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(54) **THREE-DIMENSIONAL ULTRASONIC SCANNER**

3D-ULTRASCHALLSCANNER

SCANNER ULTRASONORE TRIDIMENSIONNEL

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Description

[Technical Field]

[0001] The present disclosure relates to a three-dimensional ultrasound scanner. More particularly, the present invention relates to a three-dimensional ultrasound scanner which provides a swing mechanism for making the scanner easy to hold and lightweight to maneuver in order to enhance the user convenience.

[Background Art]

[0002] The statements in this section merely provide background information related to the present disclosure and may not constitute the prior art.

[0003] In the medical field, ultrasound diagnosis technology is widely known. Ultrasound diagnosis equipment is comprised of a main body for ultrasound diagnosis and an ultrasound scanner. The ultrasound scanner includes an array transducer consisting of a number of transducers for transmitting and receiving ultrasound waves. When the ultrasound scanner is positioned on the skin of body, the ultrasound waves transmitted from the array transducer is reflected back after hitting the object for diagnosis. The ultrasound diagnosis equipment processes and analyzes the reflected signals to provide a visual representation of cross-sectional images of the interior of the body through a monitor.

[0004] If the array transducer is fixedly installed in the ultrasound scanner, it is very difficult to synthesize a three-dimensional image. A user may deliberately tilt or move the ultrasound scanner to obtain a three-dimensional image but an observation of the object for diagnosis at an optimal angle and location can hardly be achieved and a distortion will occur during data acquisition.

[0005] FIG. 1 illustrates an internal constitution of conventional three-dimensional ultrasound scanner.

[0006] As illustrated, 3-D ultrasound scanner 10 is enclosed by a scanner case 12 which houses an array transducer 14 positioned in reciprocating movement due to a swing mechanism 16. Scanner case 12 is internally divided by a base 18 into two spaces. Swing mechanism 16 is positioned in a top space above base 18, and array transducer 14 is positioned in a bottom space below base 18.

[0007] Swing mechanism 16 is comprised of a motor 20 which rest on base 18, gears 22, a shaft 24, and an arm 26. Array transducer 14 is constructed to hang on swing mechanism 16 through arm 26. In this construction, when motor 20 starts, gears 22, shaft 24, and arm 26 make sequential movements for impelling array transducer 14 to carry out a swing motion about the axis of shaft 24. With repetitive swing motions of array transducer 14, there are sequentially repeated acquisitions of scanned surfaces within the range of the swing, whereby a three-dimensional ultrasound image may be generated.

[0008] GB 2,067,759 A describes ultrasound equipment for generating section images in which the angle of the swing of the sound head carrier and the angular width of the sector-shaped section image can be adjusted to different values by adjusting means. A crank mechanism is provided, which comprises a connecting rod, which is pivoted on an axis spaced from the geometric axis of rotation of the motor. The connecting rod is mounted in a bearing member, which is disposed adjacent to the axis of rotation and which is pivoted to the sound transducer head carrier on a transverse axis. The angle between the axis of the connecting rod and the axis of rotation of the motor and the angle of swing of the sound transducer head carrier can be adjusted by an alteration of the ratio of the effective length a of the connecting rod to the distance b from the axis of the motor to that end of the connecting rod that is nearer to the motor.

[Disclosure]

[Technical Problem]

[0009] However, the conventional 3-D ultrasound scanner has a problem of causing inconvenience to the user with holding the scanner by hand because the placement of the motor alongside the swing axis inflates the scanner handle portion.

[0010] In addition, since conventional 3-D ultrasound scanners utilize multiple pulleys, belts, or gears which increases the reduction gear ratio requiring a high-speed and hence a high capacity motor, they end up to become problematic heavyweight products.

[0011] Such heavy and inconvenient scanner construction causes a wrist pain for frequent scanner users.

[0012] Moreover, employment of pulleys, belts, or gears involves the difficulty of making alignments to a level of required precision in manufacturing the scanner and causes backlash between the components leading to imprecise images at the scene of the three-dimensional ultrasound diagnosis and even results in scanner malfunctions.

[Technical Solution]

[0013] In view of the foregoing problems, the present disclosure provides a lightweight and comfortable three-dimensional ultrasound scanner which is not hard on the users' wrists in carrying out the ultrasound diagnosis.

