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(54) **ULTRASOUND PROBE CAP AND METHOD FOR TESTING ULTRASOUND PROBE USING THE SAME AND ULTRASOUND DIAGNOSIS SYSTEM THEREOF**

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(57) **ABSTRACT**

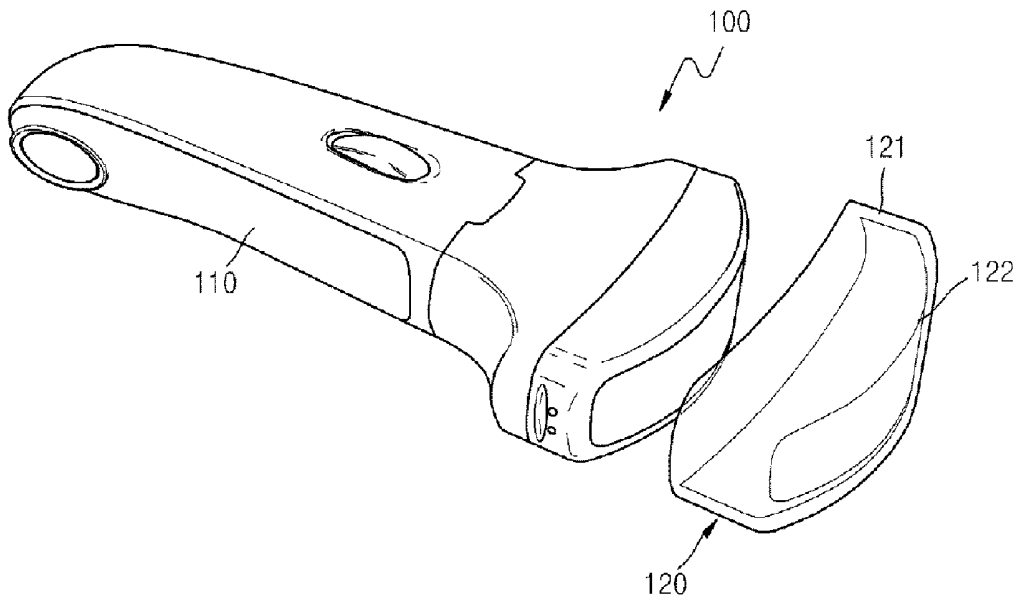
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Provided is an ultrasound diagnosis system including an ultrasound probe apparatus transmitting an ultrasound signal to obtain an ultrasound image of a subject, and an ultrasound diagnosis apparatus constructing a database for ultrasound echo data of a normal operation of the piezoelectric device module provided in the ultrasound probe apparatus.

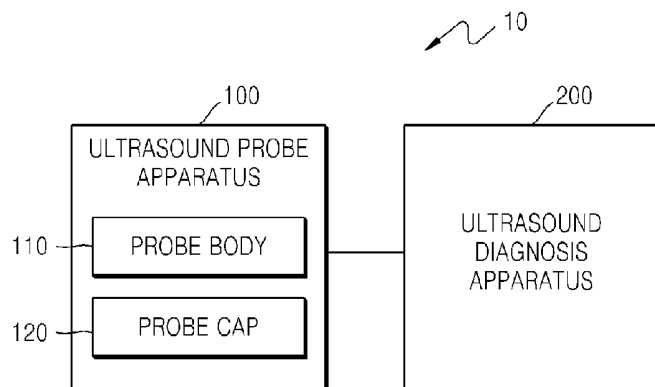
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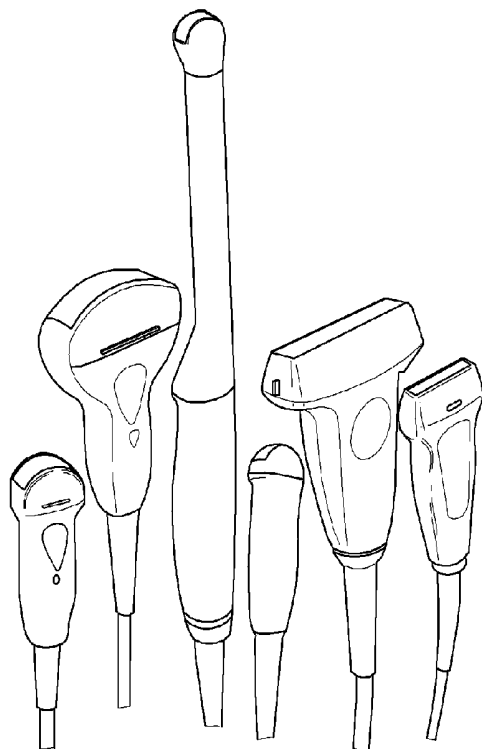
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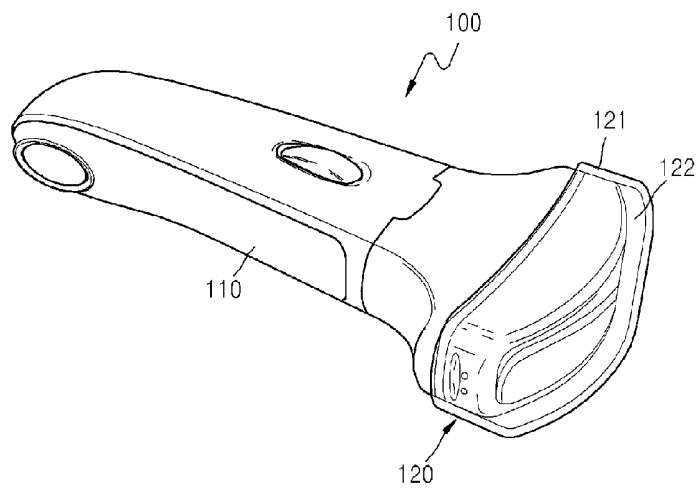
[Fig. 1]



