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(54) **ULTRASONIC PROBE AND ULTRASONIC IMAGING APPARATUS**

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(57) **ABSTRACT**

An ultrasonic probe and an ultrasonic imaging apparatus are disclosed. The ultrasonic probe includes a vibration generator for transferring sound beneficial to a fetus so as to transmit the sound signal to the fetus more efficiently than a conventional ultrasonic probe. An ultrasonic probe includes a transducer configured to transmit an ultrasonic signal to an object or receive an ultrasonic signal reflected from the object. The ultrasonic probe includes a frame and a vibration generator. The vibration generator is located in the frame, and generates vibration when the ultrasonic probe contacts the object in such a manner that the generated vibration is transferred to a fetus of the object.

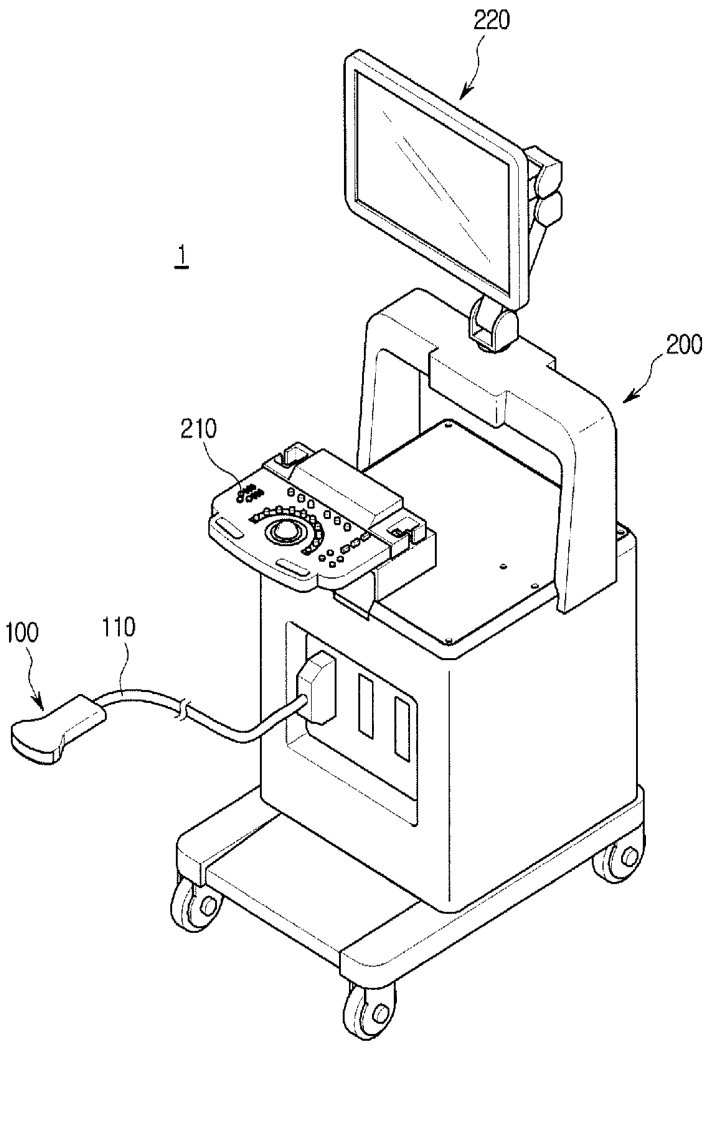


FIG. 1

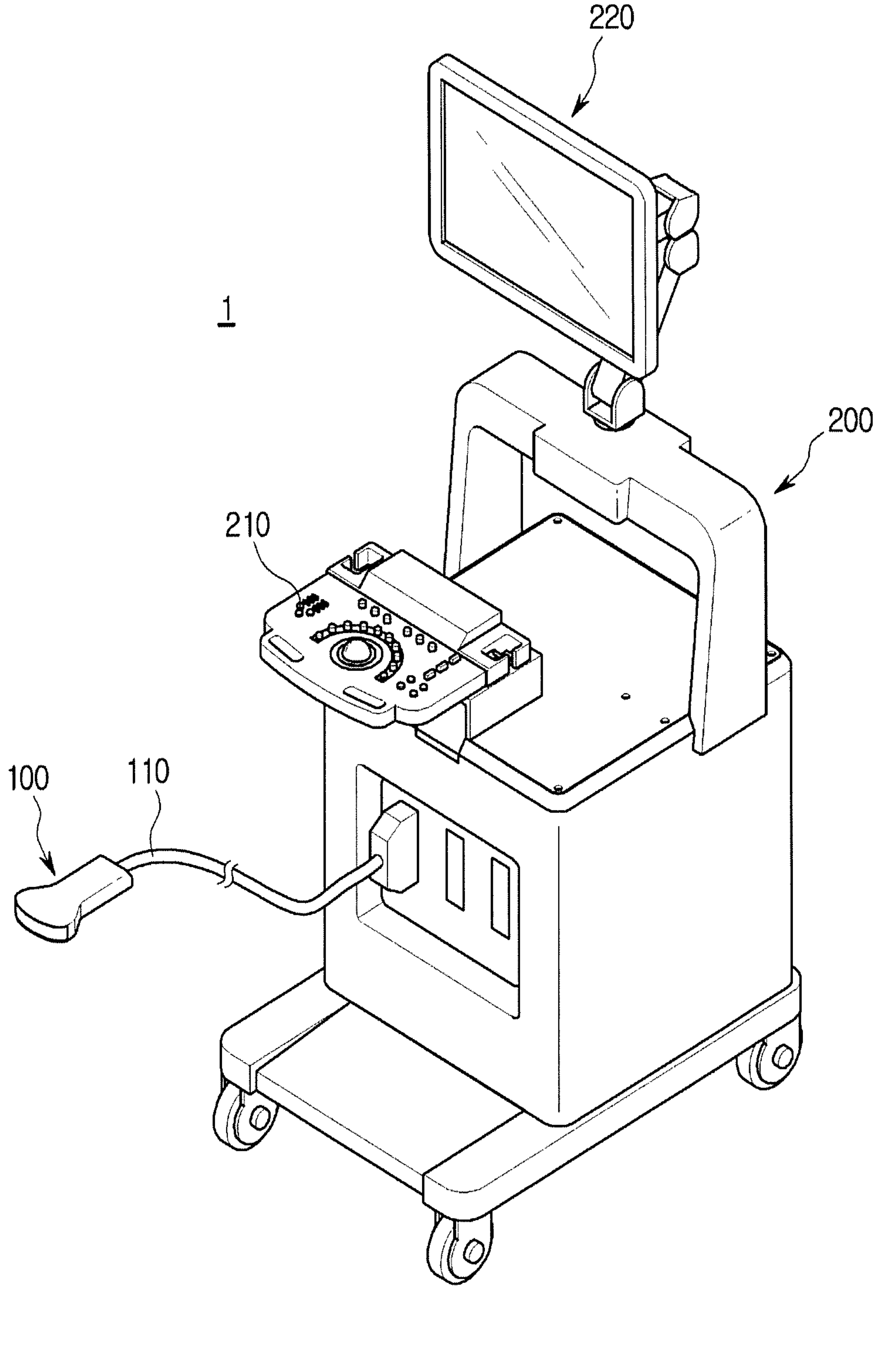


FIG. 2A

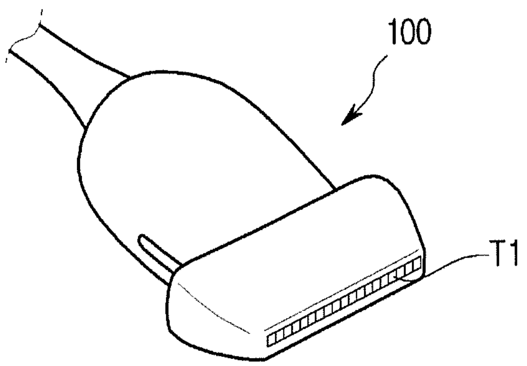


FIG. 2B

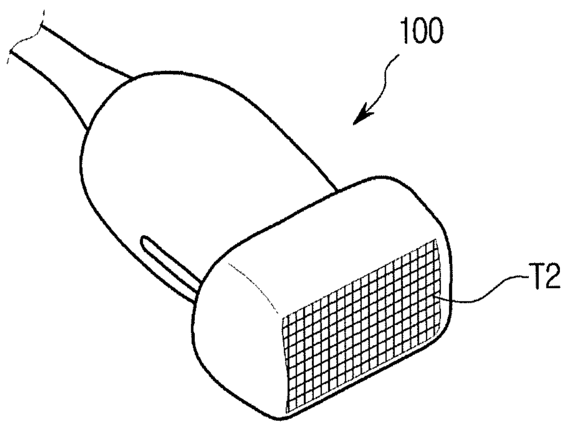


FIG. 2C

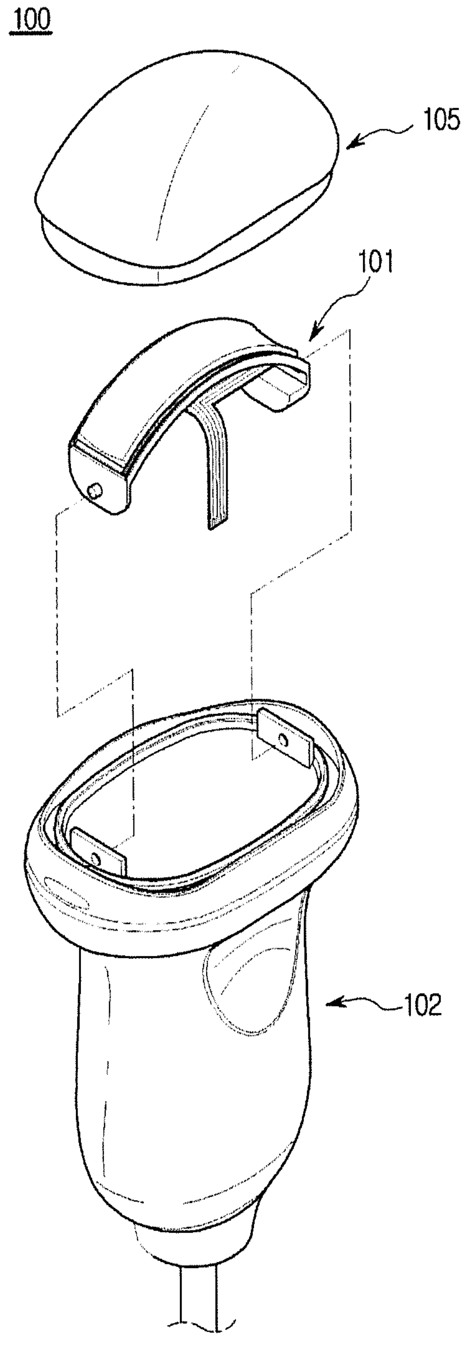


FIG. 3

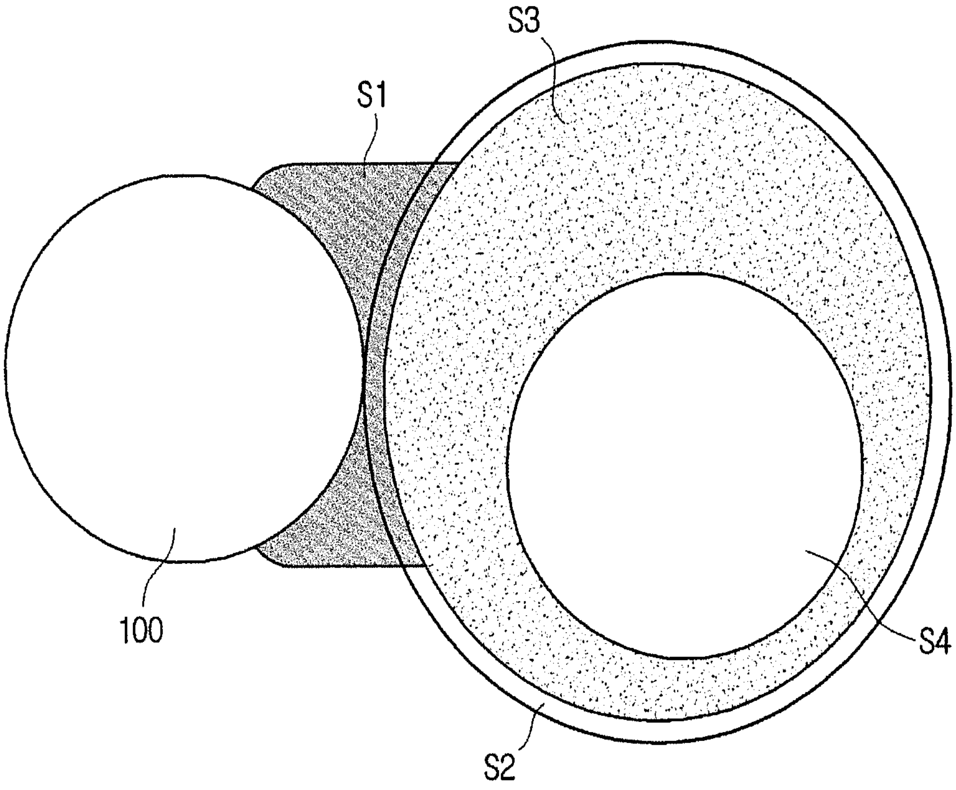


FIG. 4

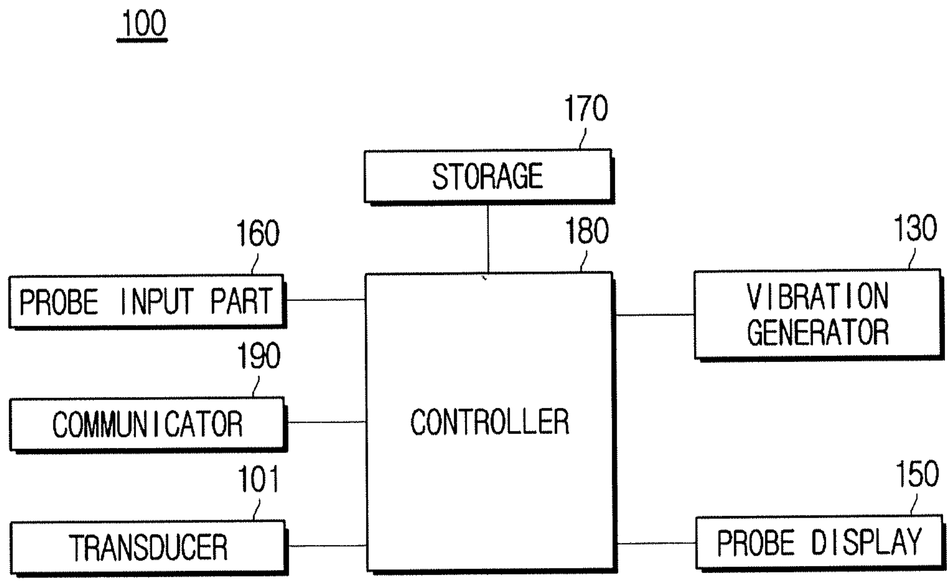

100
170
STORAGE
160
PROBE INPUT PART
180
130
VIBRATION GENERATOR
190
COMMUNICATOR
CONTROLLER
101
150
TRANSDUCER
PROBE DISPLAY