[0014] In addition, the present disclosure provides a three-dimensional ultrasound scanner that eliminates a backlash from a swing mechanism to thereby offer a high precision.

[0015] For this purpose, the three-dimensional ultrasound scanner according to an aspect of the present disclosure includes: a scanner case; a transducer unit positioned on an interior floor of the scanner case; a motor positioned perpendicular to a swing axis of the transducer

unit; and a swing mechanism for transmitting a rotary power of the motor to the transducer unit to reciprocate the transducer unit.

[0016] Additionally, the three-dimensional ultrasound scanner according to another aspect of the present disclosure includes: a scanner case including a handle and a scanning body; a transducer unit positioned on an interior floor of the scanner body; a motor, inserted in the handle, having a rotational axis perpendicular to a swing axis of the transducer unit; a first power transmitter following a rotary operation of the motor to swing about an axis of rotation within a certain angular range; and a second power transmitter for transmitting a rotary power of the first power transmitter to the transducer unit to reciprocate the transducer unit.

[0017] Furthermore, the three-dimensional ultrasound scanner according to yet another aspect of the present disclosure includes: a scanner case; a transducer unit positioned on an interior floor of the scanner case; a motor for generating a rotary power for causing a reciprocating movement of the transducer unit; an arm holder connected to a rotational axis of the motor; an arm connected to the arm holder to rotate about the rotational axis of the motor within a certain angular range; a link, attached to the arm, for moving in unison with the arm; and a shaft, connected to the link, for transmitting a rotary power of the arm to the transducer unit.

[Advantageous Effects]

[0018] As mentioned above, the arrangement of the drive motor for the swing mechanism as perpendicular to the swing axis of the transducer unit gives more flexibility in the design of the handle of the three-dimensional ultrasound scanner for a user to hold.

[0019] In addition, the simplified swing mechanism capable of employing a smaller capacity motor facilitates the implementation of a lighter three-dimensional ultrasound scanner.

[0020] Further, eliminating the need for pulleys, belts or gears precludes an alignment issue in manufacturing the scanners, while backlashes due to worn out components are virtually zero, which promotes implementation of precision three-dimensional ultrasound scanners.

[Description of Drawings]

[0021]

FIG. 1 is a diagram illustrating a conventional three-dimensional ultrasound scanner;

FIG. 2 is a cross sectional view of a three-dimensional ultrasound scanner according to the present disclosure;

FIG. 3 is a perspective view of a swing mechanism according to the present disclosure; and

FIG. 4 is a perspective view of a link according to the present disclosure.

[Mode for Invention]

[0022] First of all, the present disclosure provides a precise performance three-dimensional ultrasound scanner that is agile for a hand to easily hold by suggesting a novel construction of a swing mechanism wherein an arrangement of the drive motor perpendicular to the swing axis requires a small capacity motor, eliminating a backlash from occurring.

[0023] In the following, as aspect of the present disclosure will be detailed referring to the drawings.

[0024] FIG. 2 is a cross sectional view of a three-dimensional ultrasound scanner according to the present disclosure.

[0025] As shown in FIG. 2, a three-dimensional ultrasound scanner 40 is enclosed by a scanner case 42 which houses a transducer unit 44 having a number of transducers for transmitting and receiving ultrasound waves, a swing mechanism 46 for reciprocating transducer unit 44, a motor 60 for generating a rotary power for operating swing mechanism 46.

[0026] A novel arrangement of swing mechanism 46 and motor 60 shapes scanner case 42 to have a handle 42a and a scanning body 42b. Motor 60 is positioned in handle 42a of scanner 40 and transducer unit 44 is positioned on an internal floor of scanning body 42b.

[0027] Although not shown, transducer unit 44 is comprised of a number of transducer elements arranged over a convex surface, an acoustic lens for converging ultrasound waves transmitted from a number of transducer elements, matching layer for providing an impedance matching between the transducer elements and the lens, and backing layer for absorbing unnecessary portion of ultrasound waves. Transducer unit 44 reciprocates with the assistance of swing mechanism 46, sequentially repeating acquisitions of scanned surfaces within the range of the reciprocating motion.

