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(54) **CRADLE FOR AN ULTRASOUND PROBE**

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USPC **248/299.1**

(57) **ABSTRACT**

A cradle for holding an ultrasound probe used to image a patient prior to and during medical procedures includes a base for securing to a stepper-stabilizer, roller-bearings supported on the base, and a probe-holder that rotates on the otter-bearings in a smooth angular rotation on a horizontal axis relative to the base. The probe-holder includes a front yoke and a rear yoke, and a yoke retainer supporting the front yoke. A pivot side rail and a lock side rail span rigidly between the front yoke and the rear yoke. A locking knob that is captured to the lock side rail to prevent the locking knob from detaching. A latch hinged to the pivot side rail is engaged by the locking knob for securement over the probe. A detent insures precise 90-degree alignment of the yoke retainer with respect to the base. The rollers rotatably support the yoke retainer and the rear yoke, and free rotation of the front yoke is controlled by the yoke retainer to allow for correction of misalignment.

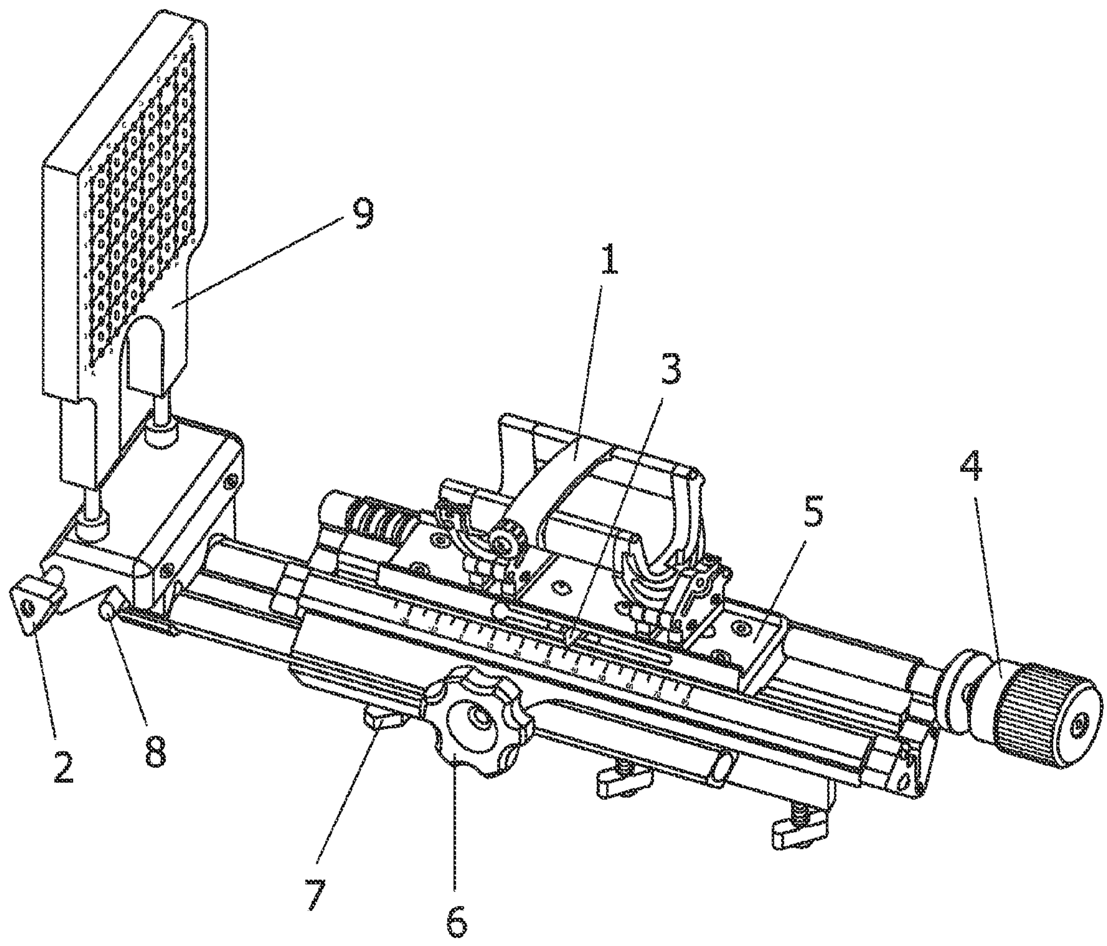


FIG.1

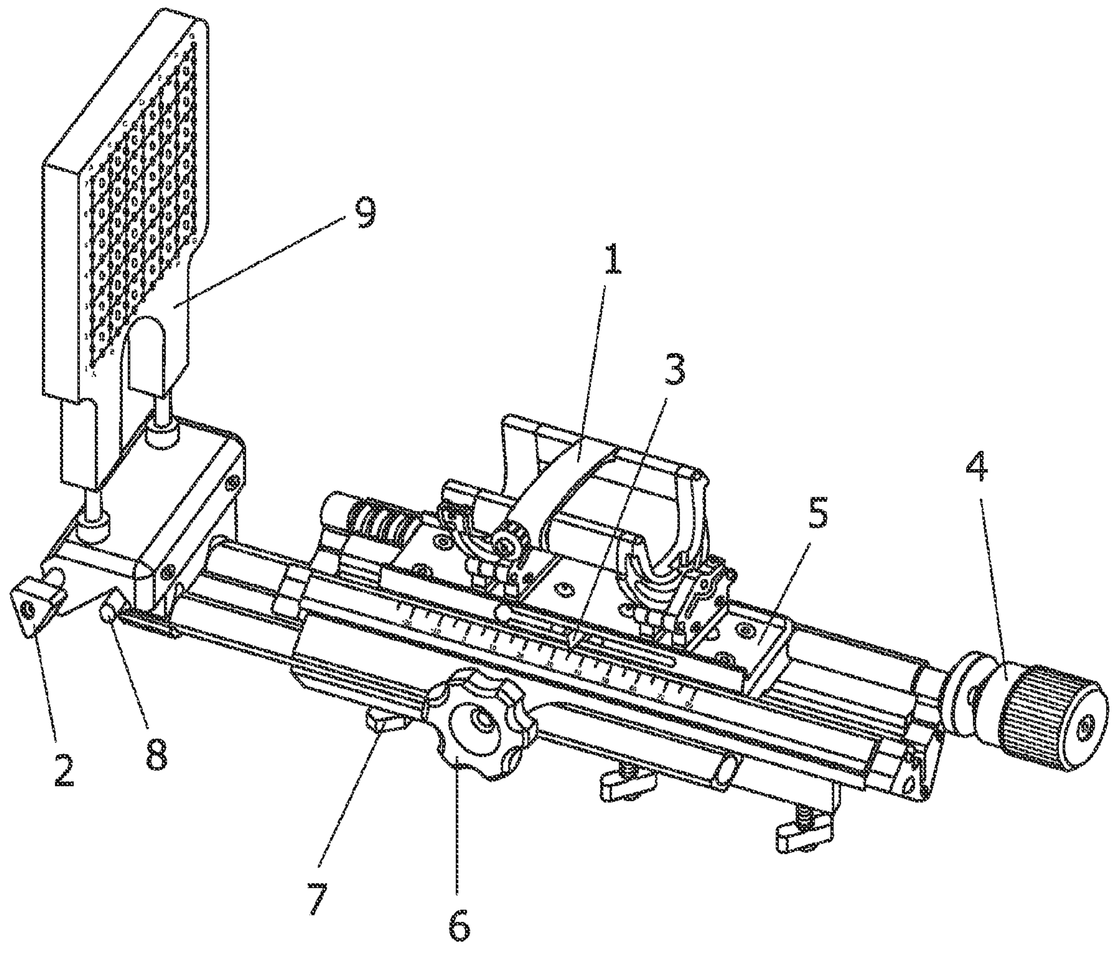


FIG. 2

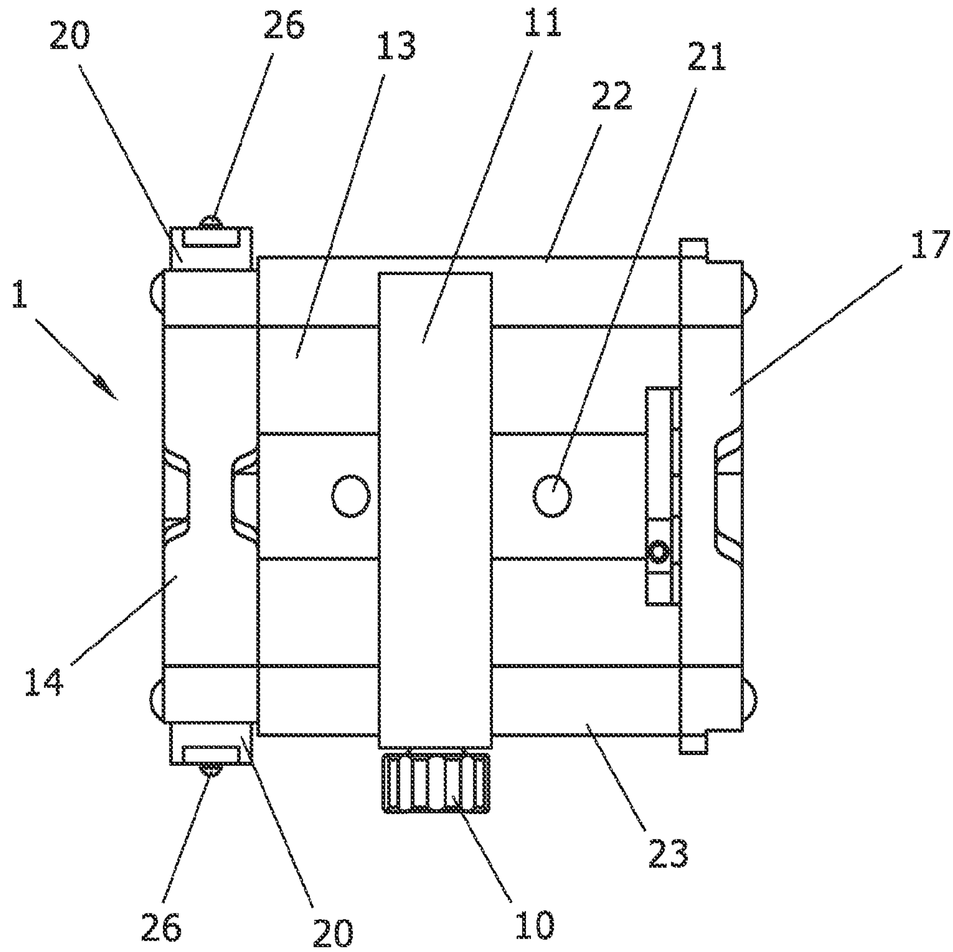


FIG.3

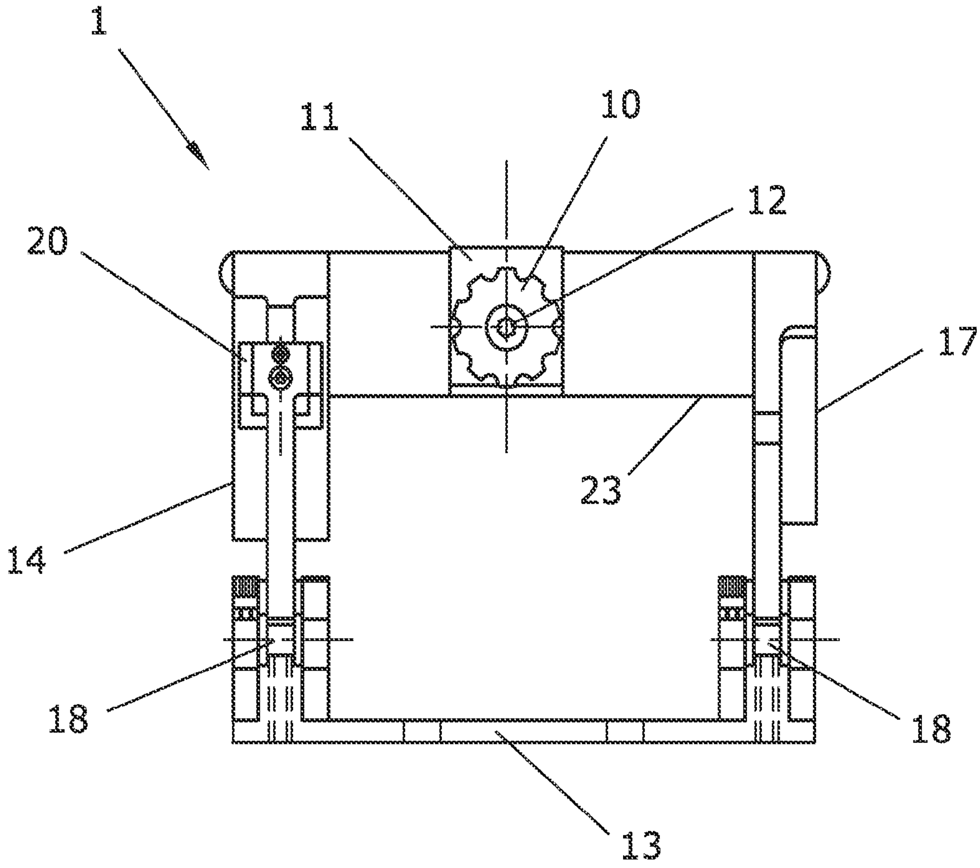


FIG.4

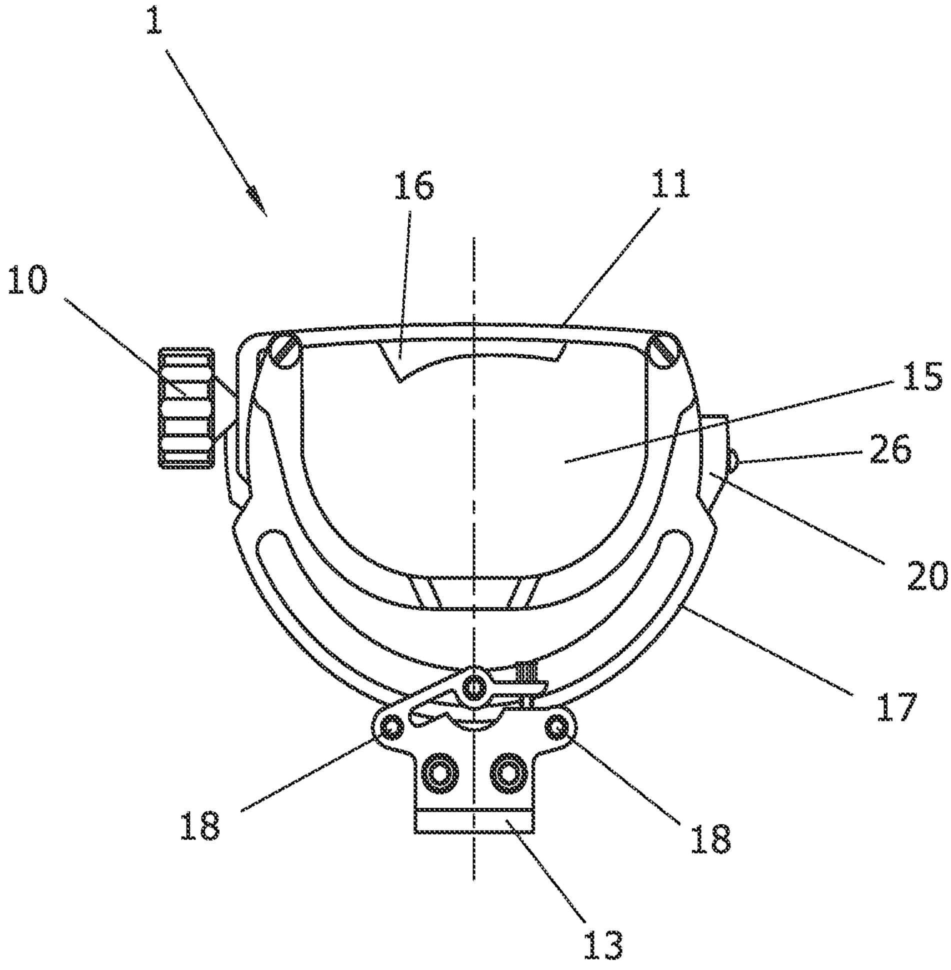


FIG.5

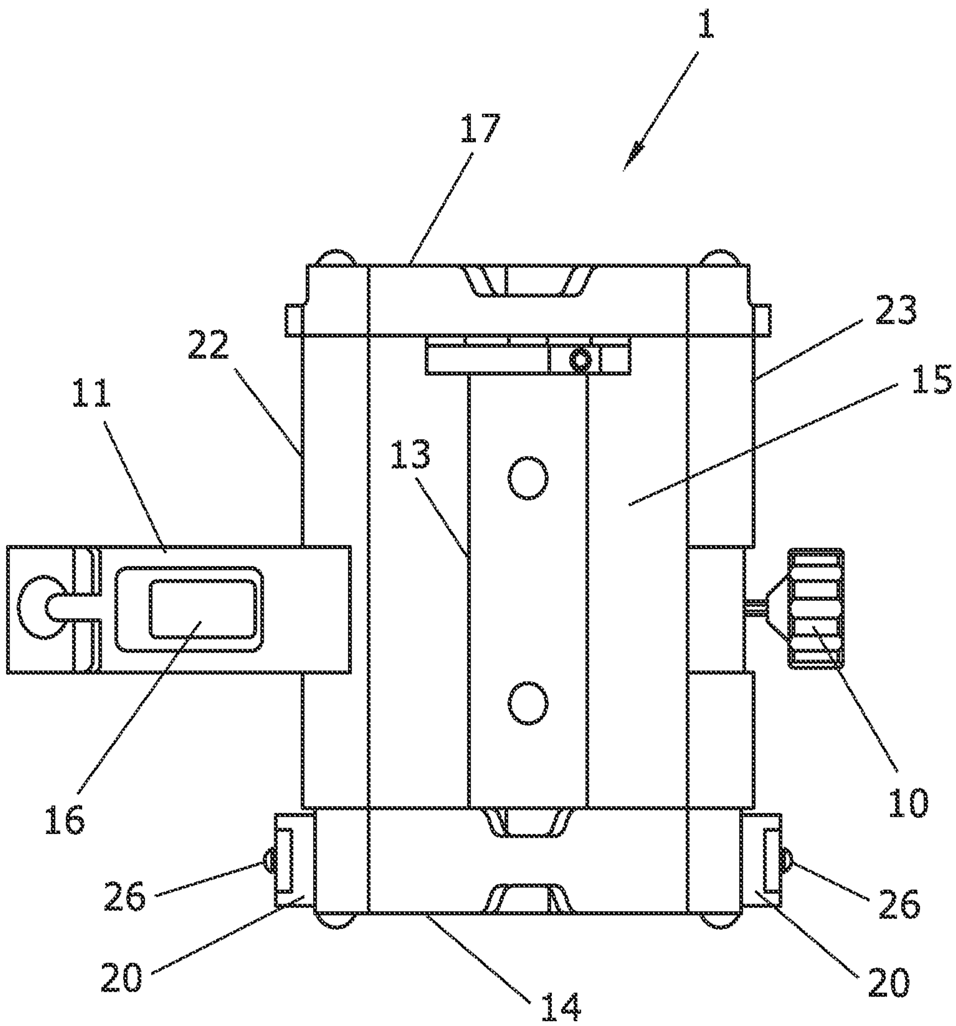


FIG.6

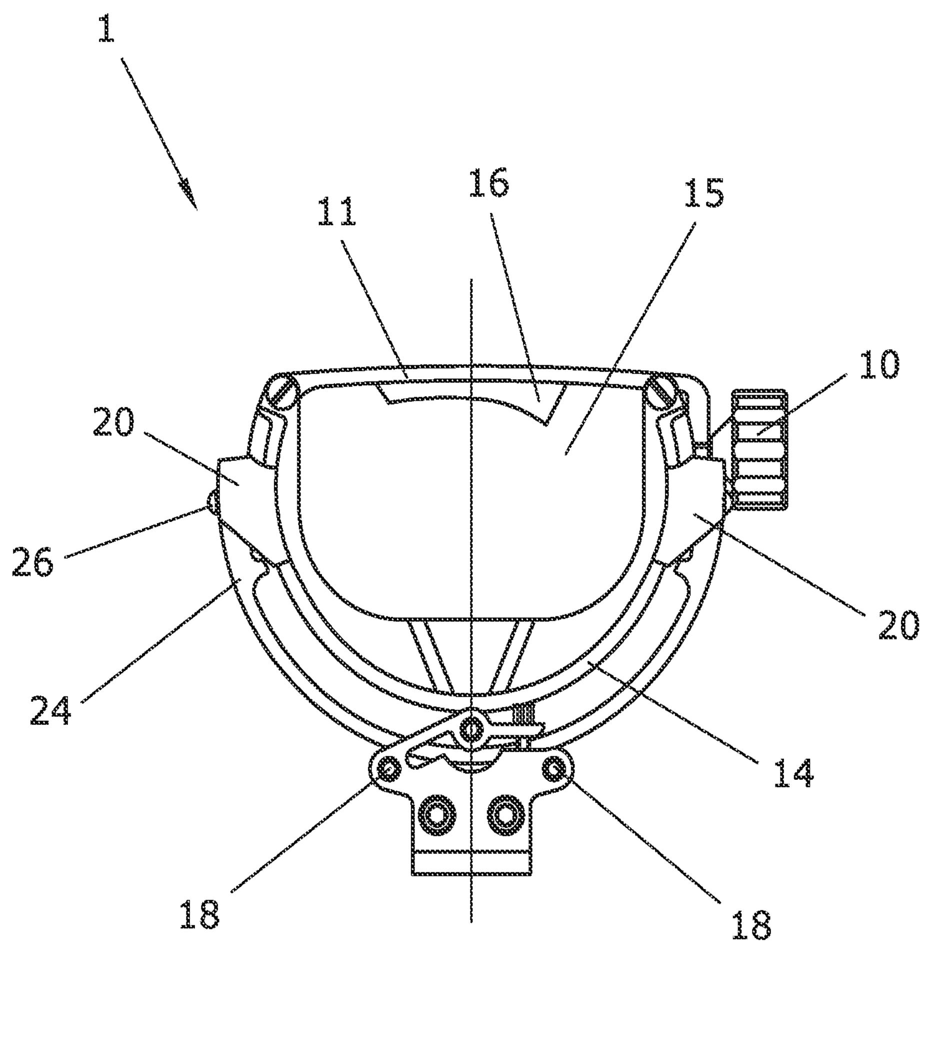