FIG. 5A

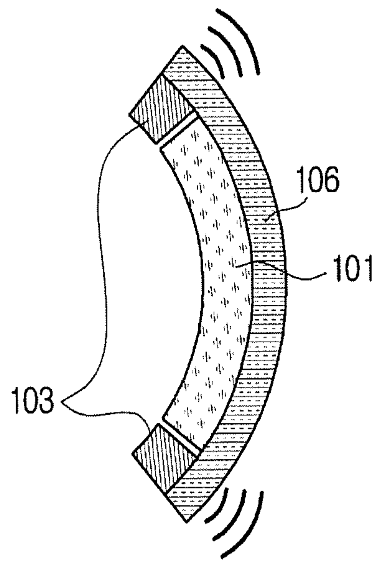


FIG. 5B

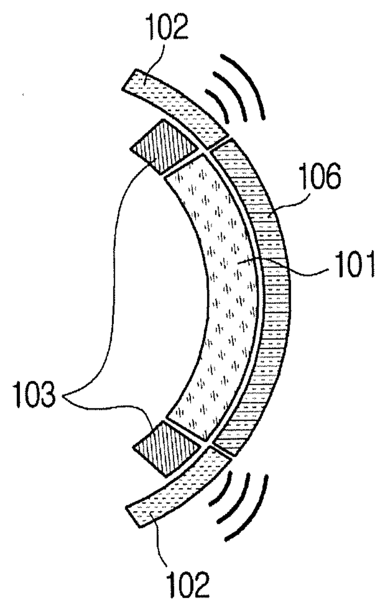


FIG. 6A

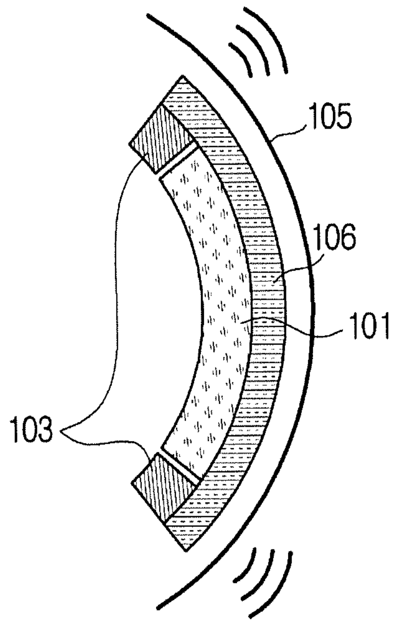


FIG. 6B

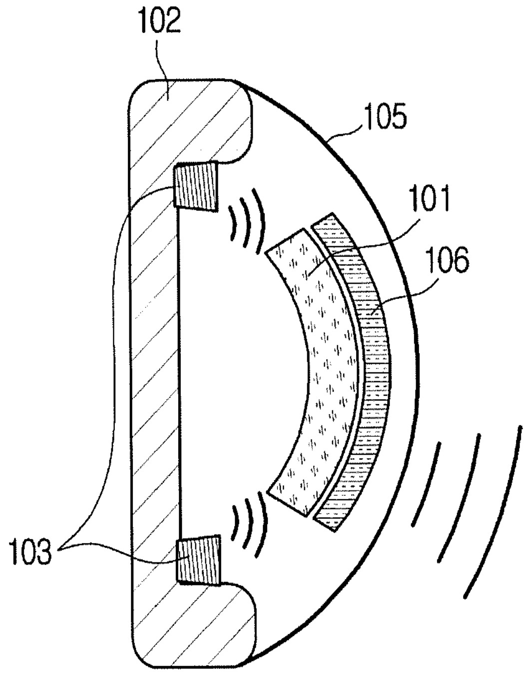


FIG. 6C

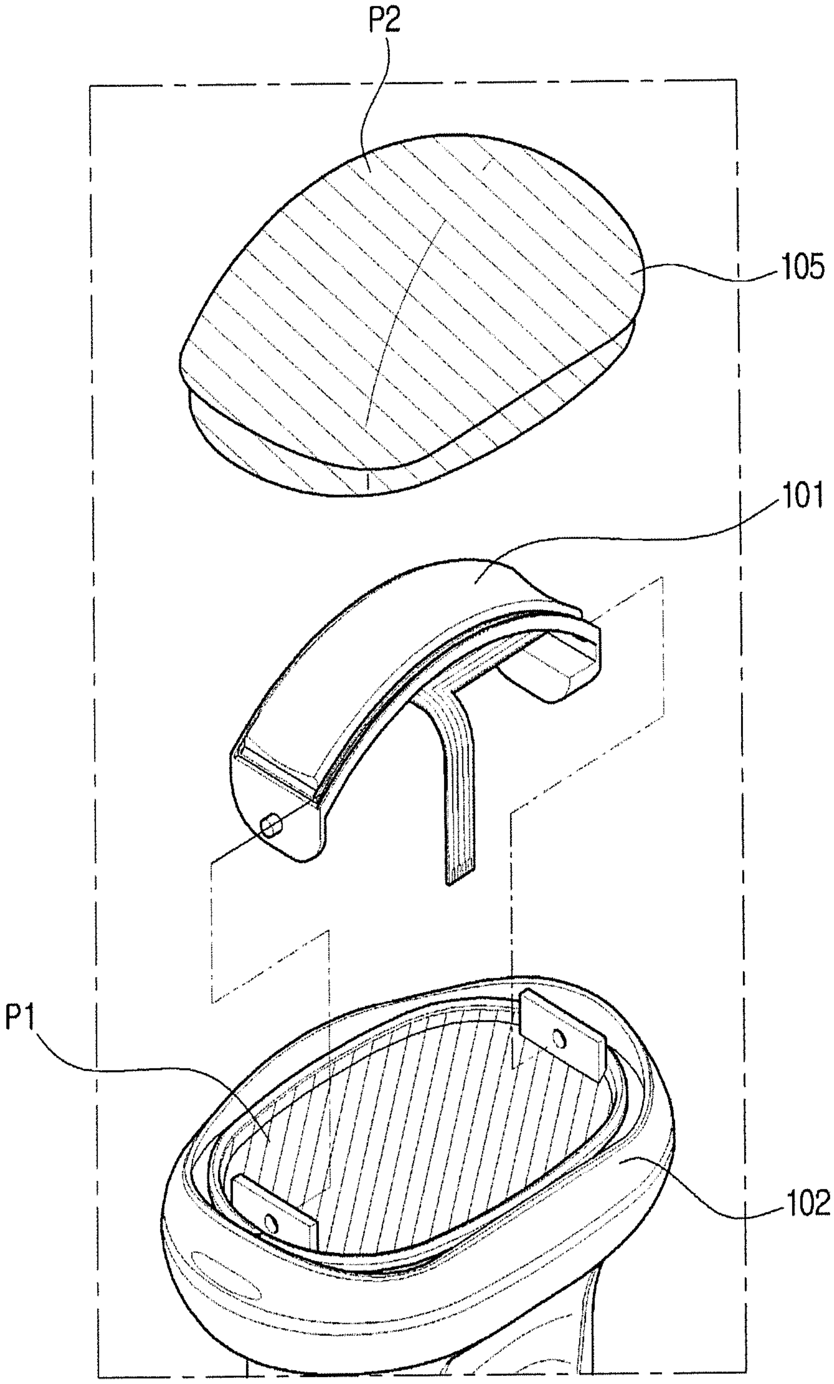
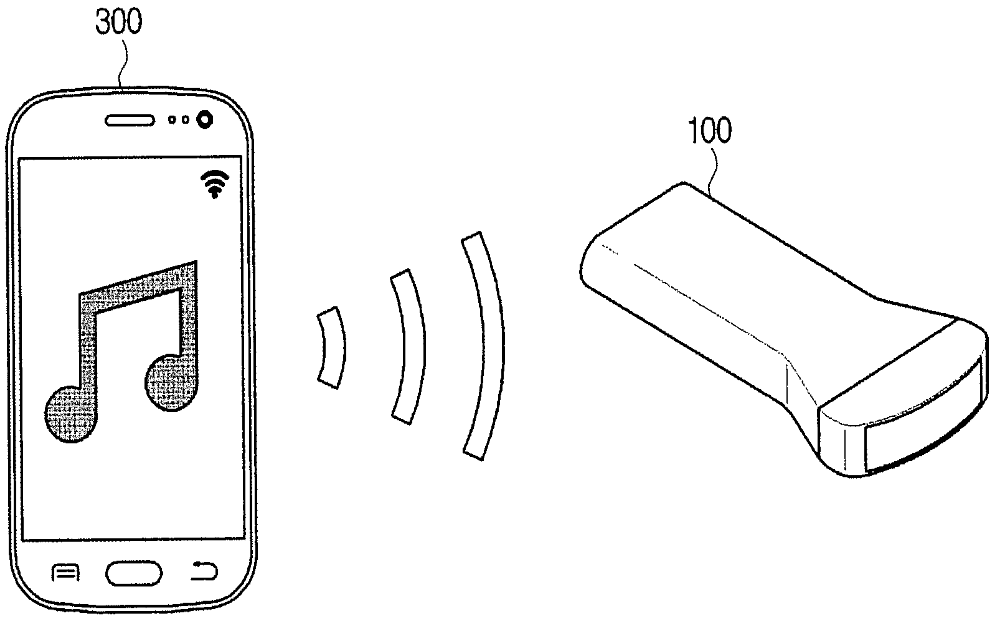


