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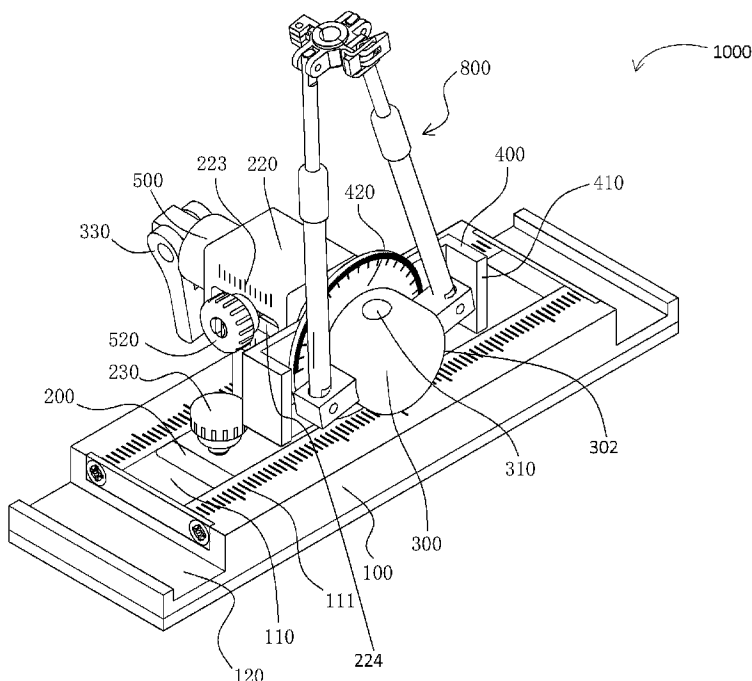
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(54) Title: MICROWAVE ABLATION NEEDLE POSITIONING DEVICE



(57) Abrégé/Abstract:

Examples of a microwave ablation needle positioning device are disclosed. The microwave ablation needle positioning device provides adjustment of a position of the microwave ablation needle position in X-axis direction and Z-axis direction. In addition, the angle adjustment is provided with a locking mechanism for fixing the needle position and locking it in a fast and convenient manner.

Abstract

Examples of a microwave ablation needle positioning device are disclosed. The microwave ablation needle positioning device provides adjustment of a position of the microwave ablation needle position in X-axis direction and Z-axis direction. In addition, the angle adjustment is provided with a locking mechanism for fixing the needle position and locking it in a fast and convenient manner.

MICROWAVE ABLATION NEEDLE POSITIONING DEVICE

Technical Field

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The present disclosure generally relates to a microwave ablation needle positioning device and more particular to a microwave ablation needle positioning device which is used for positioning the microwave ablation needle when performing microwave ablation.

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Background

Unless otherwise indicated herein, the materials described in this section are not prior art to the claims in this application and are not admitted to be prior art by inclusion in this section.

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With the increasing incidence of malignant tumors year by year, medical experts have been actively studying and exploring various methods that can effectively treat cancer, including surgical resection, drug therapy, radiation therapy, and interventional therapy. Microwave ablation process has been widely used in tumor treatment due to its remarkable characteristics of being minimally invasive, precise, high-efficiency and low toxic and side effects associated with the microwave ablation treatment.

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Microwave ablation treatment involves directly puncturing a microwave ablation needle into the tumor site under the guidance of the computed tomography (CT) imaging. The polar molecules in the tissue move at high speed under the action of the microwave field, and rub against each other to generate heat, so that the temperature rises rapidly in the tumor site. When it reaches about 60 °C, the cancer cell protein denatures and coagulates, leading to irreversible necrosis, and the tumor is inactivated in situ.

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At present, in the process of using microwave ablation treatment, after the microwave ablation needle is inserted into the cancerous foci of the patient, it is necessary for the medical staff to perform related fixation work by hand in order to avoid the deviation and sliding of the microwave ablation needle. This process significantly increases the labor intensity of the medical staff.

In addition, when the medical staff insert the microwave ablation needle into the patient's body, because there is no puncture positioning device, the puncture angle cannot be accurately controlled and an error may occur, which may easily cause inaccurate puncture. This additionally increases the inconvenience and complicates the treatment of tumors.