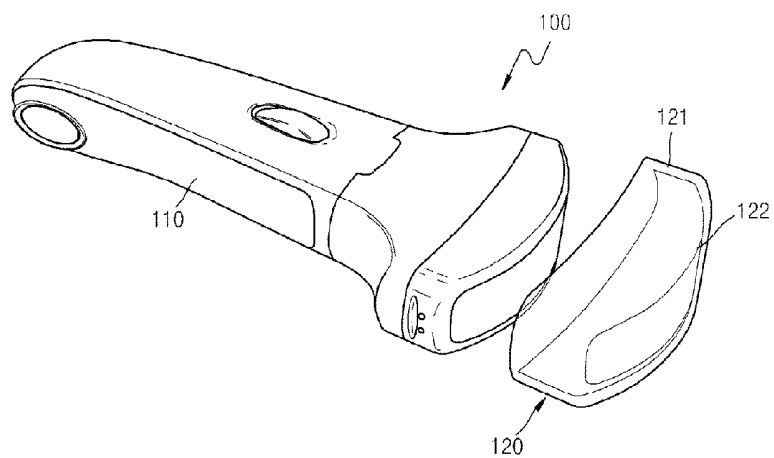
[Fig. 2]



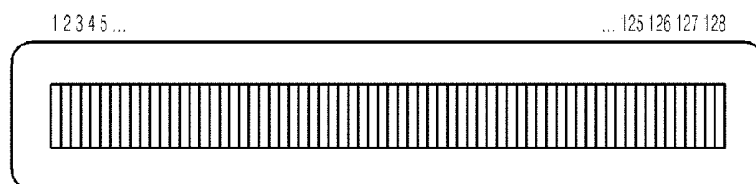
[Fig. 3]



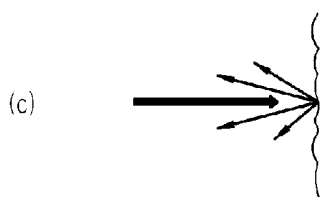
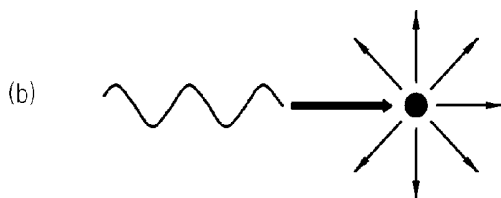
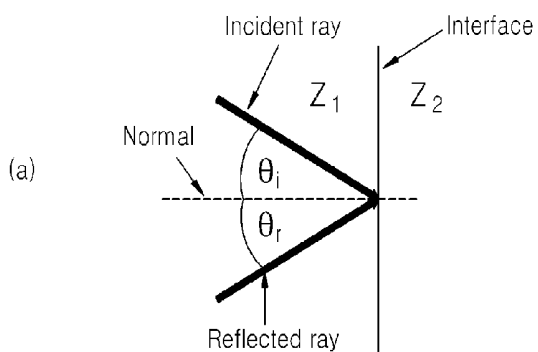
[Fig. 4]



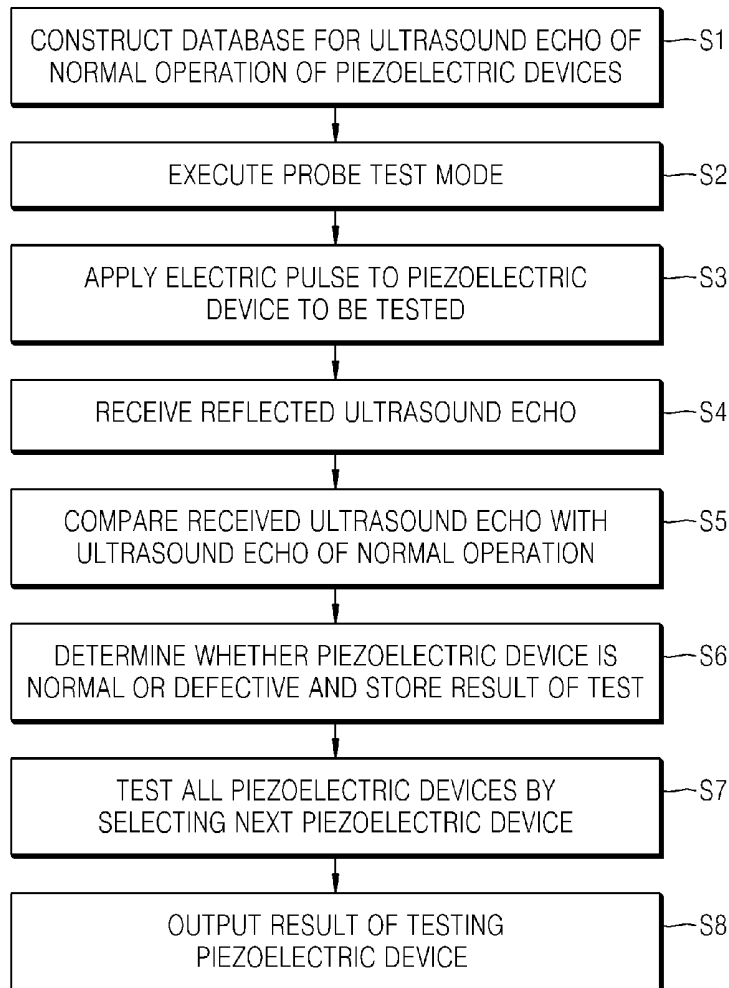
[Fig. 5]