FIG. 7



ULTRASONIC PROBE AND ULTRASONIC IMAGING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of Korean Patent Application No. 10-2016-0109207, filed on Aug. 26, 2016 in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference.

BACKGROUND

1. Field

[0002] Embodiments of the present disclosure relate to an ultrasonic probe for acquiring an ultrasonic signal, and an ultrasonic imaging apparatus for imaging the acquired ultrasonic signal.

2. Description of the Related Art

[0003] An ultrasonic imaging system is one of the important imaging systems applicable to various technical fields, and has non-invasive and non-destructive characteristics. Accordingly, the ultrasonic imaging apparatus has been widely utilized for various medical fields. The ultrasonic imaging system acquires diagnostic images from the interior of a target object using an ultrasonic probe, and displays 2D or 3D images through an ultrasonic diagnostic device.

[0004] Noise may unexpectedly occur in the diagnostic process based on the ultrasonic probe. Such noise may be harmful to a target object (specially, a fetus) to be diagnosed, such that many developers and companies are conducting intensive research into a method for reducing noise and transmitting a sound signal beneficial to the fetus.

SUMMARY

[0005] Therefore, it is an aspect of the present disclosure to provide an ultrasonic probe including a vibration generator for transferring sound beneficial to a fetus so as to transmit the sound signal to the fetus more efficiently than a conventional ultrasonic probe, and an ultrasonic imaging apparatus.

[0006] In accordance with one aspect of the present disclosure, an ultrasonic probe includes a transducer configured to transmit an ultrasonic signal to an object or receive an ultrasonic signal reflected from the object. The ultrasonic probe includes a frame and a vibration generator. The vibration generator is located in the frame, and generates vibration when the ultrasonic probe contacts the object in such a manner that the generated vibration is transferred to a fetus of the object.

[0007] The vibration generator may generate vibration by vibrating the frame such that vibration is transferred to the fetus of the object.

[0008] The vibration generator may contact the frame.

[0009] The ultrasonic probe may further include: a lens located at one surface of the transducer. The vibration generator generates vibration by vibrating the lens such that vibration is transferred to the fetus of the object.

[0010] The vibration generator may vibrate the lens through the frame such that vibration is transferred to the fetus of the object.

[0011] The vibration generator may contact the lens.

[0012] The ultrasonic probe may further include: a cap configured to enclose the transducer. The vibration generator generates vibration by vibrating the cap through the frame such that vibration is transferred to the fetus of the object.

[0013] The ultrasonic probe may further include: a lens located at one side of the transducer. The vibration generator generates vibration by vibrating at least one of the cap and an acoustic coupler disposed between the transducer and the cap through the lens such that vibration is transferred to the fetus of the object.

[0014] The vibration generator may contact at least one of the cap and the frame.

[0015] The ultrasonic probe may further include: a communicator configured to transmit and receive sound data to and from an external part; and a controller configured to control the vibration generator so as to generate vibration on the basis of the sound data.

[0016] The ultrasonic probe may further include: a storage part configured to pre-store sound data therein; and a controller configured to control the vibration generator so as to generate vibration on the basis of the sound data pre-stored in the storage part.

[0017] In accordance with another aspect of the present disclosure, an ultrasonic imaging apparatus includes: an ultrasonic probe configured to include a transducer for transmitting an ultrasonic signal to an object or receiving an ultrasonic signal reflected from the object; an image processor configured to acquire an image on the basis of the reflected ultrasonic signal; and a display configured to display the image acquired by the image processor. The ultrasonic probe includes: a frame and a vibration generator. The vibration generator may be located in the frame, and may generate vibration when the ultrasonic probe contacts the object in such a manner that the generated vibration is transferred to a fetus of the object.

[0018] The ultrasonic probe may generate vibration by vibrating the frame such that vibration is transferred to the fetus of the object.

[0019] The ultrasonic probe may further include a lens located at one surface of the transducer. The ultrasonic probe may generate vibration by vibrating the lens such that vibration is transferred to the fetus of the object.

[0020] The ultrasonic probe may vibrate the lens through the frame such that vibration is transferred to the fetus of the object.

[0021] The ultrasonic probe may further include: a cap configured to enclose the transducer. The ultrasonic probe may generate vibration by vibrating the cap through the frame such that vibration is transferred to the fetus of the object.

[0022] The ultrasonic probe may further include a lens located at one side of the transducer. The ultrasonic probe may generate vibration by vibrating at least one of the cap and an acoustic coupler disposed between the transducer and the cap through the lens such that vibration is transferred to the fetus of the object.

[0023] The ultrasonic probe may further include: a communicator configured to transmit and receive sound data to and from an external part; and a controller configured to control the vibration generator so as to generate vibration on the basis of the sound data.

[0024] The ultrasonic probe may further include: a storage part configured to pre-store sound data therein; and a controller configured to control the vibration generator so as to generate vibration on the basis of the sound data pre-stored in the storage part.

[0025] Additional aspects of the invention will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] These and/or other aspects of the invention will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings of which:

[0027] FIG. **1** is a perspective view illustrating an external appearance of an ultrasonic imaging apparatus according to an embodiment of the present disclosure.

[0028] FIGS. **2**A to **2**C illustrate external appearances of ultrasonic probes according to different embodiments, and are exploded views illustrating the ultrasonic probes according to different embodiments.

[0029] FIG. **3** is a conceptual diagram illustrating a method for transmitting a sound signal using the ultrasonic probe according to an embodiment of the present disclosure.