Summary of the Invention

In one aspect a microwave ablation needle positioning device is provided. The device comprises a base with a X-direction sliding path and a X-direction position adjustment seat that has a sliding block configured to slide along the X direction sliding path of the base. The X-direction position adjustment seat also comprises a case that extends upwardly from the sliding block, a sliding hole that extends through the case in a Z-direction forming a Z-direction path into the case, an opening formed in a side wall of the case and a X-direction locker. The device also comprise an angle adjustment seat that is rotatably adjusted relative to the X-direction position adjustment seat and that has a head with a positioning hole that extends along in radial direction of the head, an angle adjustment shaft that has a first end connected to the head and a second end extending in a Z-direction away from the head and a locker handle. A clamping and fixing structure is detachably connected to the angle adjustment seat to clamp a needle bar of a microwave ablation needle. A Z-direction adjustment seat is also provided that comprises a

cylindrical body that has a front end part, a rear end part and a through hole that extends in Z-axis direction and which is in communication with the Z-direction path formed in the case of the X-direction position adjustment seat. The front end part of the Z-direction adjustment seat is adjacent to a front side of the case abutting the angle adjustment seat head while the rear end part of the Z-direction adjustment seat is adjacent to a rear side of the case facing the locker handle. A radial hole is formed in a side wall and a Z-direction locker is configured to engage with the radial hole to lock a position of the Z-direction adjustment seat relative to the X- direction position adjustment seat. The angle adjustment shaft of the angle adjustment seat is inserted through the cylindrical through hole of the Z-direction adjustment and the locker handle is detachable hinged to the second end of the angle adjustment shaft such that a position of the angle adjustment seat in relation to a position of the Z-direction adjustment seat can be quickly locked by positioning the lock handle in a locked position.

In addition to the aspects and embodiments described above, further aspects and embodiments will become apparent by reference to the drawings and study of the following detailed description.

Brief Description of the Drawings

Throughout the drawings, reference numbers may be re-used to indicate correspondence between referenced elements. The drawings are provided to illustrate example embodiments described herein and are not intended to limit the scope of the disclosure. Sizes and relative positions of elements in the drawings are not necessarily drawn to scale. For example, the shapes of various elements and angles are not drawn to scale, and some of these elements are arbitrarily enlarged and positioned to improve drawing legibility.

FIG.1 is a perspective view of an example of a microwave ablation needle positioning device according to an embodiment of the application.

FIG.2 is an exploded view of a microwave ablation needle positioning device according to an embodiment of the application.

5 FIG. 3 is a perspective view of an example of a microwave ablation needle positioning device according to an embodiment of the application with a Z-direction locker away from a Z- direction adjustment seat.

Detailed Description of Specific Embodiments

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The present application discloses a microwave ablation needle positioning device that accurately controlled the position of the ablation needle during insertion into the tumor site as well as lock the position of the ablation needle at a pre-determined (desired) position during the microwave ablation treatment preventing any change of position/orientation or sliding of the needle.

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In the co-pending patent application publication No. CN 111920516 A, included herein in its entirety by reference, the applicant discloses a microwave ablation needle positioning and fixing device under the guidance of CT, where the microwave needle can be quickly adjusted to the correct puncture angle, puncture depth, and puncture plane under the CT guidance. In addition, the microwave ablation needle can be effectively fixed after punctured into the cancer foci in the patient's body, which effectively reduces the labor intensity of the medical staff.

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The present application further discloses adjustment of the microwave ablation needle position in Z-axis direction, which makes the device more adaptable. In addition, the angle locking mechanism for fixing the needle position is improved, making the angle locking more convenient and faster.

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The present invention describes a microwave ablation needle positioning device, which is capable of realizing X axis and Z axis adjustment and has an angle quick lock mechanism.

