, a second roller 42 is mounted on one end of the second operation arm 20, and a third roller 43 is mounted at the pivot 30. In the structure of the bender shown in Figs.3 and 4, the third roller 43 operates as the bolt pivotably connecting the first operation arm 10 and the second operation arm 20, as described above. And, for facilitating describing, the end of the operation arm mounted by the roller is termed as a roller end, and the other end of the operation arm is termed as an operation arm.

The rollers 41~43 are mounted as shown in the partially exploded view of Fig.4. Taking the first roller 41 as an example, it can be seen from Fig.4 that the roller end of the first operation arm 10 is formed by a first roller mounting aperture 11. A shank 44 of the first roller 41 can be inserted into the first roller mounting aperture 11 from one side of the first roller mounting aperture 11, and a first screw 51 is inserted from the other side of the first roller mounting aperture 11, and is screwed into a threaded bore 46 formed within the shank 44 of the first roller 41. Thus, the first roller 41 is rotatably mounted in the first roller mounting

aperture 11.

Similarly, a second roller mounting aperture 21 is formed at a roller end of the second operation arm 20, thus the second roller is rotatably mounted on the second operation arm 20 by means of the second roller mounting aperture 21 and a second screw 52, and a third roller mounting aperture 31 is formed on the pivot 30, thus the third roller 43 is rotatably mounted on the pivot 30 by means of the third roller mounting aperture 31 and a third screw 53.

By means of the bender 1 with the above mentioned structure, when the operation ends of the first and second operation arms 10, 20 are in a state of spacing apart from each other, the first and second rollers 41, 42 on the roller ends of the operation arms 10, 20 are close to each other, and is spaced apart from the third roller 43 in a longitudinal direction of the bender 1. And, when an external force is applied on the operation end of the first and second operation arms 10, 20, so that the operation ends move towards each other, the first and second rollers 41, 42 move away from each other, and a distance to the third roller 43 in the longitudinal direction is reduced. By such a way, a fixing rod/fixing plate positioned between the first and second rollers 41, 42 and the third roller 43 is bent.

Preferably, a biasing device 60 is provided between the operation ends of the first and second operation arms 10, 20 and the pivot 30, the biasing device 60 biases the operation ends of the first and second operation arms 10, 20 in a direction of spacing apart from each other. The biasing device 60 may be of any known structure. For example, the biasing device 60 may be formed of two elastic sheets, the two elastic sheets connects with each other at one end thereof, and the other end of each of the two elastic sheets connects to the first and second operation arms 10, 20, respectively. Or, the biasing device may be a compression spring, the ends of which connect respectively to the first and second operation arms 10, 20.

Fig.5 shows a structure of the roller mounted in the bender 1. Such a structure of the roller may be used as at least one of the first ~ third rollers 41, 43. As shown in Fig.5, the bender 1 of the present invention includes the shank 44 as mentioned above, and further includes a roller head 45. The roller head 45 comprises a large diameter portion 451 and a small diameter portion 452, thus forms in a stepped shape. In the preferred embodiment

shown in Fig.3 and 4, all the roller heads 45 of the first ~third rollers 41~43 are formed in stepped shape.

The present invention realizes a two step bending operation by means of the rollers 41~43 having stepped shaped roller heads 45. The operation of the bender 1 of the present invention will be described in detail as follows:

First, the bender 1 is set in a status that the operation ends of the first and second operation arms 10, 20 are spaced apart from each other. This status may be realized manually by the surgeon. Or alternatively, such a status may be realized by the biasing device 60 provided between the first and second operation arms 10, 20.

Then, the fixing rod/fixing plate is put between the first and second rollers 41, 42 and the third roller 43, and is abutted against the small diameter portion 452 of the roller.

After putting the fixing rod/fixing plate in position, an external force is applied on the operation ends of the first and second operation arms 10, 20, so that the two operation ends moves towards each other. Such a movement results in that the first roller 41 and the second roller 42 positioned on the roller ends of the operation arms 10, 20 move away from each other, and move closer in a longitudinal direction of the bender to the third roller 43. By such a movement between the first, second and third rollers 41~43, the fixing rod/fixing plate is initially bent.