[0030] FIG. **4** is a control block diagram illustrating the ultrasonic probe according to an embodiment of the present disclosure.

[0031] FIGS. **5**A and **5**B are cross-sectional views illustrating the ultrasonic probe according to an embodiment of the present disclosure.

[0032] FIGS. **6**A to **6**C are a cross-sectional view and an exploded view illustrating the ultrasonic probe according to an embodiment of the present disclosure.

[0033] FIG. **7** is a conceptual diagram illustrating communication between the ultrasonic probe and the external device according to an embodiment of the present disclosure.

DETAILED DESCRIPTION

[0034] Reference will now be made in detail to the embodiments of the present disclosure, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout.

[0035] The terms used in the present application are merely used to describe specific embodiments and are not intended to limit the present invention. A singular expression may include a plural expression unless otherwise stated in the context. In the present application, the terms "including" or "having" are used to indicate that features, numbers, steps, operations, components, parts or combinations thereof described in the present specification are present and presence or addition of one or more other features, numbers, steps, operations, components, parts or combinations is not excluded.

[0036] In description of the present invention, the terms "first" and "second" may be used to describe various components, but the components are not limited by the terms. The terms may be used to distinguish one component from another component. For example, a first component may be called a second component and a second component may be called a first component without departing from the scope of the present invention. The term "and/or" may include a combination of a plurality of items or any one of a plurality of items.

[0037] Throughout the specification of the present disclosure, if it is assumed that a certain part includes a certain component, the term 'comprising or including' means that a corresponding component may further include other components unless a specific meaning opposed to the corresponding component is written. In addition, another term '. . . part', ". . . unit', 'module' or the like means a unit for processing at least one function or operation, and this unit may be implemented by hardware, software, or a combination thereof. As used in the specification and appended claims, the terms "a", "an", "one", "the" and other similar terms include both singular and plural forms, unless context clearly dictates otherwise.

[0038] FIG. **1** is a perspective view illustrating an external appearance of an ultrasonic imaging apparatus according to an embodiment of the present disclosure.

[0039] Referring to FIG. **1**, the ultrasonic imaging apparatus **1** may include an ultrasonic probe **100** and a main body **200**. The ultrasonic probe **100** may transmit an ultrasonic signal to a target object, may receive an echo ultrasonic signal from the target object, and may convert the received echo ultrasonic signal into an electrical signal to obtain an ultrasonic image. The main body **200** may be connected to the ultrasonic probe through a cable **100**, and may display an ultrasonic image.

[0040] The ultrasonic probe **100** may be connected to the main body **200** through the cable **100**, may receive various signals needed to control the ultrasonic probe **100**, or may transmit an analog or digital signal corresponding to the ultrasonic echo signal received by the ultrasonic probe **100**. In addition, the ultrasonic probe **100** may transmit information regarding the operation state of the ultrasonic probe **100** to the main body **200**.

[0041] The main body **200** may be used for ultrasonic diagnosis in hospitals or the like as shown in FIG. **1**. However, the scope or spirit of the main body **200** is not limited to FIG. **1**.

[0042] The main body **200** of FIG. **1** may include an input part **210** and a display **220**. The input part **210** may receive setup information related to the ultrasonic probe **100**, various control commands, etc. from the user.

[0043] In accordance with the embodiment, setting information of the ultrasonic probe **100** may include gain information, zoom information, focus information, time gain compensation (TGC) information, depth information, frequency information, power information, frame average information, dynamic range information, etc. However, the scope or spirit of the setup information of the ultrasonic probe **100** is not limited thereto, and the setup information may include various kinds of information capable of being established for ultrasonic imaging.

[0044] In accordance with another embodiment, the input part **210** may receive a control command related to the ultrasonic probe **100** or the main body **200** from the user. The above-mentioned information or command may be transmitted to the ultrasonic probe **100** through the cable **110**, and the ultrasonic probe **100** may be established according to the received information.

[0045] The input part **210** may be implemented as a keyboard, a foot switch or a foot pedal. For example, the keyboard may be implemented by hardware. The keyboard may include a switch, a key, a joystick, a track ball, etc. In another example, the keyboard may also be implemented by software such as a graphical user interface (GUI). In this case, the keyboard may be displayed on the display **220**. The foot switch or the foot pedal may be located below the main body **200**, and the user may control the main body **200** using the foot pedal.

[0046] The display **220** may display an ultrasonic image regarding a target site contained in the target object. The ultrasonic image displayed on the display **220** may be a 2D ultrasonic image or a 3D ultrasonic image. Various ultrasonic images may be displayed according to the operation mode of the ultrasonic imaging apparatus. In addition, the display **220** may display menus or information related to the ultrasonic image, and may display information regarding the operation state of the ultrasonic probe **100**.

[0047] The display **220** may be implemented by any well-known display panel, for example, a Cathode Ray Tube (CRT), a Liquid Crystal Display (LCD), a Light Emitting Diode (LED), a Plasma Display Panel (PDP), an Organic Light Emitting Diode (OLED), etc., without being limited thereto.

[0048] If the display **220** is implemented as a touchscreen, the display **220** may also act as the input part **210**. That is, the user may input various commands through the display **220** or the input part **210**.

[0049] Meanwhile, the ultrasonic imaging apparatus **1** may include an image processor configured to convert the received echo ultrasonic signal into an ultrasonic image. The image processor may be implemented by hardware such as a microprocessor, or may be implemented by software capable of being executed in hardware.

[0050] The image processor may acquire image information through image processing of the ultrasonic image. In this case, the image information may be information regarding images contained in the respective pixels contained in the ultrasonic image, and may include brightness, color, illumination, chromatic contrast, etc. of the respective pixels.

[0051] The ultrasonic probe **100** according to the embodiment of the present disclosure will hereinafter be described with reference to the attached drawings.

[0052] FIGS. **2**A to **2**C illustrate external appearances of ultrasonic probes according to different embodiments, and are exploded views illustrating the ultrasonic probes according to different embodiments.

[0053] Referring to FIGS. **2**A to **2**C, the ultrasonic probe **100** may contact the surface of the target object, and may transmit the ultrasonic signal to the target object. In more detail, the ultrasonic probe **100** may transmit the ultrasonic signal to the interior of the target object upon receiving a control command signal from the main body **200**, may transmit the ultrasonic signal to the interior of the target object, may receive the echo ultrasonic signal reflected from a specific site contained in the target object, and may transmit the received echo ultrasonic signal to the main body **200**. Therefore, the ultrasonic probe **100** may transmit the echo ultrasonic signal received from the target object to the main body **200**, or may acquire the ultrasonic image from the echo ultrasonic signal and transmit the acquired ultrasonic image. However, the scope or spirit of the ultrasonic probe **100** is not limited thereto.

[0054] The transducer **101** may include a piezoelectric layer for converting an electrical signal into a sound signal and vice versa through vibration of a piezoelectric material; a sound matching layer for reducing a difference in acoustic impedance between the piezoelectric layer and the target object so as to maximally transmit an ultrasonic signal generated by the piezoelectric layer to the target object; a lens layer for focusing the ultrasonic signal proceeding in a forward direction of the piezoelectric layer to a specific position; and a backing layer (also called a sound absorption layer) for preventing image distortion by preventing the ultrasonic signal from proceeding in a backward direction of the piezoelectric layer.

[0055] In this case, the ultrasonic probe **100** may include a transducer array for converting an electrical signal into an ultrasonic signal and vice versa to transmit ultrasonic signals to the interior of the target object. The transducer array may include a plurality of transducer elements.