[0028] Swing mechanism 46 includes an arm holder 48, an arm 50, and a shaft 54. Referring to FIGs. 2 and 3, the construction of swing mechanism 46 will be described in detail. Arm holder 48 is connected to an axis 68 of rotation of motor 60 to transmit the rotary power of motor 60 to arm 50. Arm 50 is co-rotationally connected to arm holder 48 so that the arm 50 rotates about axis 68 of rotation of motor 60 within a certain angular range. A link 52 is connected to arm 50 to move therewith. The structure of link 52 will be described with reference to FIG. 4. Shaft 54 is connected to link 52 for transmitting the rotary power of arm 50 to transducer unit 44.

[0029] Inside scanner case 42 is a frame 56 installed to place motor 60 in its upper space and transducer unit 44 in its lower space. Transducer unit 44 is constructed to hang on a swing axis 58 installed on opposite ends of frame 56 so that transducer unit 44 swings about swing axis 58. Motor 60 is seated on top of frame 56 so that

axis 68 of rotation of motor 60 may be perpendicular to swing axis 58.

[0030] Upon receiving power from a power source, motor 60 rotates which also turns arm holder 48 together with its coupled axis 68. Motor 60 repeats forward and reverse rotations at a predetermined angular velocity within a certain angular range. Accordingly, arm 50 connected to arm holder 48 swings repeatedly about axis 68 within the certain angular range.

[0031] Rotational reciprocation of arm 50 is transmitted via link 52 to shaft 54 mounted on top of transducer unit 44. Link 52 connects arm 50 and shaft 54 to effectively transmit the rotary power of arm 50 to transducer unit 44. When the reciprocating rotational movement of arm 50 is transmitted through link 52 to shaft 54, shaft 54 follows arm 50 in its rotational directions to thrust transducer unit 44 sideways in reciprocation.

[0032] Referring to FIG. 4, link 52 is comprised of two members. Specifically, link 52 is made of a first link member 62 having an opening 62a for arm 50 and a second link member 64 having a bore 64a for accepting shaft 54. First link member 62 and second link member 64 are connected by a link coupler 66, and they are preferably interconnected through a ball bearing. Articulated by the ball bearing, link 52 is adapted to compensate for the changes in angle between arm 50 and shaft 54.

[0033] A ball bushing system 70 is applied to opening 62a of first link member 62 for receiving arm 50 as well as to bore 64a of second link member 64 for receiving shaft 54. Ball bushing system 70 mainly plays the role of reducing frictional forces between arm 50, shaft 54, and link 52 during the repetitive rotational reciprocation.

[0034] A person skilled in the art could improve or diversify the technical idea of the present disclosure into different forms. Therefore, present disclosure should not be understood restrictedly by the very aspect stated but the scope of right of the present disclosure should be strictly understood as what is claimed below.

Claims

1. A three-dimensional ultrasound scanner comprising:

a scanner case (42) comprising an upper space and a lower space;
a transducer unit (44) housed in the lower space of the scanner case (42) and hung on a swing axis (58);
a motor (60) for generating a rotary power housed in the upper space of the scanner case (42), wherein a rotational axis of the motor (60) is perpendicular to the swing axis (58); and
a swing mechanism (46) connecting the transducer unit (44) and the motor (60) and configured to transmit the rotary power of the motor to the transducer unit to swing the transducer unit (44) about the swing axis (58),

wherein the swing mechanism (46) comprises:

an arm holder (48) connected to the rotational axis of the motor (60);
an arm (50) connected to the arm holder (48), and configured to swing within a certain angular range about the rotational axis depending on rotation of the motor (60);
a link (52), attached to the arm (50), for moving in unison with the arm (50); and
a shaft (54) connected to the link (52) and mounted on top of the transducer unit (44), the shaft extended from the link (52) to the transducer unit (44) in a direction substantially parallel to the rotational axis of the motor (60), and configured such that the swing movement of the arm (50) delivered to the shaft (54) via the link (52) causes the shaft (54) to swing around the rotational axis of the motor (60) and thereby thrusts the transducer unit (44) sideways such that the transducer unit (44) swings about the swing axis (58).

2. The scanner according to claim 1, wherein the link (52) comprises:

a first link member (62); and
a second link member (64) connected via a link coupler (66) to the first link member (62) and accepting the shaft (54).

3. The scanner according to claim 2, wherein the first link member (62) comprises a first opening (62a) for receiving the arm (50) and the second link member (64) comprises a second opening (64a) for receiving the shaft (54).