After the fixing rod/fixing plate is initially bent, the first and second operation arms 10, 20 are restored to the status of spacing apart from each other, for example by manual operation or by the biasing force of the biasing device 60.

Then, the fixing rod/fixing plate is repositioned, so that the fixing rod/fixing plate abuts against the large diameter portion 451 of the roller.

Applying an external force on the operation end of the first and second operation arms 10, 20 once again, so that the two operation ends moves towards each other. At this time, the fixing rod/fixing plate initially bent is further bent by means of the large diameter portion 451.

Thus, it can be seen that the bender 1 of the present invention bends the fixing rod/fixing plate by two steps, so as to obtain desired degree of bending. Thus, in each step of

bending, the distance between the spaced apart operations ends of the first and second operation arms 10, 20 will not be too large for holding, thus allowing the surgeon to bend the fixing rod/fixing plate by one hand, even when the hand is small.

The roller used for the bender as mentioned above includes a stepped shaped roller head formed by two portions, so that the fixing rod/fixing plate may be bent in two steps. On such a basis, one skilled in the art can contemplate that the stepped shaped roller head may be formed by three or more portions, with three or more different diameters. In such a case, the fixing rod/fixing plate may be bent in selected number of steps, which can be determined based on the practical requirements.

CLAIMS

1. A bender comprising:

a first operation arm comprising a roller end and an operation end, a first roller is mounted on the roller end of the first operation end;

a second operation arm comprising a roller end and an operation end, a second roller is mounted on the roller end of the second operation end, and the first operation arm and the second operation arm connect together at a pivot and are pivotable around the pivot, a third roller is mounted on the pivot;

characterized in that a roller head of the third roller at least comprises a first portion of a first diameter and a second portion of a second diameter, the first diameter is larger than the second diameter, so that the roller head is formed in a stepped shape.

2. The bender according to claim 1, characterized in that the roller head of at least one of the first roller and the second roller is also formed in a stepped shape.

3. The bender according to claim 1, characterized in that a first roller mounting aperture is formed at the roller end of the first operation arm, a shank of the first roller extends into the first roller mounting aperture from one side of the first roller mounting aperture, and a first screw extends into the first roller mounting aperture from another side of the first roller mounting aperture, and is screwed in a threaded bore formed in the shank of the first roller; and/or

a second roller mounting aperture is formed at the roller end of the second operation arm, a shank of the second roller extends into the second roller mounting aperture from one side of the second roller mounting aperture, and a second screw extends into the second roller mounting aperture from another side of the second roller mounting aperture, and is screwed in a threaded bore formed in the shank of the second roller; and/or

a third roller mounting aperture is formed at pivot, a shank of the third roller extends into the third roller mounting aperture from one side of the third roller mounting aperture, and a third screw extends into the third roller mounting aperture from another side of the third

roller mounting aperture, and is screwed in a threaded bore formed in the shank of the third roller.

4. The bender according to claim 1, characterized in that a biasing device is provided between the first operation arm and the second operation arm, the biasing device is located between the operation ends of the first and second operation arms and the pivot, and applies a biasing force on the first operation arm and the second operation arm, so that the operation end of the first operation arm is spaced apart from the operation end of the second operation arm.

5. The bender according to claim 4, characterized in that the biasing device is formed of two elastic sheets, the two elastic sheets connect to each other at one end thereof, and the other end of the two elastic sheets connect respectively to the first operation arm and the second operation arm.

6. The bender according to claim 4, characterized in that the biasing device is a compression spring, the ends of the compression spring connect respectively to the first operation arm and the second operation arm.