Referring now to FIGs.1 and 2, an example of a microwave ablation needle positioning and fixing device **1000** is illustrated. The device **1000** includes a base **100** that includes a sliding path **110** that extends in X-direction along a length of the base **100**. A X-direction position adjustment seat **200** is slidably positioned in the sliding path **110** of the base **100** and is configured to adjust a position of the microwave ablation needle in X-direction with respect to the patient body. The X-direction position adjustment seat **200** can comprise a X - direction sliding block **210** that can slide along the sliding path **110** and forms a lower part of the X-direction position adjustment seat **200**. Two ends of the base **100** are respectively provided with tape positioning grooves **120**. One end of a medical tape (not shown) is adhered to the patient's skin on one side of the base **100**, while the other end of the medical tape passes through the tape positioning groove **120** and is adhered to the patient's skin on the opposite side of the base **100**, such that the base **100** of the microwave ablation needle positioning device **1000** is secured and prevents displacing of the base **100** during the sliding process of the X-direction position adjustment seat **200**. The cross-sections of the sliding block **210** is dovetail-shaped to improve the sliding performance between the sliding path **110** and the sliding block **210**, such that the sliding block **210** can slide along the sliding path **110** and avoid that the sliding block **210** coming out of the sliding path **110** during the sliding process, which further improves the practical performance of the microwave ablation needle positioning and fixing device **1000**.

Scale lines **111** are provided on an upper surface of the base **100** on both sides along the sliding path **110**, so that the X-direction position adjustment seat **200** can slide to desired position in X-direction as required by the medical staff.

5 The X-direction position adjustment seat **200** further comprises a case **220**,
that extends upwardly from the X-direction sliding block **210**, and a X-direction
locker **230**. The X-direction locker **230** can be for example a locking screw **230**,
that is configured to pass through a threaded hole **211** that is formed into the X-
direction sliding block **210**. When the locker **230** is in the locked positioned, it
engages with the sliding path **110** thus preventing the sliding block **210** from
10 sliding along x-direction. For example, a head of the X-direction locking screw
230 can abut and firmly engage with the bottom (upper surface) of the X-direction
sliding path **110** thus fixing the position of the X-direction position adjustment
seat **200** on the base **100**. The case **220** comprises a sliding hole **221** that extend
through the case **220** in Z-direction thus forming a Z-direction sliding path **222**
15 formed in the case **220**. Z-direction scale lines **223** are also provided on both sides
of side walls of the case **220** along the Z direction sliding path **222**. An elongated
opening **224** is formed in each of the side walls of the case **220** as a window in the
Z-direction sliding path **222** and the scale lines **223** are provided along the length
of the opening **224**.

20 The microwave ablation needle positioning device **1000** further comprises an
angle adjustment seat **300** configured to adjust a puncture angle of the microwave
ablation needle (not shown). The angle adjustment seat **300** can be rotatably
adjusted relative to the X-direction position adjustment seat **200**. The angle
adjustment seat **300** comprises a head **302** having a puncture positioning hole **310**
25 that extends along in radial direction of the head **302** so that the microwave
ablation needle can pass through the hole **310**. An angle adjustment shaft **320** is
connected to the head **302** at one end and extends in a Z-direction away from the

angle adjustment seat head **302**. A locking handle **330** is hingedly connected on the opposite (free) end of the angle adjustment shaft **320** away from the angle adjustment seat head **302**. The lock handle **330** can have a pair of eccentric cams **332** fixed to each side of a hinge pin **331** and a pressing part **333** connected to the eccentric cams **332**.

The microwave ablation needle positioning device **1000** further comprises a Z- direction adjustment seat **500** having a cylindrical body with a through hole **510** extending in the Z-axis direction that is in communication with the Z-direction sliding path **222** formed in the case **220**. In one embodiment, the cylindrical body of the Z- direction adjustment seat **500** is inserted through the sliding hole **221** of the case **220** such that the cylindrical through hole **510** is coaxial with the Z-direction sliding path **222**. The body of the Z-direction adjustment seat **500** can comprise a front end part **501** that is adjacent to a front side of the case **220** facing the angle adjustment seat head **302** and a rear end part **502** of the Z- direction adjustment seat **500** that is adjacent to the opposite (rear) side of the case **220** facing the locker handle **330**. The Z- direction adjustment seat **500** further comprises a radial screw hole **530** (see FIG. 3) formed in a side wall of its body and a Z-direction locker **520**. For example the Z-direction locker **520** can be Z-direction locking screw **520**, and a stud part of the Z-direction locking screw **520** passes through the opening **224** provided in the case **220** into the Z-direction sliding path **222** and is then screwed into the radial screw hole **530** to tighten the Z-direction locking screw **520**, so that the shoulder of the Z-direction locking screw **520** is in abutting engagement with an outer surface of the side wall of the case **220** fastening the Z-direction adjustment seat **500** and the case **220** together.