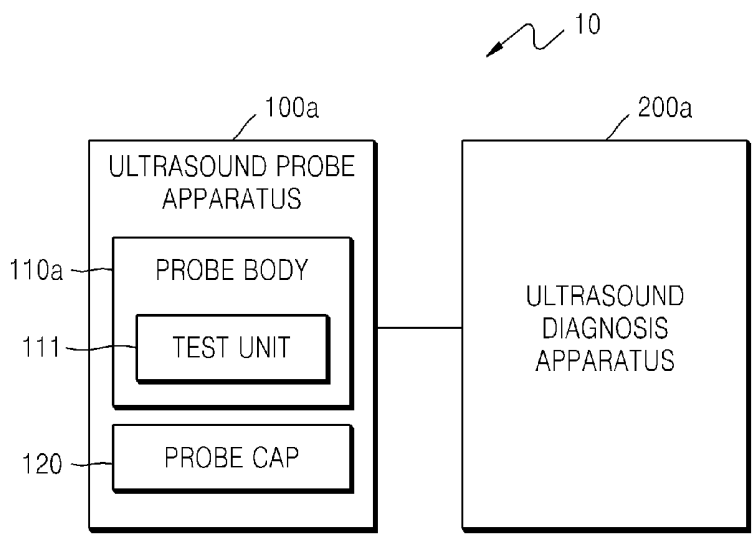
[Fig. 6]



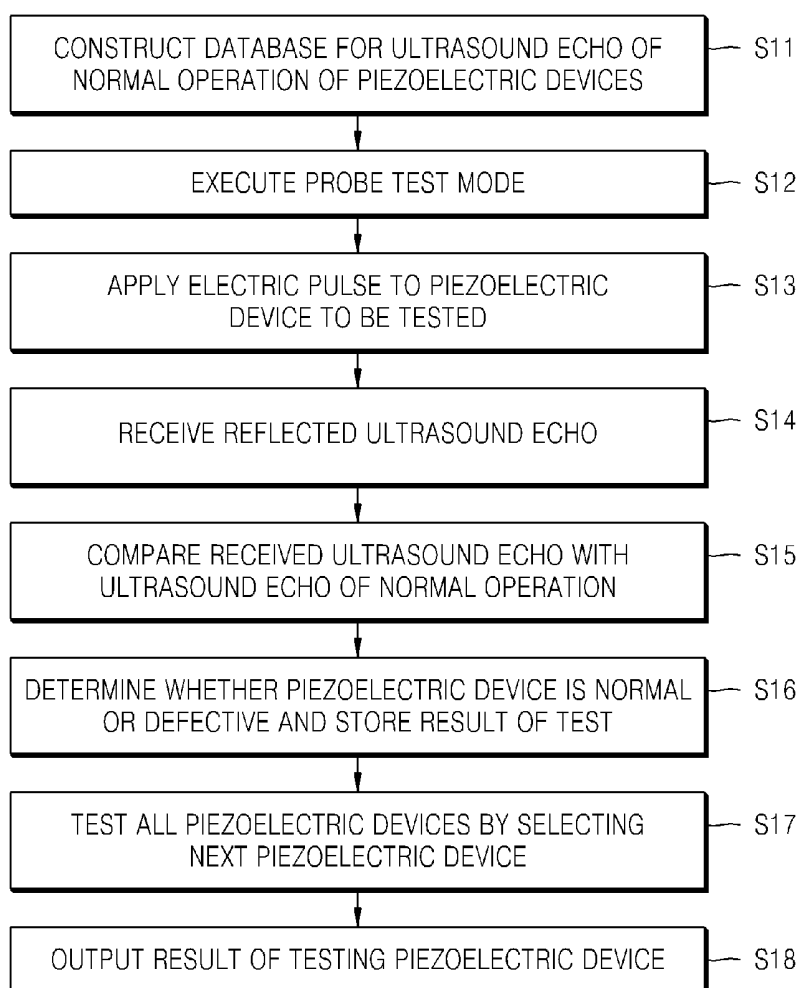
[Fig. 7]



[Fig. 8]



[Fig. 9]



**ULTRASOUND PROBE CAP AND METHOD
FOR TESTING ULTRASOUND PROBE USING
THE SAME AND ULTRASOUND DIAGNOSIS
SYSTEM THEREOF**

TECHNICAL FIELD

[0001] The present invention relates to an ultrasound diagnosis system, and more particularly, to an ultrasound probe protection cap capable of protecting an ultrasound probe while keeping the same and individually checking an operation state and function of ultrasound piezoelectric devices multiply arranged in an array and an ultrasound probe test method and an ultrasound diagnosis system, using the cap.

BACKGROUND ART

[0002] Since having noninvasive and nondestructive properties, ultrasound diagnosis systems are generally used in the medical field to obtain information of the inside of an object. Since high-resolution images of internal organizations of objects may be provided to doctors with no surgical operations of directly incising and observing objects, ultrasound diagnosis systems are very importantly used in the medical field.

[0003] Ultrasound diagnosis systems are a system that emits an ultrasound signal from a body surface of a subject toward a target portion inside a body of the subject, extracts information from a reflected ultrasound signal, and obtains an image of a section of soft tissue or a blood flow in a noninvasive manner.

[0004] Comparing with other imaging diagnosis apparatuses such as X-ray inspection apparatuses, computerized tomography (CT) scanners, magnetic resonance image (MRI) scanners, and nuclear medicine inspection apparatuses, ultrasound diagnosis systems described above have a small size, are cheap, may display in real time, and have excellent safety without being exposed to X-rays, thereby being generally used to diagnose hearts, internal organs in an abdominal cavity, urinary systems, and genital organs.

[0005] Ultrasound diagnosis systems each includes a probe for transmitting an ultrasound signal to a subject in order to obtain an ultrasound image of the subject and receiving the ultrasound signal reflected from the subject.