[0056] The transducer **101** may include the transducer array, and the transducer array may include a plurality of transducer elements. The transducer array may be a one-dimensional (1D) array or a two-dimensional (2D) array. For example, as can be seen from FIG. **2**A, the transducer module may include a one-dimensional (1D) array transducer T**1**. In another example, as can be seen from FIG. **2**B, the transducer **101** may include a 2D array transducer T**2**.

[0057] For example, respective transducer elements constructing the 1D transducer array may convert ultrasonic signals into electrical signals and vice versa. For this purpose, each of the transducer elements may be implemented by any of a magnetostrictive ultrasonic transducer using magnetostrictive effects of a magnetic material, and a piezoelectric ultrasonic transducer or piezoelectric micromachined ultrasonic transducer (pMUT) using the piezoelectric effects of a piezoelectric material. If necessary, the transducer element may also be implemented as a capacitive micromachined ultrasonic transducer (cMUT) to transmit and receive ultrasonic waves using vibration of several hundred or thousands of micromachined thin films.

[0058] Referring to FIG. **2**B, the transducer **101** may also include the 2D array transducer T**2**. If the transducer **101** includes the 2D array transducer T**2**, the transducer **101** may perform 3D imaging of the interior of the target object.

[0059] The respective transducer elements constructing the 2D array transducer are identical to those of the 1D array transducer, and as such a detailed description thereof will herein be omitted for convenience of description and better understanding of the present disclosure.

[0060] Referring to FIG. **2**C, the ultrasonic probe **100** may include a rotatable transducer **101**. The ultrasonic probe **100** may include a frame **102** grasped by a user who desires to use the transducer **101**. A cap **105** contacting the target object to be diagnosed may be arranged at the front end of the frame **102**. The transducer **101** may be contained in the cap **105**.

[0061] The transducer **101** may include an ultrasonic vibrator to transmit and receive ultrasonic signals. The transducer **101** may be rotatably installed in the cap **105** so that the transducer **101** can read the 3D image of the target object to be diagnosed.

[0062] The transducer **101** may be mounted to a rotational shaft. The rotational shaft may receive driving power from the driving device so that the rotational shaft can rotate. If the rotational shaft rotates, the transducer **101** mounted to the rotational shaft can also rotate.

[0063] The cap **105** may include an inner surface facing an outer surface of the transducer **101** in a manner that a constant spacing between the inner surface of the cap **105** and the outer surface of the transducer **101** can be maintained during rotation of the transducer **101**. For example, the outer surface of the transducer **101** and the inner surface of the cap **105** may be formed in an arc shape having the same central point.

[0064] The inner space of the cap **105** may be filled with an acoustic coupler acting as a medium through which ultrasonic signals generated by the transducer **101** can be transferred.

[0065] The ultrasonic probe **100** may include a vibration generator **103** therein, and a detailed description thereof will hereinafter be given.

[0066] FIG. **3** is a conceptual diagram illustrating a method for transmitting a sound signal using the ultrasonic probe **100** according to an embodiment of the present disclosure.

[0067] According to an audible route of a user, eardrums of the user vibrate due to air vibrations so as to vibrate lymph fluid in the cochlea, such that the user can listen to various sound signals through the auditory nerves.

[0068] However, according to bone conduction vibration used by a vibration generator of the embodiment, sound waves vibrate the skull or cranium of the user so that the resultant sound waves arrive at the inner ears and finally arrive at the auditory nerves. Bone conduction may be classified into indirect bone conduction in which external sound waves arrive at the inner ears after passing through the skull at loud sound of 2 kHz or higher; and direct bone conduction in which vibration of an object contacting the head or other vibration generated in the human body arrives at eardrums or middle ears and finally arrives at the inner ears. The vibration generator **103** operated by bone conduction does not receive the external sound using vibration transmission, so that the vibration generator **103** can effectively transfer sound waves to the fetus.

[0069] Referring to FIG. **3**, the ultrasonic probe **100** may generate the sound signal by the vibration generator **103** mounted to one surface of the ultrasonic probe **100**. The transmission position of the sound signal of the ultrasonic probe **100** will hereinafter be described in detail. The sound signal (i.e., vibration) generated by the ultrasonic probe **100** may be transferred to a skin **S2** of the target object after passing through a gel **S1**.

[0070] The ultrasonic probe **100** may operate in close contact with the skin **S2** of the target object through the gel **S2**, such that it can easily transfer vibration generated by the ultrasonic probe **100**. The sound signal transferred to the skin **S2** of the target object may be transferred to the amniotic fluid **S3** enclosing the fetus **S4**. The amniotic fluid **S3** may act as a medium through which the sound signal received from the skin **S3** of the target object can pass. The sound signal may be transferred to bones of the fetus after passing through the amniotic fluid **S3**, and then be transferred to the auditory nerves of the fetus. Through the above-mentioned scheme, the sound signals are not transferred to the outside, and the sound signals can be transferred by contacting the skin of the target object. The ultrasonic probe **100** for use in the above-mentioned vibration transmission process will hereinafter be described in detail.

[0071] FIG. **4** is a control block diagram illustrating the ultrasonic probe **100** according to an embodiment of the present disclosure.

[0072] Referring to FIG. **4**, the ultrasonic probe **100** may include a probe display **150**, a probe input part **160**, and a controller **180**. The ultrasonic probe **100** may further include a transducer **101**.

[0073] The transducer **101** may transmit ultrasonic signals to the target object, and may receive the echo ultrasonic signal reflected from the target object.

[0074] The transducer **101** may acquire ultrasonic images from the echo ultrasonic signal. In addition, assuming that the ultrasonic probe **100** includes the 2D array transducer or the 1D array transducer moving in the elevation direction, the transducer **101** may also generate 3D ultrasonic images using a plurality of 2D cross-sectional images.

[0075] The controller **180** may be integrated in a System on Chip (SoC) embedded in the ultrasonic probe **100**. In this case, only one SoC may not be included in the ultrasonic probe **100**, such that the scope or spirit of the present disclosure is not limited to only one SoC.

[0076] The controller **180** may generate vibrations by controlling the vibration generator **103**, and may control the vibration generator **103** upon receiving sound data (i.e., sound source data) from a communicator **190**.

[0077] A storage part **170** may store various kinds of data therein. The storage part may store data regarding the ultrasonic image acquired from the transducer **101**, image information acquired from the ultrasonic image, etc.

[0078] In addition, the storage part **170** may store data regarding air images per mode. Here, the air images may denote ultrasonic images obtained when the ultrasonic signal is reflected from the air. The storage part **170** may store sound data used as a basis of vibrations to be generated by the vibration generator **103**. For example, the sound data (sound source data) may include MP3, MPEG2 BC, MPEG2 AAC, RealAudio G2, LiquidAudio, WMA, and MP3 Pro.

[0079] The storage part **170** may be implemented as at least one of a flash memory type, a hard disk type, a multimedia card micro card, a card type memory (e.g. a Secure Digital (SD) memory or an eXtreme Digital (XD) memory), a Random Access Memory (RAM), a Static Random Access Memory (SRAM)), a Read Only Memory (ROM), an Electrically Erasable Programmable Read Only Memory (EEPROM), a Programmable Read Only Memory (PROM), a magnetic memory, a magnetic disk, an optical disk, etc., without being limited thereto.

[0080] The communicator **190** may transmit and receive various kinds of data to and from the main body **200** through the cable. The communicator **190** may transmit and receive various kinds of data (e.g., ultrasonic images, echo ultrasonic signals, Doppler data, etc.) related to diagnosis of the target object to and from the main body **200** through the cable. In addition, the communicator **190** may receive various kinds of control command signals from the main body **200**.