4. The scanner according to claim 2, wherein the link coupler (66) is a ball bearing.

5. The scanner according to claim 4, wherein the ball bearing causes articulated motion between the first link member and the second link member according to the rotary power of the motor, to thereby compensate for changes in angle between the arm and the shaft.

6. The scanner according to claim 2, wherein a ball bushing is applied to the first link member and the second link member.

7. The scanner according to claim 1, wherein the arm (50) is extended from the arm holder (48) in a direction orthogonal to the rotational axis of the motor (60).

8. A method for rotating a transducer unit by actuation of a motor at an ultrasound scanner, the method

comprising:

swinging an arm (50) within a certain angular range based on rotation of the motor (60), wherein the arm is connected to a rotational axis of the motor (60) and is extended from the rotational axis in a direction orthogonal to said rotational axis;
delivering the swing movement of the arm (50) to a shaft (54) via a link (52), wherein the link (52) connects between the arm (50) and the shaft (54), and the shaft is connected to the link (52) and mounted on top of the transducer unit (44), wherein the shaft is extended from the link (52) to the transducer unit (44) in a direction substantially parallel to the rotation axis of the motor (60);
swinging the shaft (54) depending on the swing movement of the arm (50) delivered to the shaft (54) via the link (52); and
directly thrusting the transducer unit (44) sideways by the swing movement of the shaft (54) to thereby swing the transducer unit (44) about a swing axis (58) perpendicular to the rotational axis of the motor (60).

9. The method of claim 8, wherein the link (52) comprises a first link member (62) configured to accept the arm (50) and a second link member (64) configured to accept the shaft (54) and connected to the first link member (62) via a link coupler (66).

Patentansprüche

1. Dreidimensionaler Ultraschall-Scanner mit:

einem Scannergehäuse (42), das einen oberen Raum und einen unteren Raum aufweist;
einer Wandlereinheit (44), die in dem unteren Raum des Scannergehäuses (42) untergebracht und an einer Schwingachse (58) aufgehängt ist;
einem Motor (60) zum Erzeugen einer Drehkraft, der in dem oberen Raum des Scannergehäuses (42) untergebracht ist, wobei eine Drehachse des Motors (60) senkrecht zu der Schwingachse (58) ist; und
einem Schwingmechanismus (46), der die Wandlereinheit (44) und den Motor (60) verbindet und dazu konfiguriert ist, die Drehkraft des Motors an die Wandlereinheit zu übertragen, um die Wandlereinheit (44) um die Schwingachse (58) zu schwingen,

wobei der Schwingmechanismus (46) aufweist:

einen Armhalter (48), der mit der Drehachse des Motors (60) verbunden ist;
einen Arm (50), der mit dem Armhalter (48) verbunden und dazu konfiguriert ist, in einem bestimmten Winkelbereich um die Drehachse zu schwingen, abhängig von der Drehung des Motors (60);
ein Gelenk (52), das an dem Arm (50) befestigt ist, um sich zusammen mit dem Arm (50) zu bewegen; und
eine Welle (54), die mit dem Gelenk (52) verbunden und oben auf der Wandlereinheit (44) angebracht ist, wobei sich die Welle von dem Gelenk (52) zu der Wandlereinheit (44) in einer zu der Drehachse des Motors (60) im Wesentlichen parallelen Richtung erstreckt, und so konfiguriert ist, dass die Schwingbewegung des Arms (50), die über das Gelenk (52) an die Welle (54) übertragen wird, veranlasst, dass die Welle (54) um die Drehachse des Motors (60) schwingt und dadurch die Wandlereinheit (44) zur Seite schiebt, so dass die Wandlereinheit (44) um die Schwingachse (58) schwingt.

2. Scanner nach Anspruch 1, wobei das Gelenk (52) aufweist:

ein erstes Gelenkelement (62); und
ein zweites Gelenkelement (64), das über eine Gelenkkupplung (66) mit dem ersten Gelenkelement (62) verbunden ist und die Welle (54) aufnimmt.

3. Scanner nach Anspruch 2, wobei das erste Gelenkelement (62) eine erste Öffnung (62a) zum Aufnehmen des Arms (50) aufweist und das zweite Gelenkelement (64) eine zweite Öffnung (64a) zum Aufnehmen der Welle (54) aufweist.