The angle adjustment shaft **320** of the angle adjustment seat **300** is inserted through the cylindrical through hole **510** of the Z- direction adjustment seat **500**,

in order to provide a rotation cooperation of the angle adjustment seat **300** and the Z -direction adjustment seat **500**. The position of the angle adjustment seat **300** can be locked in relation to the position of the Z- direction adjustment seat **500** by positioning the quick lock handle **330** in locked positioned which will prevent rotation of the shaft **320** and thus the angular positioning of the angle adjustment seat **300** can be achieved. When the lock handle **330** is in the locked position (facing down), the rear elevation of the angle adjustment seat **300** is in abutting engagement with a front elevation **503** of the Z direction adjustment seat **500**. The pressing part **333** of the lock handle **330** engages the back part of the Z-seat **500** therefore locking the position of the shaft **320** and thus preventing its rotation. When the lock handle **330** is in the unlocked position, the angle adjustment shaft **320** can be rotated in the Z direction adjustment seat **500**.

A reference positioning member **400** is positioned on the upper surface of the sliding block **210** and is used to confirm the puncture reference surface under the guidance of CT. The cross section of the reference positioning member **400** is L-shaped, and the reference plane positioning member **400** is symmetrically arranged on both sides of the angle adjustment seat **300**. A positioning reference surface **410** of the reference positioning members **400** is coplanar with the axis of the puncture positioning hole **310**. In addition, the reference positioning member **400** is fixed to the Z- direction adjustment seat **500**. A puncture angle dial or angle scale **420** is provided at the reference positioning member **400** such that the reference positioning member **400** and the puncture angle dial **420** can be fixed to a front part of the Z-direction adjustment seat **500**. The puncture angle scale **420** is positioned close to the puncture positioning hole **310** along the circumferential direction so that the microwave ablation needle can be easily adjusted to the required puncture angle through the angle adjustment seat **300**, and it can be guided to perform the puncture quickly and accurately.

The microwave ablation needle positioning and fixing device **1000** further comprises a clamping and fixing structure **800** that can be fixed on the angle adjustment seat **300** to clamp the needle bar of the microwave ablation needle. The clamping and fixing structure **800** can be detachably arranged on the angle
5 adjustment seat **300** and can comprise adjustable (telescoping) support rods symmetrical arranged on both sides of the puncture positioning hole **310**.

The microwave ablation needle positioning and fixing device **1000** comprising the combination of the X-direction and Z-direction adjustment seats **200** and **500**, and the angle adjustment seat **300**, can be used to accurately and
10 quickly position and lock the position of the microwave ablation needle so that it can accurately puncture into the cancer foci of the patient.

While particular elements, embodiments and applications of the present disclosure have been shown and described, it will be understood, that the scope of the disclosure is not limited thereto, since modifications can be made by those
15 skilled in the art without departing from the scope of the present disclosure, particularly in light of the foregoing teachings. Thus, for example, in any method or process disclosed herein, the acts or operations making up the method/process may be performed in any suitable sequence and are not necessarily limited to any particular disclosed sequence. Elements and components can be configured or
20 arranged differently, combined, and/or eliminated in various embodiments. The various features and processes described above may be used independently of one another, or may be combined in various ways. All possible combinations and sub-combinations are intended to fall within the scope of this disclosure. Reference throughout this disclosure to “some embodiments,” “an embodiment,” or the like,
25 means that a particular feature, structure, step, process, or characteristic described in connection with the embodiment is included in at least one embodiment. Thus, appearances of the phrases “in some embodiments,” “in an embodiment,” or the

like, throughout this disclosure are not necessarily all referring to the same embodiment and may refer to one or more of the same or different embodiments.

Various aspects and advantages of the embodiments have been described where appropriate. It is to be understood that not necessarily all such aspects or advantages may be achieved in accordance with any particular embodiment. Thus, for example, it should be recognized that the various embodiments may be carried out in a manner that achieves or optimizes one advantage or group of advantages as taught herein without necessarily achieving other aspects or advantages as may be taught or suggested herein.