[0006] Since ultrasound probes employ piezoelectric devices very vulnerable to a shock as primary components, it is necessary to give heed to ultrasound probes while ultrasound probes are being stored after use. It is impossible to repair piezoelectric devices once damaged and it is necessary to completely replace damaged piezoelectric devices. Also, it may not be recognized before use whether piezoelectric devices are damaged or not.

DISCLOSURE OF INVENTION

Technical Problem

[0007] The present invention provides an ultrasound probe protection cap capable of protecting an ultrasound probe while keeping the same and individually checking an operation state and function of ultrasound piezoelectric devices multiply arranged in an array and an ultrasound probe test method and an ultrasound diagnosis system, using the cap.

Solution to Problem

[0008] According to an aspect of the present invention, there is provided an ultrasound diagnosis system including an ultrasound probe apparatus transmitting an ultrasound signal to obtain an ultrasound image of a subject, receiving the ultrasound signal reflected from the subject, emitting ultrasound to a probe cap to test a provided piezoelectric device module, and receiving an ultrasound echo obtained from the probe cap and an ultrasound diagnosis apparatus constructing a database for ultrasound echo data of a normal operation of the piezoelectric device module provided in the ultrasound probe apparatus, executing a probe test mode for testing an operation of the piezoelectric device module, receiving data of the ultrasound echo obtained from the probe cap from the ultrasound probe apparatus, comparing with the ultrasound echo data of the normal operation of the piezoelectric device module in the database, and displaying whether the piezoelectric device module is normal or defective as a test result.

[0009] The ultrasound probe apparatus may include a probe body transmitting the ultrasound signals to obtain the ultrasound image of the subject and to perform the probe test and receiving and transmitting the reflected ultrasound signals to the ultrasound diagnosis apparatus and a probe cap coupled with a front end of the probe body, protecting the probe body and generating the ultrasound echo while testing the piezoelectric device module of the probe body.

[0010] The probe cap may include a housing forming an external shape of the probe cap and protecting the probe body from a damage caused by an external force while being coupled with the probe body, an inside thereof formed of a material having an ultrasound reflection coefficient to allow the probe test and a buffer formed on an inner surface of the housing to be allowed to be in surface contact with the front end of the probe body while the probe cap is being coupled with the probe body and formed of a buffering material having an ultrasound reflection coefficient corresponding to acoustic impedance inside a human body to allow the probe test.

[0011] According to another aspect of the present invention, there is provided a probe test method of an ultrasound diagnosis system including an ultrasound probe apparatus and an ultrasound diagnosis apparatus. The method includes, the ultrasound diagnosis apparatus, constructing a database for ultrasound echo data of a normal operation of a piezoelectric device module provided in the ultrasound probe apparatus, the ultrasound diagnosis apparatus, executing a probe test mode for testing an operation of the piezoelectric device module, the ultrasound diagnosis apparatus, when the ultrasound probe apparatus emits ultrasound to a probe cap in the ultrasound probe apparatus to test the piezoelectric device module provided in the corresponding ultrasound probe apparatus, receiving ultrasound echo data obtained from the probe cap from the ultrasound probe apparatus, and the ultrasound diagnosis apparatus, comparing the ultrasound echo data obtained from the probe cap, received from the ultrasound probe apparatus, with the ultrasound echo data of the normal operation of the piezoelectric device module in the database and displaying whether the piezoelectric device module is normal or defective as a test result.

[0012] According to still another aspect of the present invention, there is provided an ultrasound probe apparatus forming an ultrasound diagnosis system together with an ultrasound diagnosis apparatus. The ultrasound probe apparatus includes a probe body transmitting an ultrasound signal

to obtain an ultrasound image of a subject to the subject, receiving the ultrasound signal reflected from the subject, emitting ultrasound to test a provided piezoelectric device module, and receiving an ultrasound echo reflected therefrom and a probe cap coupled with a front end of the probe body, protecting the probe body and generating the ultrasound echo while testing the piezoelectric device module of the probe body.

[0013] The probe cap may include a housing forming an external shape of the probe cap and protecting the probe body from a damage caused by an external force while being coupled with the probe body, an inside thereof formed of a material having an ultrasound reflection coefficient to allow the probe test and a buffer formed on an inner surface of the housing to be allowed to be in surface contact with the front end of the probe body while the probe cap is being coupled with the probe body and formed of a buffering material having an ultrasound reflection coefficient corresponding to acoustic impedance inside a human body to allow the probe test.

[0014] According to yet another aspect of the present invention, there is provided a probe test method of an ultrasound probe apparatus forming an ultrasound diagnosis system together with an ultrasound diagnosis apparatus. The method may include, the ultrasound probe apparatus, constructing a database for ultrasound echo data of a normal operation of a piezoelectric device module provided in the corresponding ultrasound probe apparatus, the ultrasound probe apparatus, executing a probe test mode for testing an operation of the piezoelectric device module, the ultrasound probe apparatus emitting ultrasound to a probe cap in the corresponding ultrasound probe apparatus to test the piezoelectric device module provided in the ultrasound probe apparatus and receiving ultrasound echo data obtained from the probe cap, and the ultrasound probe apparatus, comparing the received ultrasound echo data obtained from the probe cap with the ultrasound echo data of the normal operation of the piezoelectric device module in the database and displaying whether the piezoelectric device module is normal or defective as a test result.

Advantageous Effects of Invention

[0015] According to the embodiments of the present invention, a probe cap is provided in an ultrasound probe apparatus, thereby protecting a piezoelectric device module in the ultrasound probe apparatus from external contacts or shocks.

[0016] Also, according to the embodiments of the present invention, in a probe test mode, operation states and functions of ultrasound piezoelectric devices multiply arranged in an array are individually checked and visually displayed while the probe cap of the ultrasound probe apparatus is coupled with a probe body, thereby preventing an error in ultrasound diagnosis and stably managing the ultrasound probe apparatus by providing a user with present state information of the ultrasound probe apparatus.