4. Scanner nach Anspruch 2, wobei die Gelenkkupplung (66) ein Kugellager ist.

5. Scanner nach Anspruch 4, wobei das Kugellager eine Gelenkbewegung zwischen dem ersten Gelenkelement und dem zweiten Gelenkelement gemäß der Drehkraft des Motors verursacht, um dadurch Winkeländerungen zwischen dem Arm und der Welle auszugleichen.

6. Scanner nach Anspruch 2, wobei eine Kugelbuchse an dem ersten Gelenkelement und dem zweiten Gelenkelement angebracht ist.

7. Scanner nach Anspruch 1, wobei sich der Arm (50) von dem Armhalter (48) in orthogonaler Richtung zur Drehachse des Motors (60) erstreckt.

8. Verfahren zum Drehen einer Wandlereinheit durch Betätigen eines Motors an einem Ultraschall-Scan-

ner, wobei das Verfahren beinhaltet:

Schwingen eines Arms (50) innerhalb eines bestimmten Winkelbereichs basierend auf der Drehung des Motors (60), wobei der Arm mit einer Drehachse des Motors (60) verbunden ist und sich von der Drehachse in orthogonaler Richtung zu der Drehachse erstreckt;
Übertragen der Schwingbewegung des Arms (50) über ein Gelenk (52) an eine Welle (54), wobei das Gelenk (52) zwischen den Arm (50) und die Welle (54) geschaltet ist und die Welle mit dem Gelenk (52) verbunden und oben auf der Wandlereinheit (44) angebracht ist, wobei sich die Welle von dem Gelenk (52) zu der Wandlereinheit (44) in einer im Wesentlichen parallelen Richtung zur Drehachse des Motors (60) erstreckt;
Schwingen der Welle (54) in Abhängigkeit von der Schwingbewegung des Arm (50), die über das Gelenk (52) an die Welle (54) übertragen wird; und
direktes zur Seite Schieben der Wandlereinheit (44) durch die Schwingbewegung der Welle (54), um dadurch die Wandlereinheit (44) um eine Schwingachse (58) zu schwingen, die senkrecht zur Drehachse des Motors (60) ist.

9. Verfahren nach Anspruch 8, wobei das Gelenk (52) ein erstes Gelenkelement (62) aufweist, das dazu konfiguriert ist, den Arm (50) aufzunehmen, und ein zweites Gelenkelement (64), das dazu konfiguriert ist, die Welle (54) aufzunehmen, und über eine Gelenkkupplung (66) mit dem ersten Gelenkelement (62) verbunden ist.

Revendications

1. Scanner à ultrasons tridimensionnel, comprenant :

un boîtier de scanner (42) comprenant un espace supérieur et un espace inférieur ;
une unité de transducteur (44) logée dans l'espace inférieur du boîtier de scanner (42) et accroché sur un axe de balancement (58) ;
un moteur (60) destiné à générer une puissance de rotation, logé dans l'espace supérieur du boîtier de scanner (42), un axe de rotation du moteur (60) étant perpendiculaire à l'axe de balancement (58) ; et
un mécanisme de balancement (46) reliant l'unité de transducteur (44) et le moteur (60) et configuré pour transmettre la puissance de rotation du moteur à l'unité de transducteur afin de balancer l'unité de transducteur (44) autour de l'axe de balancement (58),

dans lequel le mécanisme de balancement (46) comprend :

un porte-bras (48) relié à l'axe de rotation du moteur (60) ;
un bras (50) relié au porte-bras (48), et configuré pour balancer à l'intérieur d'une certaine plage angulaire autour de l'axe de rotation en fonction de la rotation du moteur (60) ;
une liaison (52), attachée au bras (50), destinée à se déplacer à l'unisson avec le bras (50) ; et
une tige (54) reliée à la liaison (52) et montée sur le dessus de l'unité de transducteur (44), la tige s'étendant depuis la liaison (52) jusqu'à l'unité de transducteur (44) dans une direction sensiblement parallèle à l'axe de rotation du moteur (60), et étant configurée de telle sorte que le mouvement de balancement du bras (50) fourni à la tige (54) par le biais de la liaison (52) amène la tige (54) à se balancer autour de l'axe de rotation du moteur (60) et pousse ainsi l'unité de transducteur (44) sur les côtés de telle sorte que l'unité de transducteur (44) se balance autour de l'axe de balancement (58).