Conditional language used herein, such as, among others, "can," "could," "might," "may," "e.g.," and the like, unless specifically stated otherwise, or otherwise understood within the context as used, is generally intended to convey that certain embodiments include, while other embodiments do not include, certain features, elements and/or steps. Thus, such conditional language is not generally intended to imply that features, elements and/or steps are in any way required for one or more embodiments or that one or more embodiments necessarily include logic for deciding, with or without operator input or prompting, whether these features, elements and/or steps are included or are to be performed in any particular embodiment. No single feature or group of features is required for or indispensable to any particular embodiment. The terms "comprising," "including," "having," and the like are synonymous and are used inclusively, in an open-ended fashion, and do not exclude additional elements, features, acts, operations, and so forth. Also, the term "or" is used in its inclusive sense (and not in its exclusive sense) so that when used, for example, to connect a list of elements, the term "or" means one, some, or all of the elements in the list. The example calculations, simulations, results, graphs, values, and parameters of the embodiments described herein are intended to illustrate and not to limit the

disclosed embodiments. Other embodiments can be configured and/or operated differently than the illustrative examples described herein.

Claims:

1. A microwave ablation needle positioning device, comprising:
 - a base having a X-direction sliding path,
 - a X-direction position adjustment seat comprising a sliding block
- 5 configured to slide along the X direction sliding path of the base, a case extending upwardly from the sliding block, a sliding hole extending through the case in a Z-direction forming a Z-direction path into the case, an opening formed in a side wall of the case and a X-direction locker;
- an angle adjustment seat rotatably adjusted relative to the X direction
- 10 position adjustment seat and having a head having a positioning hole that extends along in radial direction of the head, an angle adjustment shaft having a first end connected to the head and a second end extending in a Z-direction away from the head and a locker handle;
- a clamping and fixing structure detachably connected to the angle
- 15 adjustment seat to clamp a needle bar of a microwave ablation needle; and
- a Z-direction adjustment seat comprising a cylindrical body having a front end part, a rear end part and a through hole extending in Z-axis direction, the through hole being in communication with the Z-direction path in the case of the X-direction position adjustment seat, the front end part of the Z- direction
- 20 adjustment seat is adjacent to a front side of the case abutting the angle adjustment seat head while the rear end part of the Z- direction adjustment seat is adjacent to a rear side of the case facing the locker handle, a radial hole formed in a side wall of the cylindrical body and a Z-direction locker configured to engage with the radial hole to lock a position of the Z-direction adjustment seat relative to
- 25 the X- direction position adjustment seat,
- wherein the angle adjustment shaft of the angle adjustment seat is inserted through the cylindrical through hole of the Z-direction adjustment and the locker handle is detachable hinged to the second end of the angle adjustment shaft such

that a position of the angle adjustment seat in relation to a position of the Z-direction adjustment seat is quickly lockable by positioning the lock handle in a locked position.

2. A microwave ablation needle positioning device according to claim 1,
5 wherein a portion of the cylindrical body Z-direction adjustment seat is slidably inserted through the sliding hole of the case such that the through hole is coaxial with the Z-direction path formed in the case.

3. A microwave ablation needle positioning device according to claim 1,
10 wherein the Z-direction locker is a screw having a locker head and a stud that passes through the opening formed in the side wall of the case of the X-direction position adjustment seat into the radial hole of the Z-direction position adjustment seat such that when the stud is tighten in the radial hole the locker head of the Z-direction locker is in abutting engagement with an outer wall of the case locking a
15 position of the Z direction adjustment seat in relation to the case of the X-direction position adjustment seat.

4. A microwave ablation needle positioning device according to claim 1,
wherein the opening formed in the side wall of the case is elongated opening along the side wall of the case in Z-axis direction and further comprising Z-direction scale lines formed in proximity to the elongated opening on at least one
20 side wall of the case.

5. A microwave ablation needle positioning device according to claim 1,
wherein the lock handle comprises a pair of eccentric cams fixed to a hinge pin and a pressing part connected to the eccentric cams, the eccentric cams being mated with a rear elevation formed in the rear end part of the Z direction
25 adjustment seat.