7. A method for bending a fixing rod/fixing plate by means of the bender according to claim 1, characterized in that the method includes the following steps in sequence:

a. maintaining the first operation arm and the second operation arm in a status that the operation ends thereof are spaced apart from each other;

b. positioning the fixing rod/fixing plate between the first and second rollers and the third rollers, and abutting the fixing rod/fixing plate against the second portion of the third roller;

c. applying an external force on the operation ends of the first operation arm and the second operation arm, so that the operation ends of the first operation arm and the second operation arm move towards each other;

d. removing the external force, and restore the operation ends of the first operation arm and the second operation arm to the status of being spaced apart from each other;

e. repositioning the fixing rod/fixing plate, so that the fixing rod/fixing plate abuts

against the first portion of the third roller; and

f. applying an external force on the operation ends of the first operation arm and the second operation arm, so that the operation ends of the first operation arm and the second operation arm move towards each other once again.

8. The method according to claim 7, characterized in that the roller head of at least one of the first roller and the second roller is also formed in a stepped shape, and in step b, the fixing rod/fixing plate further abuts against a portion with smaller diameter of the roller head of at least one of the first roller and the second roller.

9. The method according to claim 7, characterized in that the roller head of at least one of the first roller and the second roller is also formed in a stepped shape, and in step e, the fixing rod/fixing plate further abuts against a portion with larger diameter of the roller head of at least one of the first roller and the second roller.