[0081] The communicator **190** may include one or more constituent elements capable of wirelessly communicating with the external device, and may receive sound data from the external device, and as such a detailed description thereof will hereinafter be given.

[0082] Meanwhile, the ultrasonic probe **100** may include a probe display **150** therein. The probe display **150** may be implemented by any of well-known display panels, for example, CRT, LCD, LED, PDP, OLED, etc. without being limited thereto. The probe display **150** may display information related to the operation state of the ultrasonic probe

100, for example, power-supply state information of the ultrasonic probe **100**. Specifically, the probe display **150** may display information related to the sound data used as a basis of vibration generated by the vibration generator **130**.

[0083] In addition, the ultrasonic probe **100** may include a probe input part **160**. The probe input part **160** may be implemented as a switch, a key, etc., without being limited thereto. The probe input part **160** may receive power ON/OFF commands of the ultrasonic probe **100** from the user, and may receive a control command related to vibration generated by the vibration generator **103**. For example, the probe input part **160** may receive various control commands, for example, the type of sound source, the magnitude of sound source, the effect of vibration, etc. The probe input part **160** may also receive a control command related to the operation mode change of the ultrasonic probe **100**, without being limited thereto.

[0084] The ultrasonic probe **100** may include the vibration generator **103**. The vibration generator **103** may be implemented as a bone conduction speaker. A general speaker may be a device for generating audible sound waves by applying an alternating current (AC) having an audible frequency, and may allow an operation part located in a magnetic field region to vibrate due to AC (Alternating Current) magnetic flux generated by a negative current flowing in the coils. Although a general speaker may include a coil, a magnet, a vibration plate, and a diaphragm for maximizing vibration of the vibration plate, vibration generated by the vibration generator **103** according to the embodiment may be directly applied to the human body, and may stimulate the auditory nerves after passing through the skull, such that the speaker may be implemented as a bone conduction speaker including no diaphragm.

[0085] FIGS. **5**A and **5**B are cross-sectional views illustrating the ultrasonic probe **100** according to an embodiment of the present disclosure.

[0086] FIGS. **5**A and **5**B are cross-sectional views illustrating the ultrasonic probe **100** shown in FIG. **2**.

[0087] Referring to FIG. **5**A, the vibration generator **103** may be provided at one side of the transducer **101**. In addition, the ultrasonic probe **100** may further include a lens **106** at one side of the transducer **101**. Ultrasonic waves generated by the transducer **101** may be focused onto the lens **106**. The lens **106** may be formed of silicon, rubber, etc. having acoustic impedance similar to acoustic impedance of the target object. The lens **106** may be formed in a convex type, the center part of which has a convex surface, or may be formed in a linear type, the center part of which has a flat surface. The vibration generator **103** may be located at one surface of the lens **106**. As described above, the vibration generator **103** may output the sound signal received through bones of the target object to be diagnosed, such that the sound signal may not spread out to the outside. The lens **106** may contact the skin of the target object, and may transmit vibration, so that the lens **106** may act as the medium of vibration. The vibration generator **103** shown in FIG. **5**A may be mounted to one surface of the lens **106** so that it can transmit the generated vibration to the lens **106**. During the diagnostic process using the ultrasonic probe **100**, the lens **106** must contact the target object, so that the vibration generator **103** can easily transmit vibration to the target object. Although the vibration generator **103** is located not only at both sides of the transducer **101** but also at the bottom surface of the lens **106** contacting the target object as shown in FIG. **5**A, assuming that only one surface of the ultrasonic probe **101** capable of vibrating the lens **106** is used, the position of the vibration generator **103** is not limited thereto.

[0088] Referring to FIG. **5**B, the vibration generator **103** may be provided at one surface of the frame **102** of the ultrasonic probe **101**. The ultrasonic probe **100** may include the frame **102**, and the frame **102** may include the vibration generator **103** and the transducer **101**. The vibration generator **103** may be provided at one surface of the frame **102** so as to vibrate the frame **102**. During ultrasonic diagnosis, the frame **102** contacts the skin of the target object, such that signals generated by the vibration generator **103** may be transferred to the frame **102**. Therefore, although the vibration generator **103** shown in FIG. **5**B is located not only at both sides of the transducer **101** but also at the bottom surface of the frame **102** contacting the target object, assuming that only one surface of the ultrasonic probe **101** capable of vibrating the frame **102** is used, the position of the vibration generator **103** is not limited thereto.

[0089] FIGS. **6**A to **6**C are a cross-sectional view and an exploded view illustrating the ultrasonic probe **100** shown in FIG. **2**C according to an embodiment of the present disclosure.

[0090] The ultrasonic probe **100** shown in FIG. **6** may be a probe to acquire 3D images, and the transducer **101** of the ultrasonic probe **100** may operate or move. As described above, the ultrasonic probe **100** may include the cap so that a constant spacing between the ultrasonic probe **100** and the transducer **101** may be maintained, and a coupler may be disposed in the spacing between the transducer **101** and the cap **105**.

[0091] Referring to FIG. **6**A, the transducer **101** may include the lens **106** in the same manner as in FIG. **5**. Therefore, the ultrasonic probe **101** of FIG. **6** may include the vibration generator **103** to vibrate the lens **106**. The vibration generator **103** may vibrate the lens **106**, and may also vibrate the coupler contacting the lens **106**. If the coupler vibrates, the cap **105** of the ultrasonic probe **101** contacting the target object may also vibrate. In brief, the ultrasonic probe **100** of FIG. **6** may allow vibration generated by the vibration generator **103** to be transferred to the cap **105** through the lens **106** and the coupler.

[0092] FIG. **6**B is a view illustrating the vibration generator **103** mounted to one surface of the frame **102**.

[0093] FIG. **6**C is an exploded view illustrating the ultrasonic probe **100** of FIG. **6**B.

[0094] Referring to FIGS. **6**B and **6**C, the ultrasonic probe **100** may include the vibration generator **103** located at one surface of the frame **102** so that the frame **102** can vibrate. Since the frame **102** may directly contact the cap **105**, vibration can be directly transferred to the cap **105** and finally arrives at the coupler. If vibration arrives at the coupler, the oil vibrates the cap **105** so that the sound signal can arrive at the target object. The ultrasonic probe **100** of FIG. **6**B includes the spacing between the transducer **101** and the frame **102** in a different way from the ultrasonic probe **100** of FIG. **5**B, and the vibration generator **103** may be located at many more installation positions than the ultrasonic probe **100** of FIG. **5**B.

[0095] Referring to FIG. **6**C, the vibration generator **103** may be located at the positions (**P1**, **P2**) of the frame **102** and the cap **105** of the ultrasonic probe **100**, respectively. Sound signals can be transmitted to the fetus according to the above-mentioned scheme because the frame **102** or the cap **105** of the ultrasonic probe **100** vibrates, such that the vibration generator **103** may be located anywhere that the vibration generator **103** can vibrate within the frame **102**. In conclusion, assuming that the vibration generator **103** is mounted to one surface of the frame and vibrates any one of the acoustic coupler, the cap **105**, and the frame **102**, the sound signal may finally arrive at the fetus. The vibration generator **103** may be located at one surface P2 of the cap **105** shown in FIG. **6**C. In this case, the vibration generator **103** may directly transmit vibration to the cap **105**. The vibration generator **105** may be mounted anywhere that the vibration generator **105** can transmit the sound signal by vibrating the frame **102** and the cap **105**.

[0096] However, the installation positions of the vibration generators **103** shown in FIGS. **5** and **6** may not be limited thereto, and the vibration generator **103** may be mounted anywhere that the vibration generator **103** can vibrate any one of the lens **106**, the frame **102**, the cap **105**, and the coil. Although two vibration generators **103** are exemplarily shown in FIGS. **5** to **6** for convenience of description, the number of the vibration generators **103** may be at least one as necessary.