BRIEF DESCRIPTION OF DRAWINGS

[0017] FIG. 1 is a block view illustrating an ultrasound diagnosis system according to an embodiment of the present invention;

[0018] FIG. 2 is a view illustrating various probe bodies according to an embodiment of the present invention;

[0019] FIGS. 3 and 4 are views illustrating an ultrasound probe apparatus according to an embodiment of the present invention;

[0020] FIG. 5 is a view illustrating a piezoelectric device module according to an embodiment of the present invention;

[0021] FIG. 6 is a view illustrating an echo phenomenon of ultrasound according to an embodiment of the present invention;

[0022] FIG. 7 is a flowchart illustrating a probe test method of an ultrasound diagnosis system of FIG. 1 according to an embodiment of the present invention;

[0023] FIG. 8 is a block view illustrating an ultrasound diagnosis system according to another embodiment of the present invention; and

[0024] FIG. 9 is a flowchart illustrating a probe test method of the ultrasound diagnosis system of FIG. 8 according to another embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0025] Hereinafter, embodiments of the present invention will be described in detail with reference to the attached drawings. The following embodiments are provided as examples to fully convey the inventive concept to those skilled in the art. Accordingly, the present invention is not limited to the embodiments described below and may be embodied in other forms. Also, in the drawings, a width, a length, and a thickness of an element may be exaggerated for convenience of description. Like reference numerals designate like elements throughout.

[0026] FIG. 1 is a block view illustrating an ultrasound diagnosis system 10 according to an embodiment of the present invention.

[0027] Referring to FIG. 1, the ultrasound diagnosis system 10 may include an ultrasound probe apparatus 100 and an ultrasound diagnosis apparatus 200.

[0028] The ultrasound probe apparatus 100 may include a probe body 110 and a probe cap 120. The probe cap 120 is coupled with a front end of the probe body 110 and protects the probe body 110. In addition, the probe cap 120 may generate an ultrasound echo while testing piezoelectric devices of the probe body 110.

[0029] The probe body 110, as shown in FIG. 2, may be embodied as various shapes. The probe body 110 transmits an ultrasound signal to a subject in order to obtain an ultrasound image of the subject and receives and transmits the ultrasound signal reflected from the subject to the ultrasound diagnosis apparatus 200. In addition, when the ultrasound diagnosis apparatus 200 executes a probe test mode while the probe cap 120 is being coupled with the probe body 110, the probe body 110 generates ultrasound for a probe test and transmits an ultrasound echo reflected from the probe cap 120 to the ultrasound diagnosis apparatus 200.

[0030] For this, the probe body 110 may include an ultrasound probe, a beam former, a data processor, a scan converter, and a display unit. The ultrasound probe may transmit an ultrasound signal to an object and may receive the ultrasound signal reflected from the object, that is, an ultrasound echo signal, thereby forming a reception signal. The ultrasound probe may include at least one transducer element operating to convert an ultrasound signal and an electric signal into each other. The beam former may analog/digital-convert the reception signal provided by the ultrasound probe, may delay a time of a digital signal considering a position and

a focusing point of each transducer element, and forms ultrasound data, that is, radio frequency (RF) data by summing up the time-delayed digital signals. The data processor performs various data processes with respect to ultrasound data, which are necessary for forming an ultrasound image. The scan converter scan-converts the processed ultrasound data to be displayed as an image. The display unit may display an operation state of the probe body 110.

[0031] The ultrasound diagnosis apparatus 200 may receive the ultrasound data from the ultrasound probe apparatus 100 and may provide an ultrasound image having high-resolution with respect to internal organs of an object for ultrasound diagnosis with no surgical operation of directly incising and observing the object.

[0032] The ultrasound diagnosis apparatus 200 may include various devices having a wireless communication function and a display unit and operating application programs. For example, there may be a personal computer, a smartphone, a tablet type device, a pad type device, and a personal digital assistance (PDA).

[0033] Since ultrasound is absorbed into a human body due to properties thereof, the ultrasound reflected by a deep part and returning late has a great loss of energy and is reduced in size. In the same human anatomy, a size of ultrasound data reflected by a deeper part has a relatively smaller size. Accordingly, it is necessary to compensate a value increased in proportion to an amount of time for being reflected and returning.

[0034] The ultrasound diagnosis apparatus 200 may generate an ultrasound image of ultrasound data compensated with a time gain and adjusted with brightness and contrast with respect to the ultrasound data received from the ultrasound probe apparatus 100 and may display the ultrasound image on the display unit.

[0035] The ultrasound diagnosis apparatus 200 may determine an ultrasound measurement depth according to an input of a user, may determine a parameter for adjusting the time gain based on the ultrasound measurement depth, and may determine degrees for adjusting brightness and contrast.

[0036] The ultrasound diagnosis apparatus 200 may receive an input of the user and may transmit the input to the ultrasound probe apparatus 100. For example, the ultrasound diagnosis apparatus 200 may transmit the determined ultrasound measurement depth to the ultrasound probe apparatus 100 to control the ultrasound probe apparatus 100.

[0037] Also, the ultrasound diagnosis apparatus 200 may execute a probe test mode for testing an operation of a piezoelectric device module of the ultrasound probe apparatus 100 and may display whether the piezoelectric device module is normal or defective, as a test result.

[0038] For this, the ultrasound diagnosis apparatus 200 may construct a database for an ultrasound echo of a normal operation of the piezoelectric device module provided in the ultrasound probe apparatus 100.

[0039] Herein, the database for the ultrasound echo of the normal operation of the piezoelectric device module generates ultrasound having a certain frequency by applying an electric pulse having a certain frequency to the piezoelectric device module and is constructed based on an ultrasound echo having a certain frequency generated by the generated ultrasound having the certain frequency.