6. A microwave ablation needle positioning device according to claim 1,
wherein the X-direction sliding block further comprises a threaded hole extending

through the sliding block such that the X-direction locker is screwed through the threaded hole to engage with the X-direction sliding path of the base to lock a position of the X-direction position adjustment seat with respect to the base.

5 7. A microwave ablation needle positioning device according to claim 1, further comprising X-direction scale lines formed on an upper surface of the base along at least one side of the X-direction sliding path.

8. A microwave ablation needle positioning device according to claim 1, further comprising a reference plane positioning member with a positioning reference surface coplanar with the positioning hole.

10 9. A microwave ablation needle positioning device according to claim 8, further comprising a puncture angle dial, the reference surface positioning member and the puncture angle dial being fixed on the front end part of the Z-direction adjustment seat.

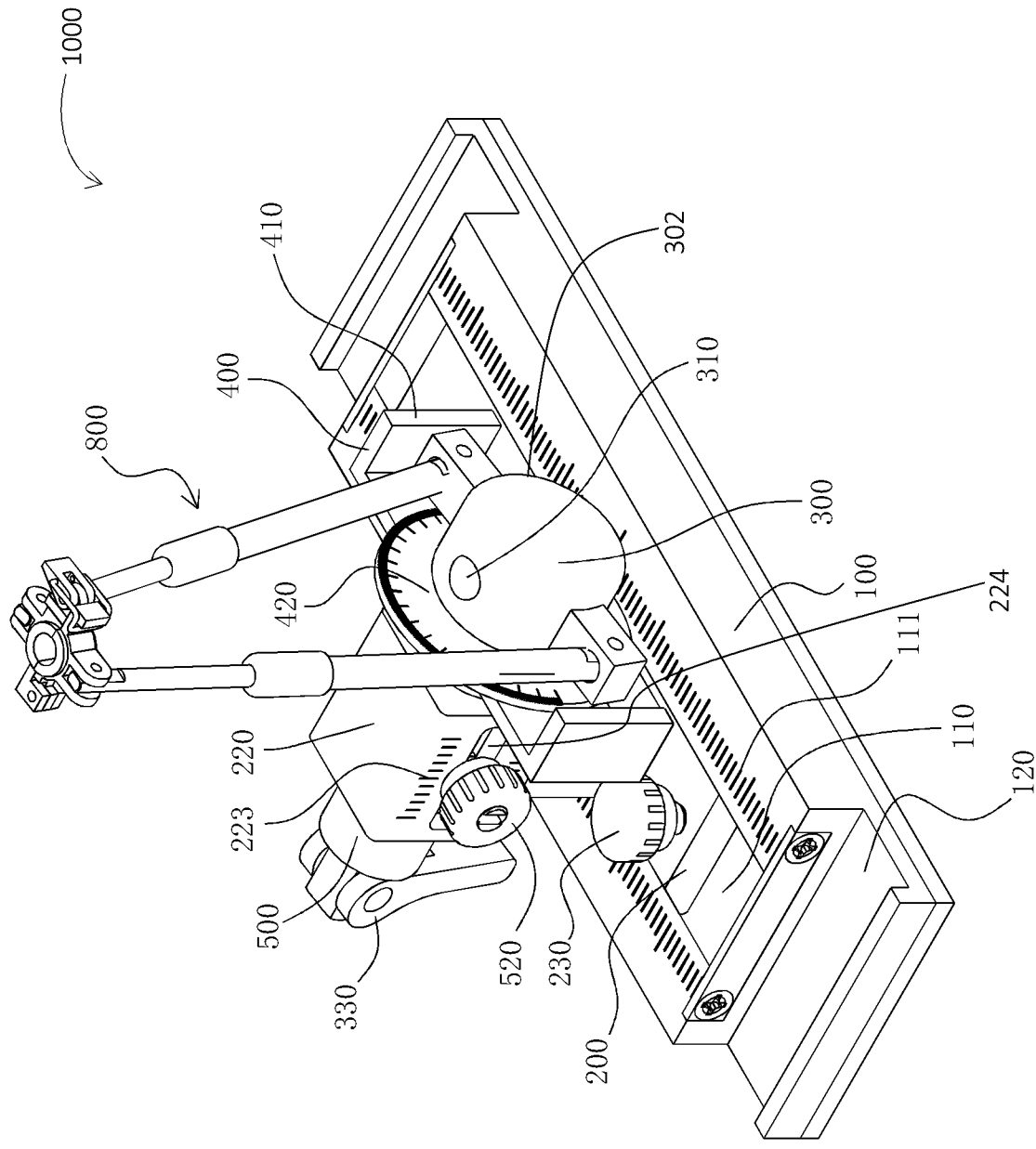


FIG. 1

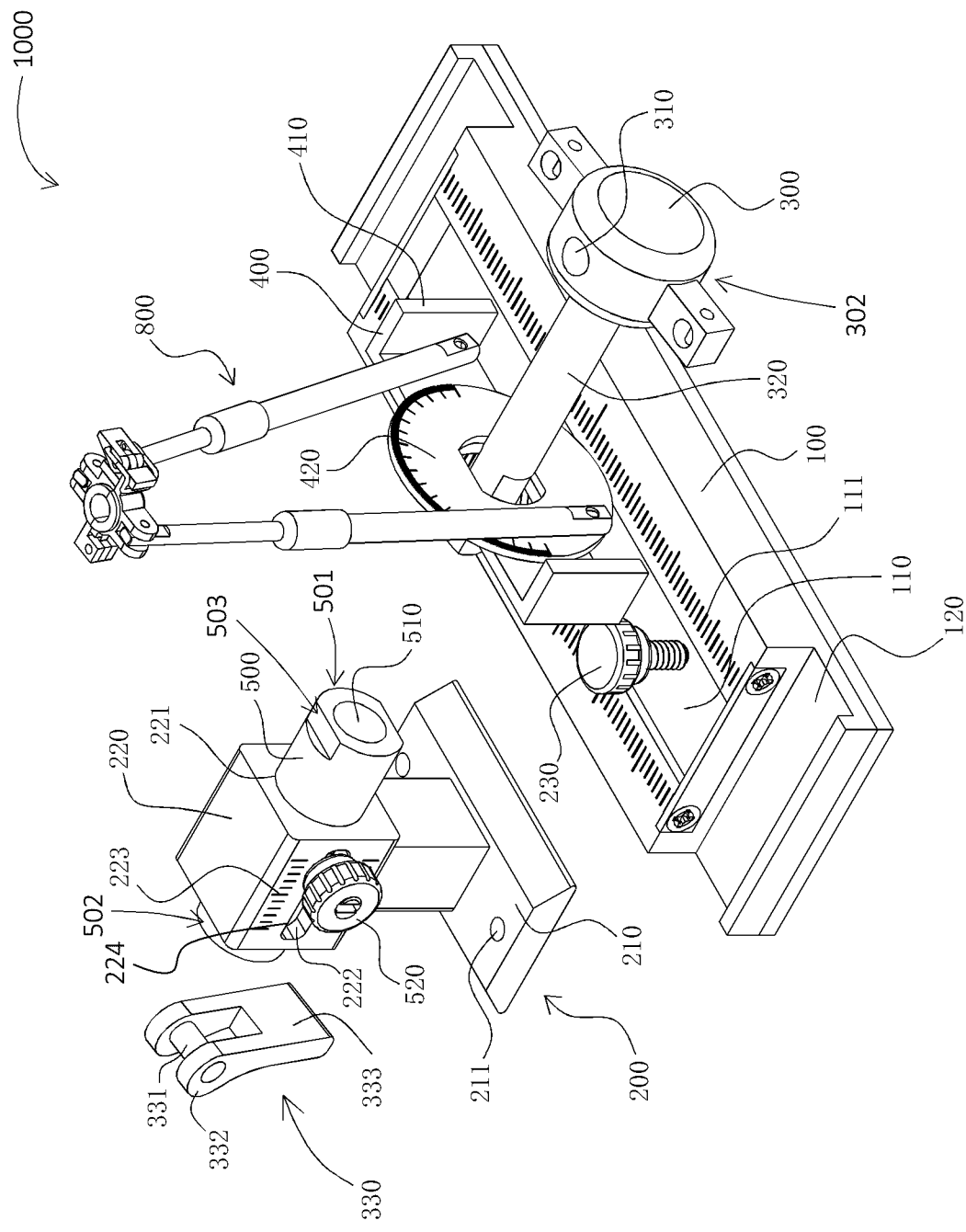


FIG. 2

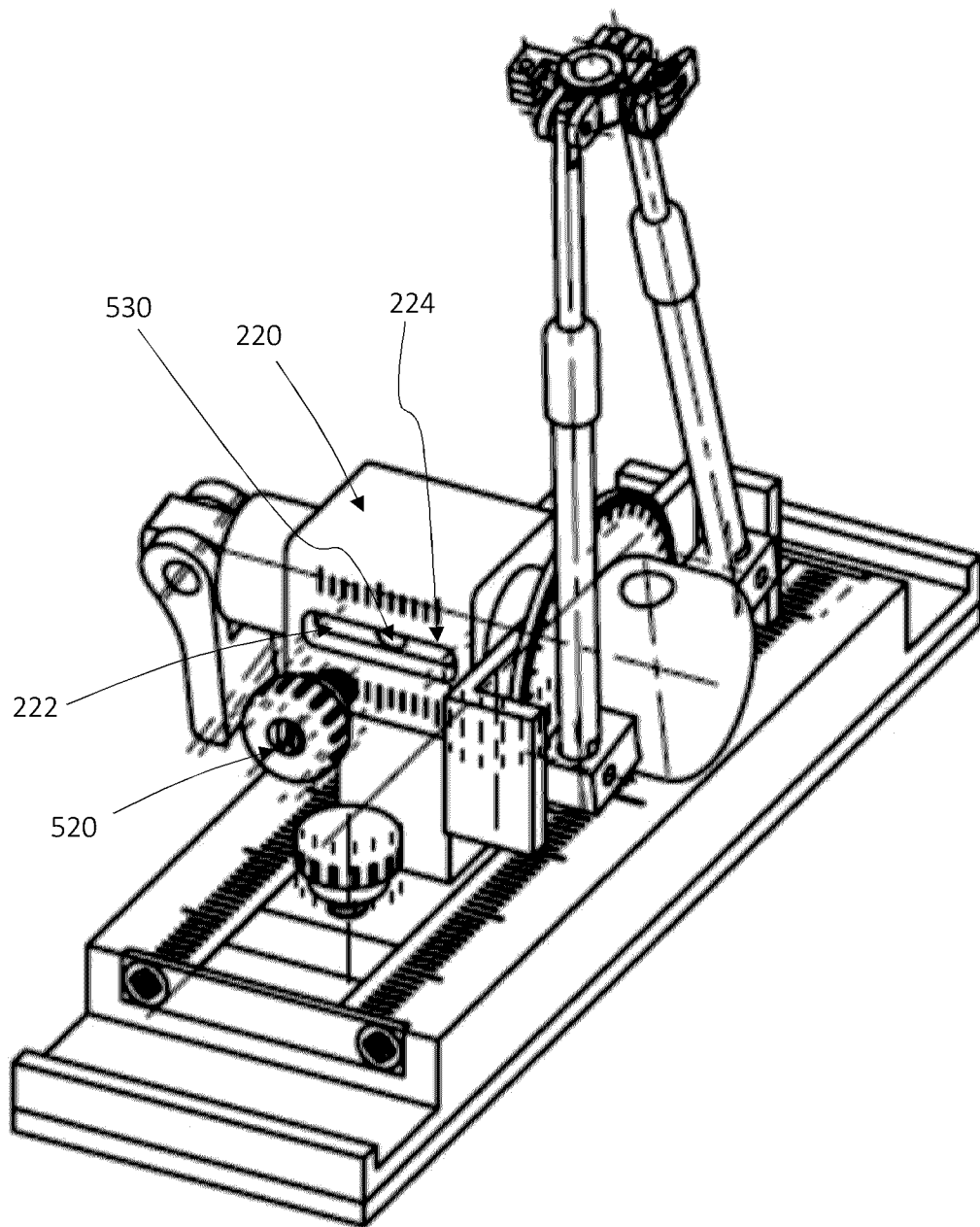


FIG. 3