2. Scanner selon la revendication 1, dans lequel la liaison (52) comprend :

un premier élément de liaison (62) ; et
un second élément de liaison (64) relié par le biais d'un coupleur de liaison (66) au premier élément de liaison (62) et acceptant la tige (54).

3. Scanner selon la revendication 2, dans lequel le premier élément de liaison (62) comprend une première ouverture (62a) destinée à recevoir le bras (50) et le second élément de liaison (64) comprend une seconde ouverture (64a) destinée à recevoir la tige (54).

4. Scanner selon la revendication 2, dans lequel le coupleur de liaison (66) est un roulement à billes.

5. Scanner selon la revendication 4, dans lequel le roulement à billes entraîne un mouvement articulé entre le premier élément de liaison et le second élément de liaison en fonction de la puissance de rotation du moteur, pour ainsi compenser les changements d'angle entre le bras et la tige.

6. Scanner selon la revendication 2, dans lequel une douille à billes est appliquée au premier élément de liaison et au second élément de liaison.

7. Scanner selon la revendication I, dans lequel le bras (50) s'étend depuis le porte-bras (48) dans une direction orthogonale à l'axe de rotation du moteur (60).

8. Procédé destiné à faire tourner une unité de transducteur par l'actionnement d'un moteur au niveau d'un scanner à ultrasons, le procédé consistant à :

balancer un bras (50) à l'intérieur d'une certaine plage angulaire sur la base de la rotation du moteur (60), le bras étant relié à un axe de rotation du moteur (60) et s'étendant depuis l'axe de rotation dans une direction orthogonale audit axe de rotation ;
fournir le mouvement de balancement du bras (50) à une tige (54) par le biais d'une liaison (52), la liaison (52) reliant le bras (50) et la tige (54), et la tige étant reliée à la liaison (52) et montée sur le dessus de l'unité de transducteur (44), la tige s'étendant depuis la liaison (52) jusqu'à l'unité de transducteur (44) dans une direction sensiblement parallèle à l'axe de rotation du moteur (60) ;
balancer la tige (54) en fonction du mouvement de balancement du bras (50) fourni à la tige (54) par le biais de la liaison (52) ; et
pousser directement l'unité de transducteur (44) sur les côtés par le mouvement de balancement de la tige (54) pour ainsi balancer l'unité de transducteur (44) autour d'un axe de balancement (58) perpendiculairement à l'axe de rotation du moteur (60).

9. Procédé selon la revendication 8, dans lequel la liaison (52) comprend un premier élément de liaison (62) configuré pour accepter le bras (50) et un second élément de liaison (64) configuré pour accepter la tige (54) et relié au premier élément de liaison (62) par le biais d'un coupleur de liaison (66).