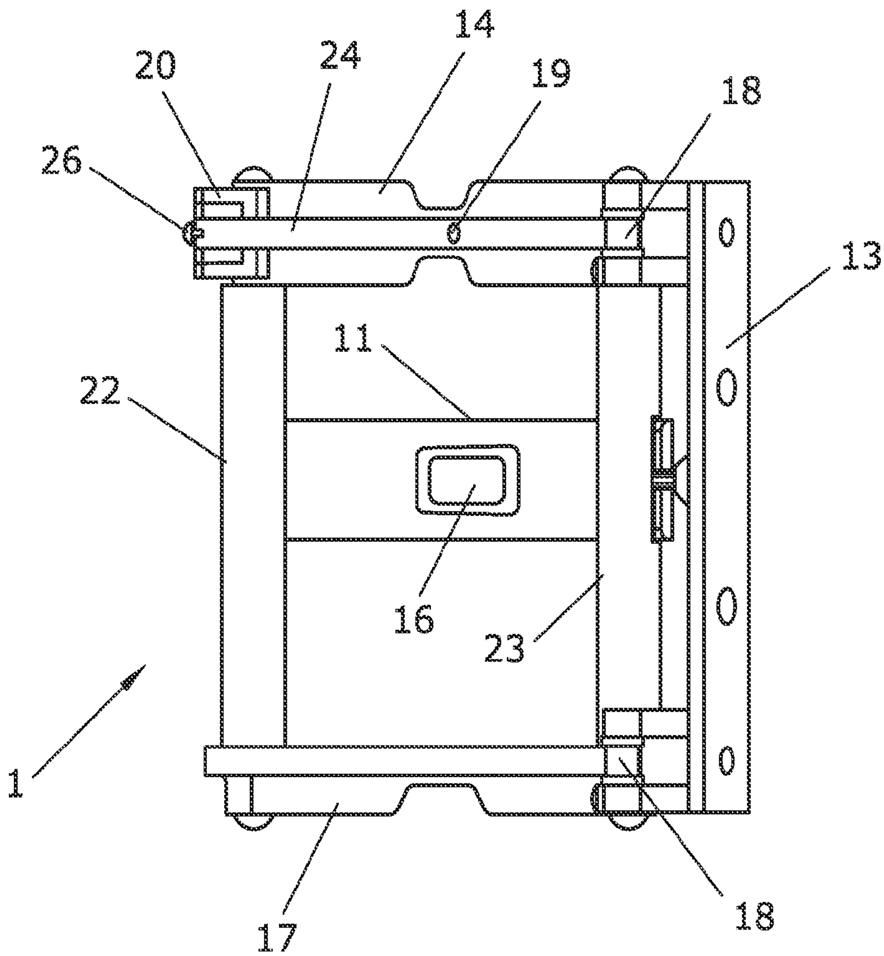


FIG.7



CRADLE FOR AN ULTRASOUND PROBE

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application is a continuation-in-part of U.S. patent application Ser. No. 13/116,071, filed May 26, 2011.

FIELD OF THE INVENTION

[0002] The invention relates to a cradle for holding an ultrasound probe, as may be used in brachytherapy.

BACKGROUND

[0003] The concept of insertion of radioactive sources into the prostate for the treatment of prostate cancer has a long history. Many patients with prostate cancer were treated by this method in the 1960s and 1970s. At that time the radioactive seeds were placed in the prostate through an open surgical incision in the lower abdomen. Because of the uncertainty of seed placement by this method, this technique was abandoned.

[0004] By the late 1980s, technologic and scientific advances in transrectal ultrasound imaging revived interest in seed implantation for the treatment of prostate cancer. Transrectal ultrasound probes make possible real-time interactive placement of radioactive seeds into the prostate. The doctor inserts an ultrasound probe into the rectum and attaches it to a stabilizing device which secures the toot to a table or chair for the duration of the treatment. In addition, 3-D simulation software allows accurate determination of the doses delivered to the prostate and surrounding structures, such as the bladder, urethra and rectum. These tools have permitted the refinement of interstitial brachytherapy for prostate cancer and have resulted in more accurate methods of delivering doses to the prostate gland.

[0005] The stepper is a lightweight, precision stepping device. The steppers modular design is adaptable to a variety of transrectal transducers. The stepper features easy-to-read marking scales.

[0006] A cradle may be connected to the stepper. The cradle holds an ultrasound probe in a fixed position. When the cradle is fixed to the stepper, the stepper allows a gentle fixed distance movement proximally and distally of an ultrasound probe held in the cradle. Each step taken by the stepper is a precise measured movement. The cradle will move with the ultrasound probe depending on the movement of the stepper.