[0040] That is, herein, a meaning of "the normal operation" is a normal operation based on data of the time when ultrasound having a certain frequency is applied to skin tissues by

applying an electric pulse to the piezoelectric device module and echo data is obtained based on data of the ultrasound having the certain frequency obtained when the ultrasound is reflected by an interface of the skin tissues.

[0041] The ultrasound diagnosis apparatus 200 may execute a probe test mode for testing an operation of the piezoelectric device module to receive ultrasound echo data obtained by the probe cap 120 from the ultrasound probe apparatus 100 to compare with the database for the ultrasound echo data of the normal operation of the piezoelectric device module, thereby displaying whether the piezoelectric device module is normal or defective, as a test result.

[0042] FIGS. 3 and 4 are views illustrating the ultrasound probe apparatus 100.

[0043] The ultrasound probe apparatus 100 may include the probe body 110 and the probe cap 120.

[0044] The probe body 110 includes a piezoelectric device module built inside a front thereof. Piezoelectric devices are formed of a piezoelectric material. The piezoelectric material may oscillate to generate and transmit pulses of a sound wave into a human body and may receive and convert a reflected echo into an electric signal. Recently, as the piezoelectric material, piezoelectric ceramic such as lead zirconatetitanate (PZT) having highest acoustoelectric conversion efficiency is generally used. The piezoelectric device module may be used while a large number such as 64, 128, and 192 of piezoelectric devices are being arranged in an array.

[0045] FIG. 5 is a view illustrating the piezoelectric device module according to an embodiment of the present invention.

[0046] Referring to FIG. 5, the piezoelectric device module may be formed of 128 of individual piezoelectric devices. The piezoelectric device module may include ultrasound piezoelectric devices multiply arranged in an array.

[0047] Accordingly, in order to determine whether the individual piezoelectric devices forming the piezoelectric device module is normally operating or not, a test capable of individually checking an operation state and function thereof is necessary.

[0048] The ultrasound diagnosis apparatus 200 may perform tests for the individual piezoelectric devices one by one by using the probe cap 120.

[0049] When sending ultrasound outputted by the probe body 110 into a human body, at an interface between soft tissues having different densities, the ultrasound is reflected, thereby generating an ultrasound echo. The reflected ultrasound echo returns to the probe body 110. The ultrasound diagnosis 200 analyzes and processes a difference in strength of the echo received from the probe body 110 to be displayed with brightness of dots, thereby forming an image.

[0050] The probe cap 120 may be coupled with or separated from the probe body 110 through a coupling unit.

[0051] The probe cap 120 may include a housing 121 and a buffer 122. The housing 121 may form an external shape of the probe cap 120 and may protect the probe body 110 from a damage caused by an external force when being coupled with the probe body 110. The housing 121 may have various external shapes and may be generally formed corresponding to the external shape of the probe body 110. A material of the housing 121 may have strength for protecting the probe body 110 from the external force and not to be damaged from dropping impacts. Additionally, an inside of the housing 121 may have a property of reflecting ultrasound emitted from the probe body 110 while being coupled with the probe body 110 and performing a probe test. Accordingly, the inside of the

housing **121** may have a material having an ultrasound reflection coefficient for allowing the probe test. Otherwise, a material layer having the ultrasound reflection coefficient for allowing the probe test may be additionally formed on an inner surface of the housing **121**.

[0052] The buffer **122** is formed on the inside of the housing **121**. The buffer **122** may be formed with a full area on the inner surface of the housing **121** to be in surface contact with the front end of the probe body **110** while the probe cap **120** is being coupled with the probe body **110**.

[0053] While the housing **121** is primarily protecting the probe body **110** from external forces or impacts, the buffer **122** may secondarily protect the probe body **110** from the external forces or impacts. For this, the buffer **122** may be formed with a full thickness, material, and area for buffering impacts. For example, the buffer **122** may be formed of urethane rubber having acoustic impedance similar to the inside of the human body in order to be appropriate for an ultrasound probe test. In addition, medical silicone may be used.

[0054] Ultrasound is beyond an audible frequency not to be heard to a human ear. A range of the frequency thereof is more than 20 KHz. An ultrasound frequency range used for diagnosis is from about 2 MHz to about 15 MHz. In order to form a human diagnosis image using ultrasound, it is necessary to allow a short pulse within from about 2 to about 15 MHz to penetrate a human body. A signal returning from an interface of tissues is received and amplified and detected by a computer, thereby forming a two-dimensional image.

[0055] The acoustic impedance indicates impedance of a medium toward sound waves and has an effect on an amplitude and strength of a signal reflected by human tissue. The acoustic impedance is obtained by multiplying medium density p (kg/m^3) by sound wave speed c (m/sec).

$$Z=p \cdot c$$

[0056] A measure of the acoustic impedance is $\text{kg/m}^2/\text{sec}$ or rayls, in which 1 rayls corresponds to 1 $\text{kg/m}^2/\text{sec}$. The acoustic impedance is proportional to the density.

[0057] When sound waves are incident to on a flat interface between two media having mutually different acoustic impedances, a part of them penetrates and another is reflected and returns. An ultrasound image is formed by the reflected and returning sound waves. An amount of reflection is determined depending on a difference between the densities of the two media, that is, a difference between acoustic impedances thereof. As the difference between the acoustic impedances becomes greater, a larger amount of reflection occurs.

[0058] When the acoustic impedances of the media are designated as $Z1$ and $Z2$, a reflection coefficient R is calculated as follows.

$$R = \frac{Z2 - Z1}{Z2 + Z1}$$

[0059] For example, since a reflection coefficient between lungs and the air is 99%, after that, ultrasound is hardly transferred. The reflection coefficient is regardless of a frequency of ultrasound but is determined depending on a difference between acoustic impedances.