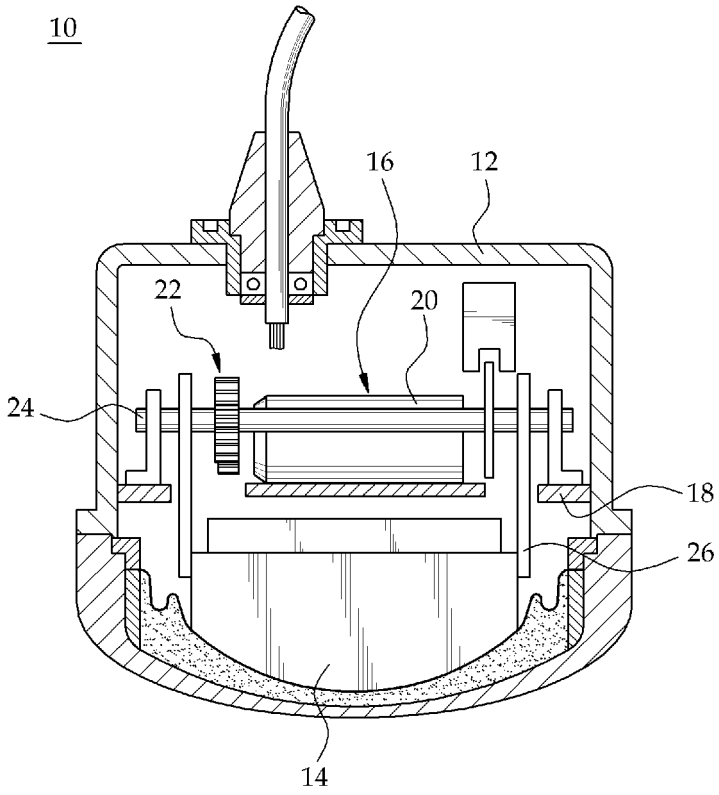

FIG. 1

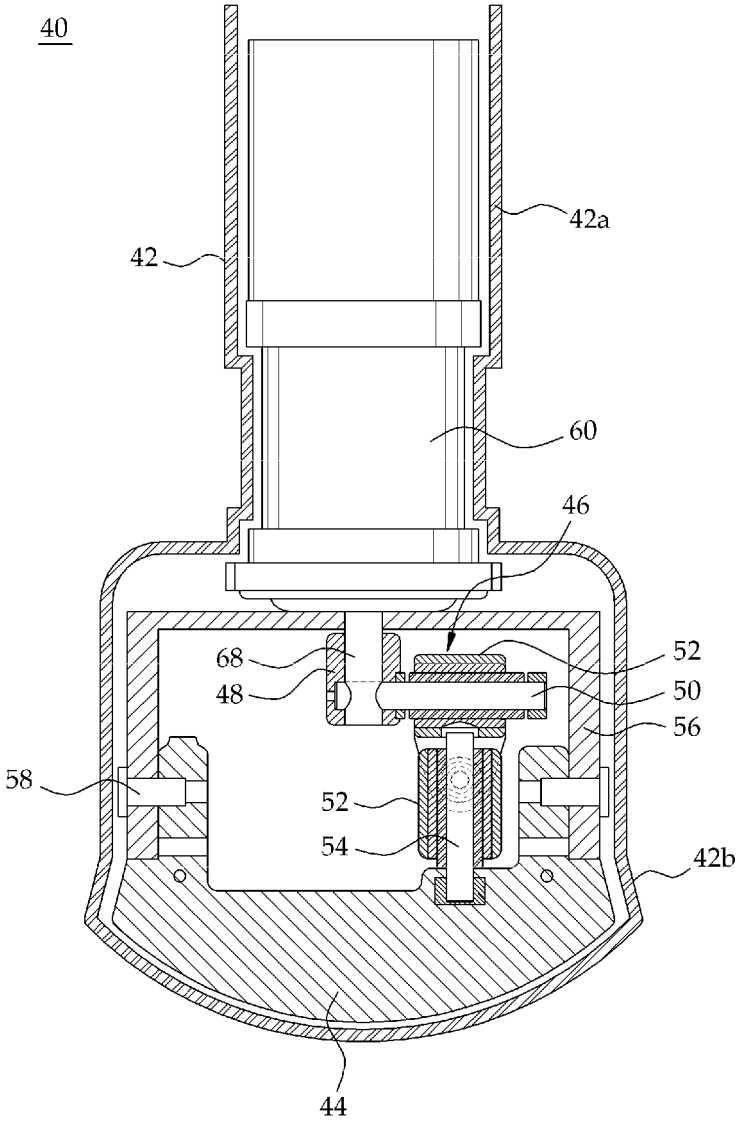

FIG. 2

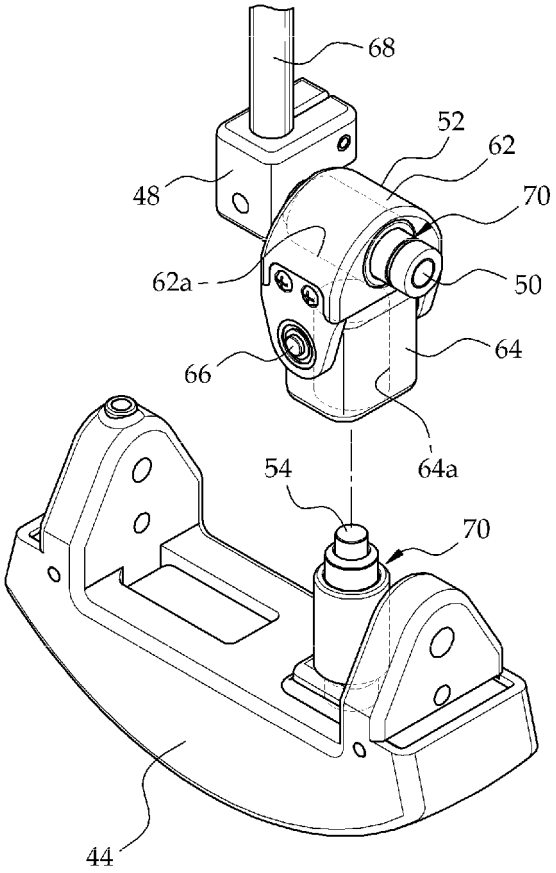

FIG. 3

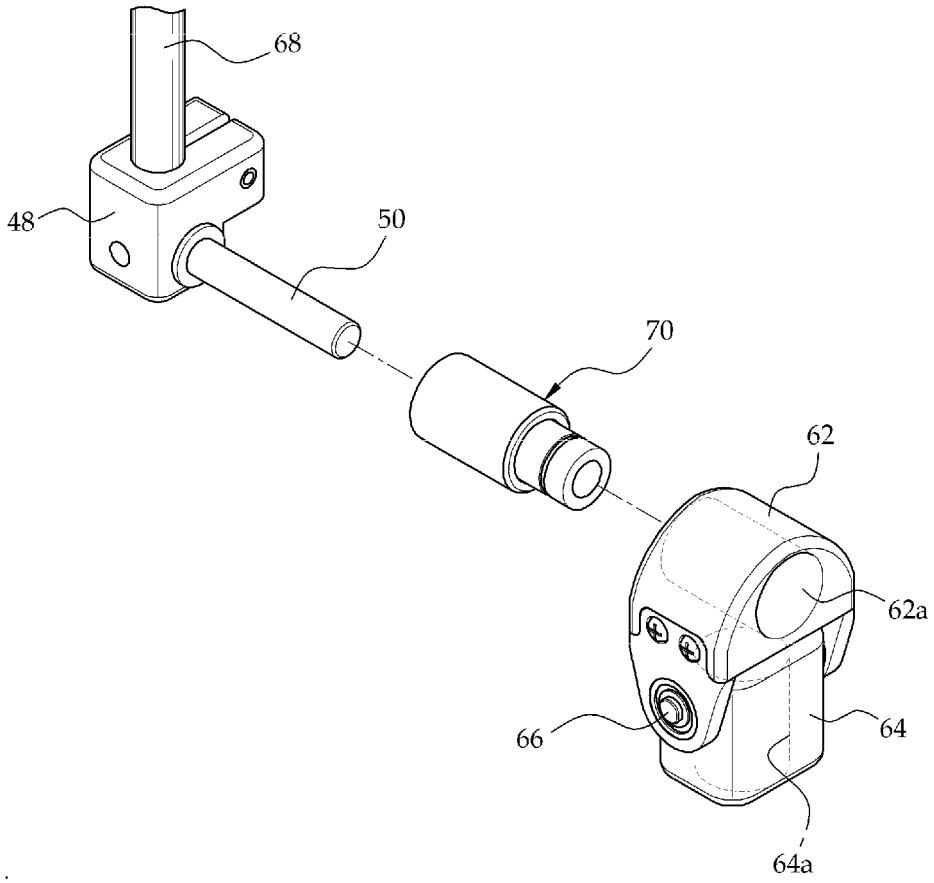

FIG. 4

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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[标]申请(专利权)人(译)	爱飞纽医疗机械贸易有限公司		
申请(专利权)人(译)	ALPINION MEDICAL SYSTEMS CO.，LTD. 庆北大学学术业界合作基础		
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摘要(译)

本公开提供了一种精确性能的三维超声扫描仪，其通过提出一种新颖的摆动机构构造而易于握持，其中驱动马达垂直于摆动轴的布置需要较小容量的马达并消除齿隙。摆动机构包括：臂支架，连接到电动机的旋转轴;连接到臂架的臂，使臂在一定的角度范围内摆动;连接在手臂上的连杆，用于与手臂一致移动;连接到连杆的轴，用于将臂的旋转动力传递到换能器单元。摆动机构可以使用较小容量的电动机操作，并且不需要皮带轮，齿轮或皮带消除背隙，以促进轻型精密三维超声扫描仪的实施。


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