[0007] In an ultrasound imaging system with an endorectal ultrasound probe, the rectal probe must be able to image in transverse section at least. It is advantageous to use a multi-plane probe to visualize any longitudinal plane in order to see the needle path. The frequency of the probe should range between 5 and 8 MHz in order to achieve the necessary spatial resolution as well as the necessary penetration depth.

[0008] The precision stepper enables the user to advance and retract an endorectal ultrasound probe in the rectum to image the prostate. The endorectal probe is inserted into and fixed to the stepper and positioned by moving the stepper/probe combination. Any endorectal probe from any producer can be fitted to the stepper. Movable length of the probe with the stepper: 100 mm, Scale for position recognition. Step width: 2.5 mm or 5 mm selectable as well as free analog movement in and out of the rectum. Additional free analogue movement of the probe to define the exact starting point for stepwise movement: 50 mm. Template is movable (100 mm) in the direction parallel to the ER probe's long axis and can be fixed in any position.

[0009] A needle guide grid system is provided for brachytherapy needles: Matrix of 13×13 individual channels (all channels for 18 Gauge needles—standard) Two nomenclatures (reversible) of the needle channel rows: 1 to 7 (every second row with number, front side of template) or 0 to 12 (every row with number, back side of template). Row spacing: 5 mm in both cases. Two nomenclatures (reversible) of the needle channel columns: A to G (every second row with letter, front side of template) or A to M (every row with letter, back side of template). Column spacing: 5 mm in both cases. The template is made of a material used for implants, and thus is fully bio-compatible.

[0010] A device that supports the stepper is the stabilizer. The stabilizer is connected to the guide rails of an OR table by a specific table holder, for example. The stabilizer and stepper can be moved and positioned manually by the integrated handle and fixed or loosed in its position in space by turning one knob.

[0011] However, recently there have been many different problems with the cradle. The problems with the cradle are the ultra-sound probe will not stay in a fixed position, therefore, not allowing proper alignment of the needle grid to the image on the display screen. Another problem with the cradle is that the cradle does not allow for proper 90° degree calibration, thereby no providing a repeatable, fixed reference point to medical personnel. Another problem with the cradle is that when providing medical treatment for the patient by the medical personnel, all moving parts on the cradle may come undone, therefore, causing the cradle to be disassembled. The disassembled cradle causes delay in providing treatment to patients. Another problem with many cradles relates to needle path verification. The needle path verification can be time consuming when the medical personnel have to calibrate the cradle holding the ultrasound probe to the needle grid. Many cradles require that the medical personnel remove or adjust the ultrasound probe, this is very time consuming and does not provide efficient medical treatment. Therefore, there is a need in the art to improve the calibration of the ultra-sound probe and the needle path verification. Furthermore, it would be appreciated to one skilled in the art to allow medical personnel to improve patient treatment time, and provide an efficient treatment modality for medical personnel.

SUMMARY OF INVENTION

[0012] According to one general aspect, a cradle holding a probe used to image a patient prior to and during medical procedures which a cradle is connected to a stepper-stabilizer via a plurality of cradle fix holes. The cradle further includes a locking knob attached to a side of the cradle for tightening and loosening a latch holding the ultrasound probe. A capture knob that is mounted inside the locking knob to prevent the locking knob from detaching from the cradle. The latch is connected on top of the cradle to wrap over and on top of the ultrasound probe. ; a pressure pad formed on the latch fastens to the probe when the latch is in a closed position, which results in anchoring the ultrasound probe inside a probe space. A micro-adjuster is connected to both sides of the cradle, and allows for refined adjustment in angular rotation around the horizontal axis of the cradle while connected to the

stepper-stabilizer. Roller-bearings attached between the cradle base and the cradle allow for smooth angular rotation on the horizontal axis.

[0013] The micro-adjuster allows the cradle to be calibrated to a predetermined angle with or without the probe affixed to cradle. The micro-adjuster allows medical personnel to adjustably rotate the cradle a maximum of 10° (+/−) via mechanically altering the cradle yoke and side-railing assembly rotatably, independently of a yoke retainer, which can be precision-aligned by way of a detent to the cradle base.

[0014] The micro-adjuster preferably utilizes bearings assembled to yoke retainer to control free rotation of the front yoke with respect to the yoke retainer. Control of front yoke rotation by the bearings may be altered by a screw or a release button for quick calibration.

[0015] The cradle holds an ultrasound probe held in place by a latch is set to lock by tightening the locking knob. The latch pushes down on the probe via the pressure pad formed on the latch. The pressure pad has a sloping, asymmetric cross-section, which achieves mechanical advantage in securing the ultrasound probe in the cradle. Once secured, alignment of the ultrasound probe image can be refined using the micro-adjuster capabilities. The pressure pad further features a concave, curved surface for engaging the ultrasound probe. In this fashion, the concave, curved surface allows from maximum surface area of the pressure pad to engage the probe, thereby resulting further in no angular movement of the probe.

DESCRIPTION OF THE DRAWINGS

[0016] FIG. **1** is a perspective view of an exemplary cradle according to the present invention, shown mounted on a stepper supporting a needle guide template.

[0017] FIG. **2** is a plan view from above of the cradle of FIG. **1**.

[0018] FIG. **3** is an elevation from the left side of the cradle of FIG. **1**.

[0019] FIG. **4** is a distal/rear elevation of the cradle of FIG. **1**.

[0020] FIG. **5** is a plan view from above of the cradle of FIG. **1**.

[0021] FIG. **6** is a proximal/front elevation of the cradle of FIG. **1**.

[0022] FIG. **7** is a plan view from below of the cradle of FIG. **1**, with a base of the cradle rotated to the right as seen on the drawing sheet.