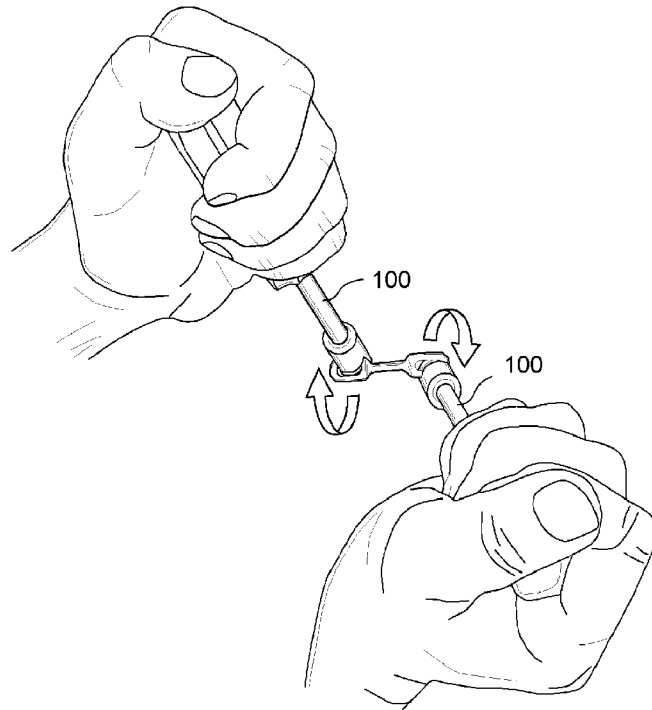


Fig.1

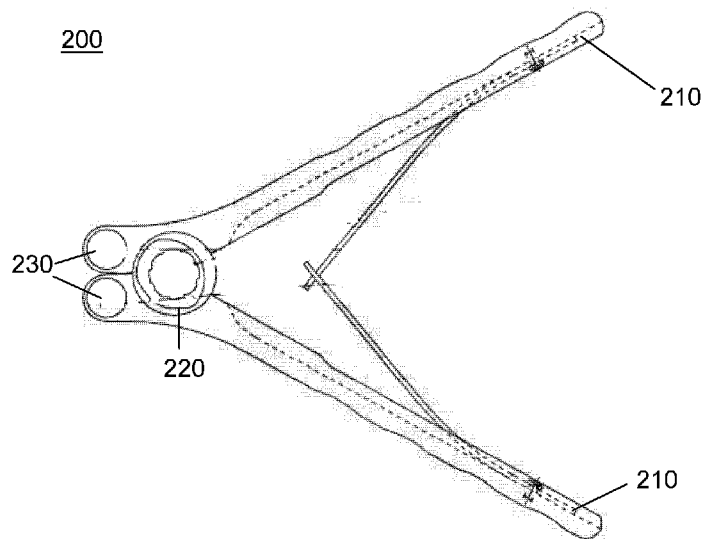


Fig.2

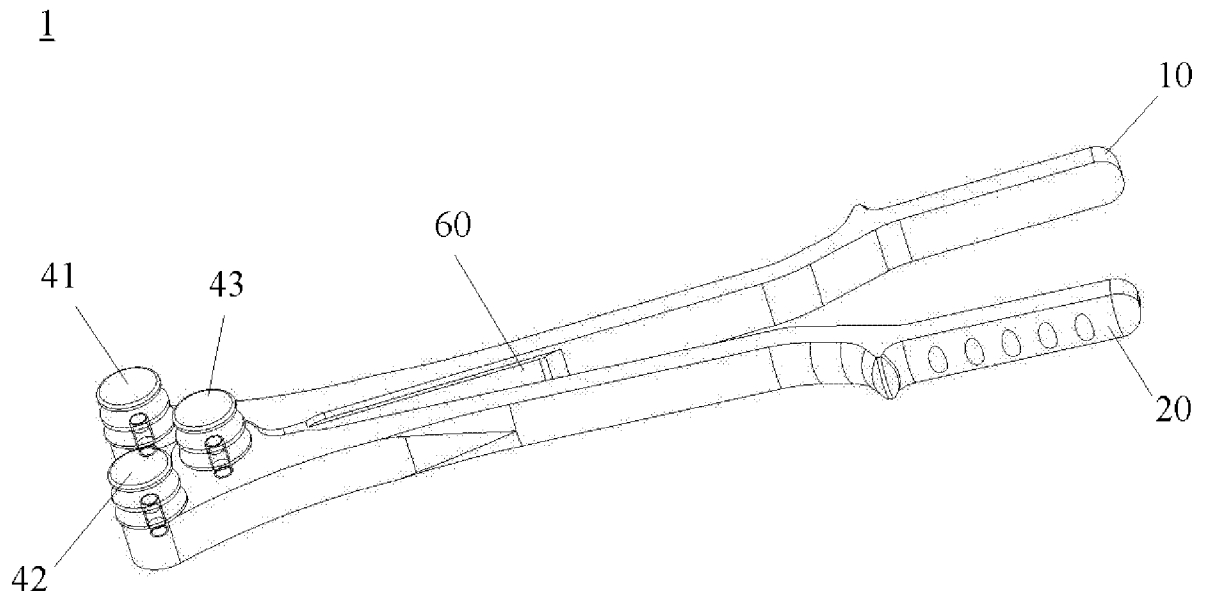


Fig.3

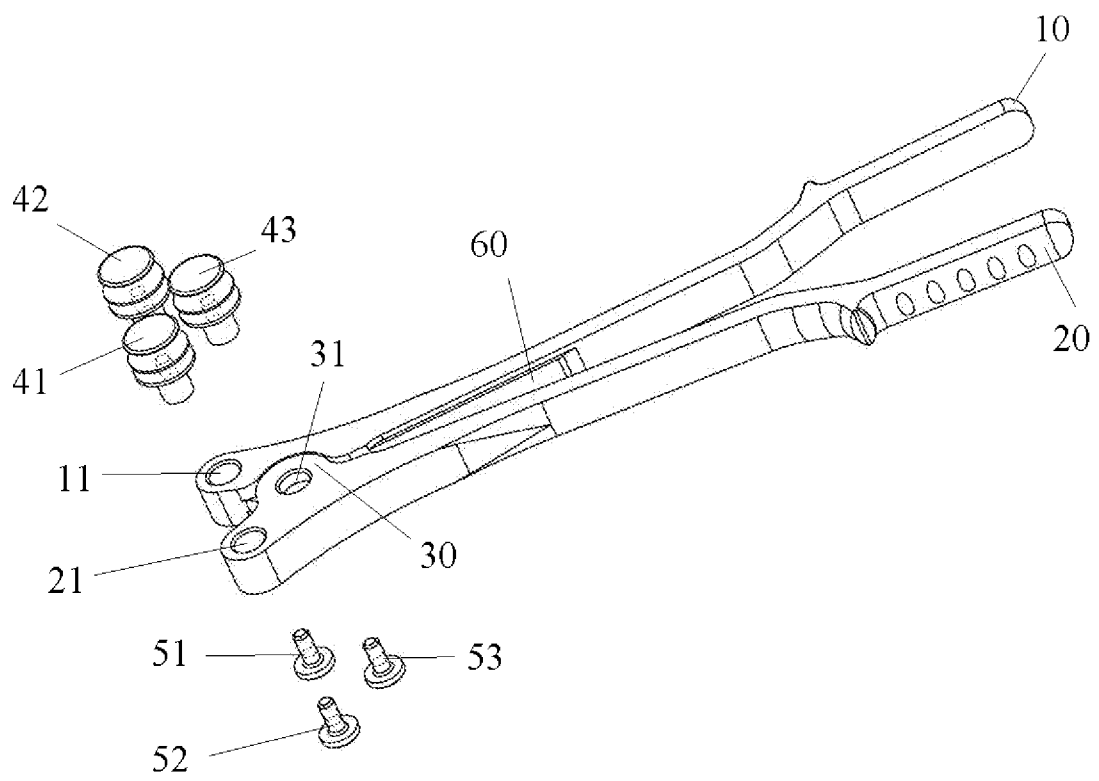


Fig.4

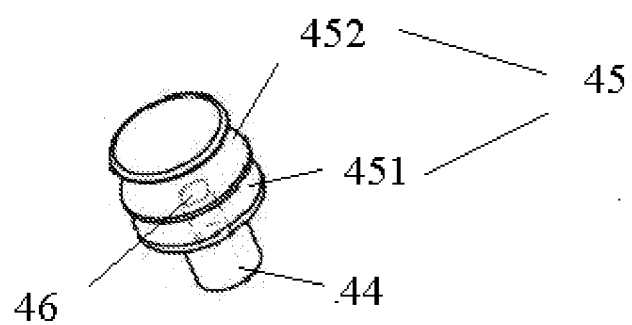


Fig.5

INTERNATIONAL SEARCH REPORT

International application No.

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A. CLASSIFICATION OF SUBJECT MATTER

A61B 17/56(2006.01)i; B21D 7/06(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)

A61B; B21D

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)

CNABS; CNTXT;DWPI;SIPOABS;USTXT;CNKI:bend+, curv+, rod, bar, plate, clip, pincers, pliers, tongs, scissors, surg+, roller, pivot+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 204121139 U (BEIJING FULE SCI & TECHNOLOGY DEV CO LTD ET AL.) 28 January 2015 (2015-01-28) description, paragraphs 0005 to 0009 and figures 1 to 7	1-9
X	US 5490409 A (K-MEDIC INC) 13 February 1996 (1996-02-13) description, column 3, line 64 to column 4, line 51 and figures 1 to 9	1-9
X	CN 202184779 U (XIAMEN DOUBLE ENGINE MEDICAL MATERIAL CO) 11 April 2012 (2012-04-11) description, paragraphs 0030 to 0037 and figures 1 to 8	1-9
A	CN 202604977 U (CHANGZHOU KANGDING MEDICAL INSTR CO LTD) 19 December 2012 (2012-12-19) the whole document	1-9
A	CN 203290996 U (CHANGZHOU KANGDING MEDICAL INSTR CO LTD) 20 November 2013 (2013-11-20) the whole document	1-9
A	US 2012047980 A1 (GLOBUS MEDICAL INC ET AL.) 01 March 2012 (2012-03-01) the whole document	1-9

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

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Name and mailing address of the ISA/CN

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INTERNATIONAL SEARCH REPORT
Information on patent family members

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PCT/CN2015/085656

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	204121139	U	28 January 2015	None			
US	5490409	A	13 February 1996	None			
CN	202184779	U	11 April 2012	None			
CN	202604977	U	19 December 2012	None			
CN	203290996	U	20 November 2013	None			
US	2012047980	A1	01 March 2012	US	2014260484	A1	18 September 2014