[0060] As shown in FIG. 6, an echo of ultrasound may occur due to various physical phenomena such as reflection FIG. 6(a), scattering FIG. 6(b), and diffuse reflection FIG. 6(c).

[0061] The reflection may occur at a portion in which two media differing in acoustic impedance are in contact with each other with a broad area. The scattering may occur while being scattered from various angles when reflection of ultrasound is performed at a small object instead of a surface. In this case, strength of a returning echo is smaller than an echo returning from an interface between media. The diffuse reflection may occur when the interface between media is not even, which is similar to the reflection.

[0062] Accordingly, the housing **110** and the buffer **120** may be formed of materials with a great difference of acoustic impedance, in order to reflect a larger amount of ultrasound in the ultrasound probe test by using ultrasound reflection properties described above. Similarly, the housing **110** and the buffer **120** may have thicknesses, areas, forming positions, and shapes necessary to reflect a larger amount of ultrasound in the ultrasound probe test by using ultrasound reflection properties described above.

[0063] FIG. 7 is a flowchart illustrating the probe test method of the ultrasound diagnosis system **10** according to an embodiment of the present invention.

[0064] Referring to FIG. 7, the ultrasound diagnosis apparatus **200** constructs a database by forming ultrasound echo data corresponding to a normal operation in advance, in order to determine whether to operate with respect to an individual piezoelectric device included in the ultrasound probe apparatus **100** or not (S1).

[0065] The ultrasound diagnosis apparatus **200** executes a probe test mode according to an input of a user (S2). The probe body **110** generates ultrasound by applying an electric pulse to a piezoelectric device to be tested as the ultrasound diagnosis apparatus **200** executes the probe test mode (S3).

[0066] The probe body **110** receives an ultrasound echo reflected by the probe cap **120** (S4). The ultrasound echo received by the probe body **110** is transmitted to the ultrasound diagnosis apparatus **200**.

[0067] The ultrasound diagnosis apparatus **200** compares the ultrasound echo received from the probe body **110** with the ultrasound echo data of the normal operation (S5).

[0068] The ultrasound diagnosis apparatus **200** determines whether the corresponding piezoelectric device is normal or not and stores a test result as normal or defective (S6).

[0069] The ultrasound diagnosis apparatus **200** selects a next piezoelectric device as an object of test and repetitively performs a test process described above with respect to all piezoelectric devices (S7).

[0070] The ultrasound diagnosis apparatus **200** outputs a final test result when testing the all piezoelectric devices is finally completed (S8).

[0071] FIG. 8 is a block view illustrating an ultrasound diagnosis system **10** according to another embodiment of the present invention.

[0072] Referring to FIG. 8, the ultrasound diagnosis system **10** may include an ultrasound probe apparatus **100a** and an ultrasound diagnosis apparatus **200b**.

[0073] The ultrasound probe apparatus **100a** may include a probe body **110a** and a probe cap **120**. The probe cap **120** is coupled with a front end of the probe body **110a** and protects the probe body **110a**. In addition, the probe cap **120** may generate an ultrasound echo while testing piezoelectric devices of the probe body **110a**.

[0074] The probe body **110a** transmits an ultrasound signal to a subject in order to obtain an ultrasound image of the subject and receives and transmits the ultrasound signal

reflected from the subject to the ultrasound diagnosis apparatus **200a**. In addition, the probe body **110a** includes a test unit **111**. Accordingly, when the test unit **111** executes a probe test mode while the probe cap **120** is being coupled with the probe body **110a**, the probe body **110a** generates ultrasound for a probe test and receives an ultrasound echo reflected from the probe cap **120**, thereby performing the probe test.

[0075] In addition, the probe body **110a** may further include an ultrasound probe, a beam former, a data processor, a scan converter, and a display unit. The ultrasound probe transmits an ultrasound signal to an object and receives the ultrasound signal reflected from the object, that is, an ultrasound echo signal, thereby forming a reception signal. The ultrasound probe may include at least one transducer element operating to convert an ultrasound signal and an electric signal into each other. The beam former may analog/digital-convert the reception signal provided by the ultrasound probe, may delay a time of a digital signal considering a position and a focusing point of each transducer element, and forms ultrasound data, that is, RF data by summing up the time-delayed digital signals. The data processor performs various data processes with respect to ultrasound data, which are necessary for forming an ultrasound image. The scan converter scan-converts the processed ultrasound data to be displayed as an image. The display unit may display an operation state of the probe body **110a**.

[0076] The ultrasound diagnosis apparatus **200a** may include various devices having a wireless communication function and a display unit and operating application programs. For example, there may be a personal computer, a smartphone, a tablet type device, a pad type device, and a PDA.

[0077] The ultrasound diagnosis apparatus **200a** may generate an ultrasound image of ultrasound data compensated with a time gain and controlled with brightness and contrast with respect to the ultrasound data received from the ultrasound probe apparatus **100a** and may display the ultrasound image on the display unit.

[0078] The ultrasound diagnosis apparatus **200a** may determine an ultrasound measurement depth according to an input of a user, may determine a parameter for adjusting the time gain based on the ultrasound measurement depth, and may determine degrees for adjusting brightness and contrast.

[0079] The ultrasound diagnosis apparatus **200a** may receive the input of the user and may transmit the input to the ultrasound probe apparatus **100a**. For example, the ultrasound diagnosis apparatus **200a** may transmit the ultrasound measurement depth determined to the ultrasound probe apparatus **100a** to control the ultrasound probe apparatus **100**.

[0080] On the other hand, the ultrasound diagnosis apparatus **200a** may receive the database for the ultrasound echo data, constructed in the ultrasound probe apparatus **100a** and may manage the corresponding ultrasound probe apparatus **100a**.