DETAILED DESCRIPTION

[0023] The invention generally relates to treatment of prostate cancer treatment by using a stepper-stabilizer to image the patient prior to and while inserting radioactive seeds for dose treatment.

[0024] FIG. **1** illustrates a top of view of a cradle **1** attached to a stepper **5**. The stepper **5** is a piece of hardware that is used to connect to a stabilizer. This overview illustrates the correlation of the cradle **1** to the stepper **5**. Further, attached to the stepper **5** is a needle guide template **9**. The needle guide template **9** is used to provide the location of brachytherapy needle strands inserted into the human body while being imaged on the patient, as by a Best NOMOS Sonalis system, for example. The needle guide template **9** is fixed on the system by way of template locking knob **2**. The template locking knob **2** allows a medical assistant to fix the template **9**, thus allowing calibration between the needle guide template **9** and an ultrasound image provided by the ultrasound probe. It is important that the ultrasound probe to be precisely aligned with the template guide as illustrated on an imaging device (not shown). However, there are still problems in the prior art with alignment because of the misalignment of cradles and steppers. This can result into placing a radioactive seed in the wrong location, or not as directed by the treatment plan.

[0025] As shown in FIG. **1**, the stepper **5** has a baseline marker **3**. The baseline marker **3** measures the depth of the probe during insertion into the human body. This allows medical personnel to insert the probe to a specific depth in the human body to image a front, middle, or back part of the prostate, for example. The baseline marker **3** can be adjusted using a fine-tuning knob **4**, which allows medical personnel to calibrate the stepper distance prior to inserting the probe into the human body. The stepper **5** can be secured to a stabilizer by way of tightening knobs on the base of the stepper **5**. A stepper knob **6** is used to move forward and backwards the stepper **5**, the cradle **1**, and an ultrasound probe secured in the cradle **1**. Wing nuts **7** securely latch the stepper **5** to rods on which a needle guide template support is located. The needle guide template support is secured to the rods by knurled knobs, of which only one, left-side knob **8**, is shown in FIG. **1**. Grommets on the needle guide support receive posts on the needle guide template **9**.

[0026] Although major adjustments of the system and component alignment are afforded, prior art devices do not allow fully for precise calibration of an ultrasound probe supported in a prior art cradle; however, the cradle **1** of the present invention was designed to allow for micro-adjustments. Further, although the stepper **5** and needle guide template support allow horizontal and vertical needle path adjustments by changing the needle guide template location to match an on-screen grid projected over an image generated by an ultrasound probe, when such horizontal and vertical adjustments are made, there may remain alignment artifacts in the screen display. Such alignment artifacts may result from manufacturing factors inherent to the ultrasound probe, for example. System and component alignment, and removal of alignment artifacts, may be accomplished using the micro-adjustment aspects developed on the cradle **1** of the present invention.

[0027] FIG. **2** illustrates a top view of the cradle **1**. The cradle **1** includes a locking knob **10**. The locking knob **1 0** secures a latch **11**, which can be fixed over an ultrasound probe to be secured in the cradle **1**. The latch **11** is pivot-mounted on a right side rail **22**. As discussed further below, the latch **11** allows for the probe to be fixed securely, whereas prior cradles had problems with ultrasound probes sliding out, or otherwise becoming loose. Also shown in FIG. **2** are micro-adjuster bearings **20**, discussed further below. The cradle **1** may be attached to the stepper **5** by screws secured via cradle-fix holes **21** formed through cradle base **13**.

[0028] FIG. **3** illustrates a left-side view of the cradle **1**, shown in elevation. The locking knob **10** is fixed against loss with a capture knob **12**. The capture knob **12** is assembled to a left side rail **23** of the cradle **1**, typically using a high-strength adhesive, while keeping locking knob **10** free to turn.

[0029] Referring further to FIG. **3**, shown are a front yoke **14** and a rear yoke **17**. The front yoke **14** and the rear yoke **17** are connected rigidly by the right side rail **22** and the left side rail **23**. The front yoke **14** is assembled to the micro-adjuster bearings **20** to form a front yoke assembly, described further below. The front yoke assembly and the rear yoke **17** are supported on various rollers **18** for rotation with respect to cradle base **13**. The micro-adjuster bearings **20** allow for control of rotational movement of the front yoke **14** and the rear yoke **17**, affording refined adjustments of the cradle through approximately 15° (7.5° +/−). As explained in further detail below, the micro-adjuster bearings **20** are used, after the cradle base **13** has been precision-located by detent in a 90-degree perpendicular plane, to account for any remaining misalignments when correlating with images from ultrasound probes secured in the cradle. The micro-adjuster bearings **20** allow medical personnel to change a beam plane alignment slightly to correct calibration errors. Specifically, some ultrasound probes are potted incorrectly during manufacture with crystal misalignment; therefore, the micro-adjuster bearings **20** allow for correction of manufacturing defects by moving the ultrasound probe, secured within the cradle, independent of a precision, 90-degree alignment obtained from a center detent, as discussed herein.

[0030] FIG. **4** illustrates a front-view of the cradle **1**. The latch **11** can open and close over a given ultrasound probe. The selected ultrasound probe may be placed into probe space **15** and enclosed by the latch **11**. The latch **11** has a probe-lock-fixer **16** that is attached to the latch **11**. This is used to hold the probe in place. Prior art cradles would hold the probe; however, during medical procedures, the probes would be known rotate a few degrees, which affects the imaging quality and device alignment during the procedure. Therefore, probe-lock-fixer **16** was designed to hold the probe in a fixed position, without causing rotational plane movement. Advantageously, pressure pad **16** has an eccentric, concave profile, as can best be seen in FIGS. **4** and **6**. The profile affords mechanical advantage in securing the chosen ultrasound probe in the probe space **15**.