[0097] FIG. **7** is a conceptual diagram illustrating communication between the ultrasonic probe **100** and the external device **300**. Referring to FIG. **7**, the communicator **190** of the ultrasonic probe **100** may wirelessly communicate with the external device **300** through at least one of a near field communication (NFC) module and a mobile communication module.

[0098] The external device **300** may be implemented as any one of a laptop, a desktop computer, and a tablet PC, or may be implemented as a smartphone as shown in FIG. **8**. The external device may include a mobile terminal such as a PDA, a watch detachably coupled to the user's body, and a glasses-type wearable terminal.

[0099] However, the external device **300** is not limited thereto, and may include any device which includes the communicator therein so as to communicate with the ultrasonic probe **100** over the wireless communication network and can transmit sound sources without departing from the scope or spirit of the present disclosure.

[0100] The ultrasonic probe **100** may communicate with the external device **300** using a communication module. The communication module may include one or more constituent elements capable of communicating with the external device **300**. For example, the communication module may include Wireless LAN, Wi-Fi, Bluetooth, ZigBee, Wi-Fi Direct (WFD), Ultra wideband (UWB), Infrared Data Association (IrDA), Bluetooth Low Energy (BLE), Near Field Communication (NFC), etc. without being limited thereto.

[0101] The external device **300** may transmit and receive RF signals to and from at least one of a base station (BS), an external terminal, and a server over the mobile communication network. For example, the mobile communication module may transmit and receive various types of data to and from the external device after passing through the BS over the 3G or 4G communication network.

[0102] The external device **300** may receive sound data through a communication network, and may transmit the received sound data to the ultrasonic probe **100**. The sound data may be digitized, and may include MP3, MPEG2 BC, MPEG2 AAC, RealAudio G2, Liquid Audio, WMA, and MP3 Pro.

[0103] As is apparent from the above description, according to the ultrasonic probe and the ultrasonic imaging apparatus, the ultrasonic probe according to the embodiment of the present disclosure includes a vibration generator for transferring sound beneficial to a fetus, such that the ultrasonic probe can transmit the sound signal to the fetus more efficiently than a conventional ultrasonic probe.

[0104] Although the above-mentioned embodiments of the present disclosure have been disclosed herein merely for illustrative purposes, the scope or spirit of the embodiments is not limited thereto, and those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the disclosure as disclosed in the accompanying claims. For example, adequate effects of the present disclosure may be achieved even if the foregoing processes and methods may be carried out in different order than described above, and/or the aforementioned elements, such as systems, structures, devices, or circuits, may be combined or coupled in different forms and modes than described above or be substituted or switched with other components or equivalents.

[0105] Although a few embodiments of the present disclosure have been shown and described, it would be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.

1. An ultrasonic probe including a transducer configured to transmit an ultrasonic signal to an object or receive an ultrasonic signal reflected from the object, comprising:
- a frame; and
- a vibration generator located in the frame, and configured to generate vibration when the ultrasonic probe contacts the object in such a manner that the generated vibration is transferred to a fetus of the object.

2. The ultrasonic probe according to claim **1**, wherein the vibration generator generates vibration by vibrating the frame such that vibration is transferred to the fetus of the object.

3. The ultrasonic probe according to claim **2**, wherein the vibration generator contacts the frame.

4. The ultrasonic probe according to claim **1**, further comprising:
- a lens located at one surface of the transducer,
- wherein the vibration generator generates vibration by vibrating the lens such that vibration is transferred to the fetus of the object.

5. The ultrasonic probe according to claim **4**, wherein the vibration generator vibrates the lens through the frame such that vibration is transferred to the fetus of the object.

6. The ultrasonic probe according to claim **4**, wherein the vibration generator contacts the lens.

7. The ultrasonic probe according to claim **1**, further comprising:
- a cap configured to enclose the transducer, and
- wherein the vibration generator generates vibration by vibrating the cap through the frame such that vibration is transferred to the fetus of the object.

8. The ultrasonic probe according to claim **7**, further comprising:
- a lens located at one side of the transducer, and
- wherein the vibration generator generates vibration by vibrating at least one of the cap and an acoustic coupler

disposed between the transducer and the cap through the lens such that vibration is transferred to the fetus of the object.

9. The ultrasonic probe according to claim **7**, wherein the vibration generator contacts at least one of the cap and the frame.

10. The ultrasonic probe according to claim **1**, further comprising:

a communicator configured to transmit and receive sound data to and from an external part; and

a controller configured to control the vibration generator so as to generate vibration on the basis of the sound data.

11. The ultrasonic probe according to claim **1**, further comprising:

a storage part configured to pre-store sound data therein; and

a controller configured to control the vibration generator so as to generate vibration on the basis of the sound data pre-stored in the storage part.

12. An ultrasonic imaging apparatus comprising:

an ultrasonic probe configured to include a transducer for transmitting an ultrasonic signal to an object or receiving an ultrasonic signal reflected from the object;

an image processor configured to acquire an image on the basis of the reflected ultrasonic signal; and

a display configured to display the image acquired by the image processor,

wherein the ultrasonic probe includes:

a frame; and

a vibration generator located in the frame, and configured to generate vibration when the ultrasonic probe contacts the object in such a manner that the generated vibration is transferred to a fetus of the object.

13. The ultrasonic imaging apparatus according to claim **12**, wherein the ultrasonic probe generates vibration by vibrating the frame such that vibration is transferred to the fetus of the object.

14. The ultrasonic imaging apparatus according to claim **12**, wherein the ultrasonic probe further includes:

a lens located at one surface of the transducer,

wherein the ultrasonic probe generates vibration by vibrating the lens such that vibration is transferred to the fetus of the object.

15. The ultrasonic imaging apparatus according to claim **12**, wherein the ultrasonic probe vibrates the lens through the frame such that vibration is transferred to the fetus of the object.

16. The ultrasonic imaging apparatus according to claim **12**, wherein the ultrasonic probe further includes:

a cap configured to enclose the transducer, and

wherein the ultrasonic probe generates vibration by vibrating the cap through the frame such that vibration is transferred to the fetus of the object.

17. The ultrasonic imaging apparatus according to claim **15**, wherein the ultrasonic probe further includes:

a lens located at one side of the transducer, and

wherein the ultrasonic probe generates vibration by vibrating at least one of the cap and an acoustic coupler disposed between the transducer and the cap through the lens such that vibration is transferred to the fetus of the object.

18. The ultrasonic imaging apparatus according to claim **12**, wherein the ultrasonic probe further includes:

a communicator configured to transmit and receive sound data to and from an external part; and

a controller configured to control the vibration generator so as to generate vibration on the basis of the sound data.

19. The ultrasonic imaging apparatus according to claim **12**, wherein the ultrasonic probe further includes:

a storage part configured to pre-store sound data therein; and

a controller configured to control the vibration generator so as to generate vibration on the basis of the sound data pre-stored in the storage part.

* * * * *

patsnap

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申请(专利权)人(译)	三星MEDISON CO.，LTD.		
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摘要(译)

公开了一种超声波探头和超声波成像设备。超声波探头包括振动发生器，用于传输对胎儿有益的声音，以便比传统的超声波探头更有效地将声音信号传输到胎儿。超声波探头包括换能器，该换能器被配置为将超声波信号发送到物体或接收从物体反射的超声波信号。超声波探头包括框架和振动发生器。振动发生器位于框架中，并且当超声波探头接触物体时产生振动，使得产生的振动传递到物体的胎儿。