[0081] Also, the ultrasound diagnosis apparatus **200a** may update management history data of the ultrasound probe apparatus **100a** with the final test result received from the ultrasound probe apparatus **100a** to manage a state of the ultrasound probe apparatus **100a**. For example, the ultrasound diagnosis apparatus **200a** may determine whether the ultrasound probe apparatus **100a** normally operates or not or whether the ultrasound probe apparatus **100a** is defective or

not to be displayed to the user and may provide the user with a point in time of replacing the ultrasound probe apparatus **100a**.

[0082] FIG. 9 is a flowchart illustrating a probe test method of the ultrasound diagnosis system **10** according to another embodiment of the present invention.

[0083] Referring to FIG. 9, the test unit **111** of the ultrasound probe apparatus **100a** constructs a database by forming ultrasound echo data corresponding to a normal operation in advance, in order to determine whether to operate with respect to an individual piezoelectric device included in the ultrasound probe apparatus **100a** or not (S11). The database for the ultrasound echo data, constructed in the ultrasound probe apparatus **100a**, may be transmitted to the ultrasound diagnosis apparatus **200a** and may be used in the ultrasound diagnosis apparatus **200a** to manage the corresponding ultrasound probe apparatus **100a**.

[0084] The test unit **111** of the ultrasound probe apparatus **100a** executes a probe test mode according to an input of a user (S12). The probe body **110a** generates ultrasound by applying an electric pulse to a piezoelectric device to be tested as the test unit **111** executes the probe test mode (S13).

[0085] The probe body **110a** receives an ultrasound echo reflected by the probe cap **120** (S14).

[0086] The test unit **111** of the ultrasound probe apparatus **100a** compares the ultrasound echo received from the probe body **111** with the ultrasound echo data of the normal operation (S15).

[0087] The test unit **111** of the ultrasound probe apparatus **100a** determines whether the corresponding piezoelectric device is normal or not and stores a test result as normal or defective (S16).

[0088] The test unit **111** of the ultrasound probe apparatus **100a** selects a next piezoelectric device as an object of test and repetitively performs a test process described above with respect to all piezoelectric devices (S17).

[0089] The test unit **111** of the ultrasound probe apparatus **100a** outputs a final test result when testing the all piezoelectric devices is finally completed (S18).

[0090] According to a request of the user, the test unit **111** of the ultrasound probe apparatus **100a** may transmit the final test result to the ultrasound diagnosis apparatus **200a**. Also, the ultrasound diagnosis apparatus **200a** may update management history data of the ultrasound probe apparatus **100a** with the final test result received from the ultrasound probe apparatus **100a** to manage a state of the ultrasound probe apparatus **100a**.

[0091] While this invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

1. An ultrasound diagnosis system comprising:
 - an ultrasound probe apparatus transmitting an ultrasound signal to obtain an ultrasound image of a subject, receiving the ultrasound signal reflected from the subject, emitting ultrasound to a probe cap to test a provided piezoelectric device module, and receiving an ultrasound echo obtained from the probe cap; and
 - an ultrasound diagnosis apparatus constructing a database for ultrasound echo data of a normal operation of the piezoelectric device module provided in the ultrasound probe apparatus, executing a probe test mode for testing

an operation of the piezoelectric device module, receiving data of the ultrasound echo obtained from the probe cap from the ultrasound probe apparatus, comparing with the ultrasound echo data of the normal operation of the piezoelectric device module in the database, and displaying whether the piezoelectric device module is normal or defective as a test result.

2. The system of claim 1, wherein the ultrasound probe apparatus comprises:

a probe body transmitting the ultrasound signals to obtain the ultrasound image of the subject and to perform the probe test and receiving and transmitting the reflected ultrasound signals to the ultrasound diagnosis apparatus; and

a probe cap coupled with a front end of the probe body, protecting the probe body and generating the ultrasound echo while testing the piezoelectric device module of the probe body.

3. The system of claim 2, wherein the probe cap comprises: a housing forming an external shape of the probe cap and protecting the probe body from a damage caused by an external force while being coupled with the probe body, an inside thereof formed of a material having an ultrasound reflection coefficient to allow the probe test; and a buffer formed on an inner surface of the housing to be allowed to be in surface contact with the front end of the probe body while the probe cap is being coupled with the probe body and formed of a buffering material having an ultrasound reflection coefficient corresponding to acoustic impedance inside a human body to allow the probe test.

4. (canceled)

5. An ultrasound probe apparatus forming an ultrasound diagnosis system together with an ultrasound diagnosis apparatus, the ultrasound probe apparatus comprising:

a probe body transmitting an ultrasound signal to obtain an ultrasound image of a subject to the subject, receiving the ultrasound signal reflected from the subject, emitting ultrasound to test a provided piezoelectric device module, and receiving an ultrasound echo reflected therefrom; and

a probe cap coupled with a front end of the probe body, protecting the probe body and generating the ultrasound echo while testing the piezoelectric device module of the probe body

6. The apparatus of claim 5, wherein the probe cap comprises:

a housing forming an external shape of the probe cap and protecting the probe body from a damage caused by an external force while being coupled with the probe body, an inside thereof formed of a material having an ultrasound reflection coefficient to allow the probe test; and

a buffer formed on an inner surface of the housing to be allowed to be in surface contact with the front end of the probe body while the probe cap is being coupled with the probe body and formed of a buffering material having an ultrasound reflection coefficient corresponding to acoustic impedance inside a human body to allow the probe test.

7. (canceled)

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专利名称(译)	超声探头帽及使用其进行超声探头测试的方法及其超声诊断系统		
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摘要(译)

提供一种超声波诊断系统，包括：超声波探头装置，其发送超声波信号以获得被检体的超声波图像；以及超声波诊断装置，其构成用于超声波探头中设置的压电装置模块的正常操作的超声波回波数据的数据库仪器。