[0031] The cradle-base **13** supports housings featuring a series of rollers **18**. The rollers **18** allow for smooth, rotational movement of the probe held in a fixed position in the cradle space **15**.

[0032] FIG. **5** is a top view of the cradle **1** with latch **11** open to show the probe-space **15**. The selected ultrasound probe is placed into the probe-space **15** and closed over by the latch **11**. The latch **11** has a cone-shaped cavity **25** that accepts the correspondingly cone-shaped lock knob **10**. The lock knob **10** cooperates with the cone-shaped cavity **25**, which allows for self-tensioning of the latch **11** that holds the ultrasound probe securely in place.

[0033] FIG. **6** illustrates a right-side rear view of the exemplary cradle **1** with latch **11** closed. The probe-lock-fixer **16** is designed in a concave, eccentric fashion, as noted above. The design allows for a maximum surface area to be held by the probe-lock-fixer **16** against the ultrasound probe.

[0034] FIG. **7** illustrates a bottom-view of the cradle. As the yoke retainer **24** and rear yoke **17** rotate on roller-bearings **18** and move from one side to another side, the cradle-base **13** slides over the detent **19**. The detent **19** cooperates with a spring-loaded ball bearing supported on the base, and is used to orient repeatably and precisely the yoke retainer **24** with respect to cradle base **13** in a 90-degree position. Prior art cradles do not have this feature and the medical personnel have to determine the angle prior to inserting the probe into the human body. However, there may be misalignment issues, despite detent **19**; thus, the micro-adjuster bearings **20** allow for medical personnel to readjust the orientation of the front and rear yokes, and hence, an ultrasound probe held in the probe space **15**, with respect to perpendicular locker detent **19** to the exact 90 degrees. Importantly, this will allow medical personnel to expedite verification of needle grid alignment.

What is claimed is:

1. A cradle for holding a probe used to image a patient prior to and during medical procedures, the cradle comprising:
- a base for securing to a stepper-stabilizer;
- roller-bearings supported on the base; and
- a probe-holder that rotates on the roller-bearings in a smooth angular rotation on a horizontal axis relative to the base

wherein the probe-holder comprises,
- a front yoke and a rear yoke;
- a yoke retainer supporting the front yoke;
- a pivot side rail and a lock side rail spanning rigidly between the front yoke and the rear yoke;
- a locking knob that is captured to the lock side rail;
- a capture knob mounted to the lock side rail inside the locking knob to prevent the locking knob from detaching; and
- a latch hinged to the pivot side rail for pivoting to engagement with the locking knob and over the probe;
- wherein rollers rotatably support the yoke retainer and the rear yoke, and free rotation of the front yoke is controlled by the yoke retainer.

2. The cradle of claim **1**, further comprising bearings assembled to the yoke retainer, wherein the yoke retainer controls free rotation of the front yoke by releasably securing the front yoke to the bearings.

3. The cradle of claim **2**, wherein the front yoke is reteasably secured to the front yoke by screws tapped through the bearings.

4. The cradle of claim **1**, further comprising a detent formed on the yoke retainer to precisely locate a 90-degree orientation of the yoke retainer with respect to the base.

5. The cradle of claim **1**, wherein the latch includes a pressure pad, whereby the latch can be closed to press on the probe via the pressure pad.

6. The cradle of claim **5**, wherein the pressure pad is provided in a concave fashion to allow for maximum surface area of the pressure pad to contacting the ultrasound probe thereby resulting in no angular movement of the ultrasound probe with respect to the cradle.

7. The cradle of claim **6**, wherein the pressure pad has an eccentric profile.

8. The cradle of claim **1**, further comprising a pressure pad attached to the latch for fastening over the ultrasound probe when the latch is in a closed position and anchoring the ultrasound probe inside a probe space.

* * * * *

patsnap

专利名称(译)	用于超声波探头的支架		
公开(公告)号	US20140034800A1	公开(公告)日	2014-02-06
申请号	US14/050009	申请日	2013-10-09
申请(专利权)人(译)	最好的医疗INTERNATIONAL，INC.		
当前申请(专利权)人(译)	最好的医疗INTERNATIONAL，INC.		
[标]发明人	STRONG DAVID		
发明人	STRONG, DAVID		
IPC分类号	A61B8/00		
CPC分类号	A61B8/4209 A61B8/0841 A61B8/085 A61B8/12 A61B8/4245 A61B2017/3411 A61B2017/3413 A61B2090/378 A61N5/1027 A61N2005/1012 A61N2005/1058		
其他公开文献	US9320494		
外部链接	Espacenet USPTO		

摘要(译)

用于保持用于在医疗程序之前和期间对患者成像的超声探头的支架包括用于固定到步进稳定器的基座，支撑在基座上的滚柱轴承，以及在轴承上旋转的探头支架。在水平轴上相对于基座的平滑角度旋转。探针支架包括前轭和后轭，以及支撑前轭的轭保持器。枢轴侧轨和锁侧轨在前轭和后轭之间刚性地跨越。锁定旋钮，锁定到锁定侧导轨，以防止锁定旋钮脱离。铰接到枢轴侧轨道的闩锁通过锁定旋钮接合，以固定在探头上。制动器确保轭架保持器相对于基座的精确90度对准。滚轮可旋转地支撑轭架保持器和后轭架，并且前轭架的自由旋转由轭架保持器控制，以允许校正未对准。