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(54) **ULTRASOUND IMAGING APPARATUS AND METHOD OF CONTROLLING THE SAME**

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(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**

A61B 8/00 (2006.01)
G01N 29/24 (2006.01)
G01S 7/52 (2006.01)

(52) **U.S. Cl.**

CPC ***G01N 29/24*** (2013.01); ***A61B 8/4405*** (2013.01); ***A61B 8/4411*** (2013.01); ***A61B 8/4444*** (2013.01); ***A61B 8/4477*** (2013.01); ***G01S 7/52082*** (2013.01); *A61B 8/467* (2013.01)

(58) **Field of Classification Search**

CPC G01N 29/24
USPC 73/620
See application file for complete search history.

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(57) **ABSTRACT**

Disclosed herein is an ultrasound imaging apparatus including a beamformer to transmit or receive an ultrasound signal; a first probe connection unit in which a first probe connector is placed; and a second probe connection unit in which a second probe connector is placed. The second probe connection unit is connected to the beamformer via the first probe connection unit, and the first probe connection unit includes a disconnecting unit to disconnect the first probe connection unit and the second probe connection unit from each other.

22 Claims, 26 Drawing Sheets

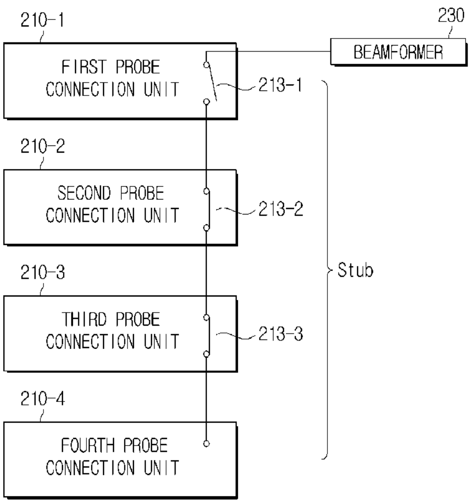


FIG. 1

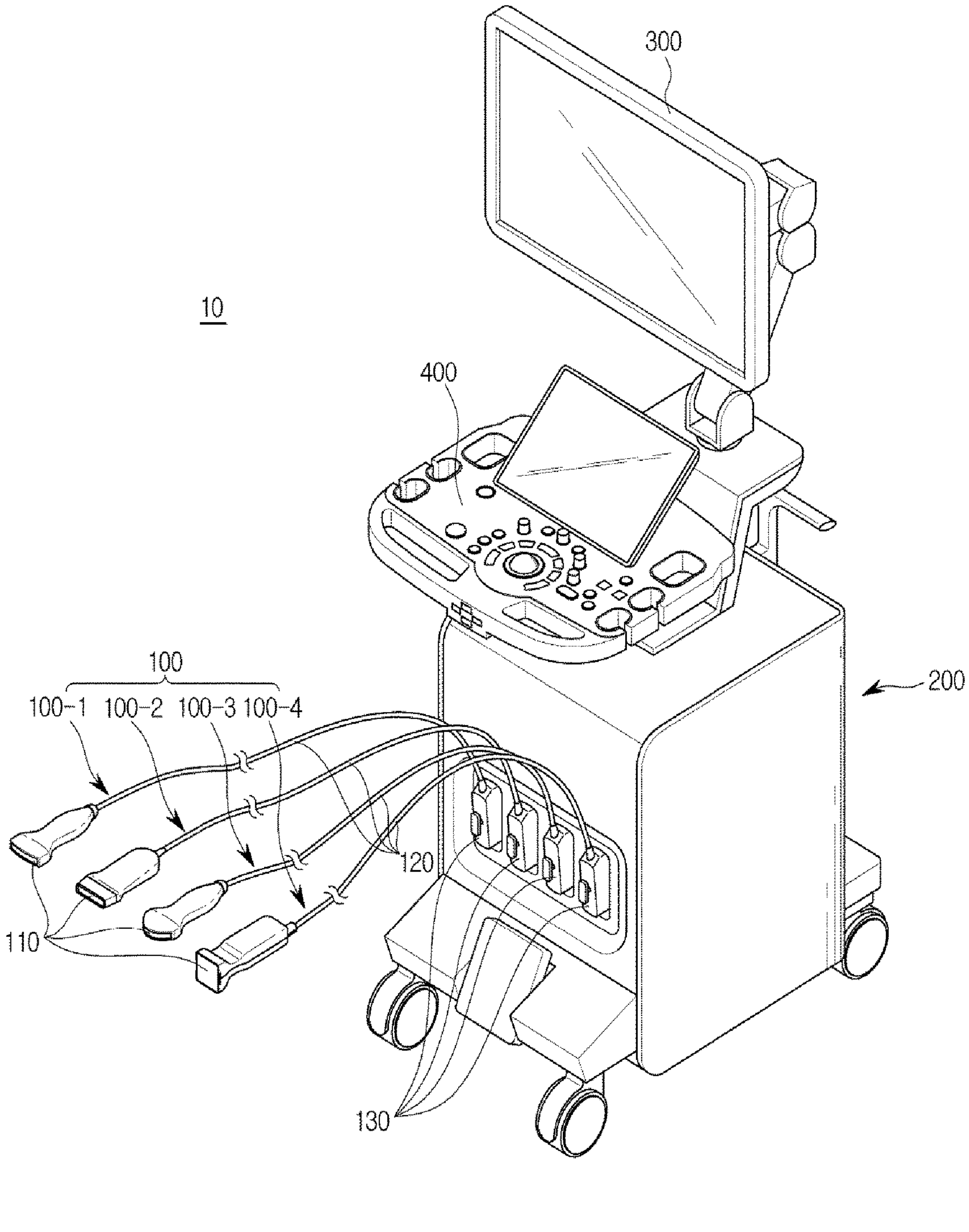


FIG. 2

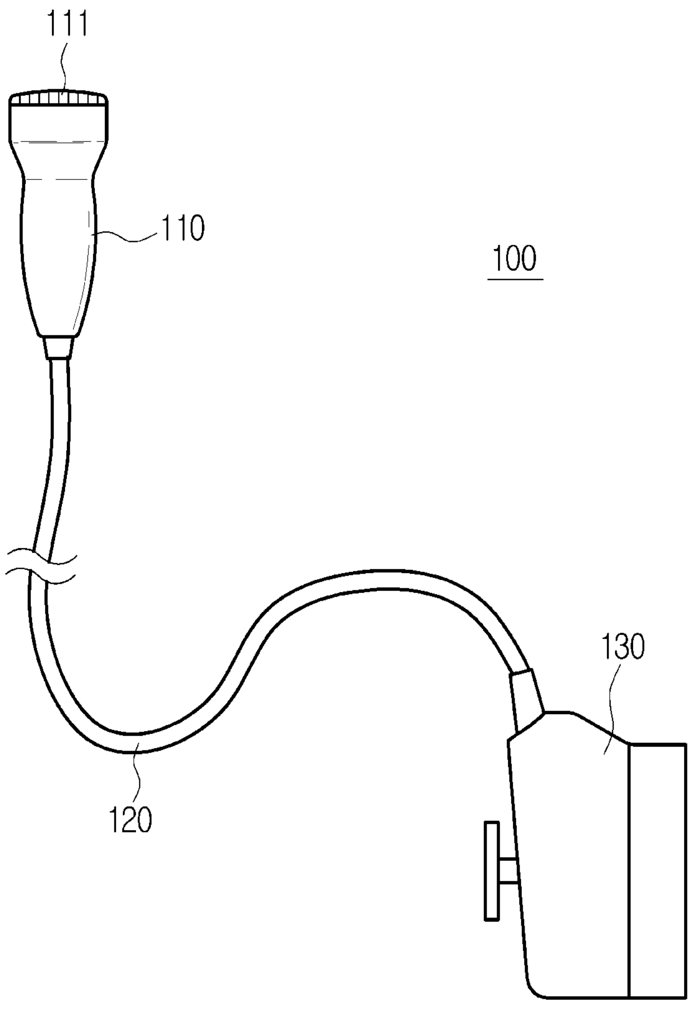


FIG. 3A

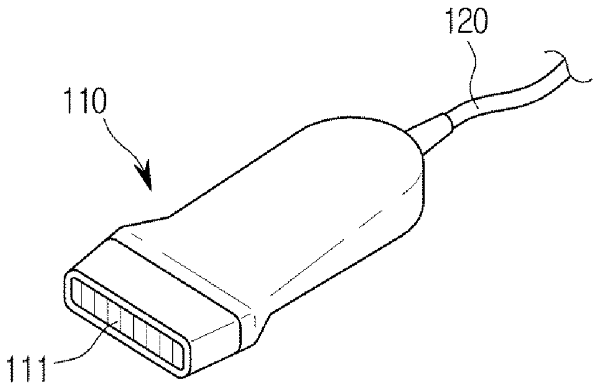


FIG. 3B

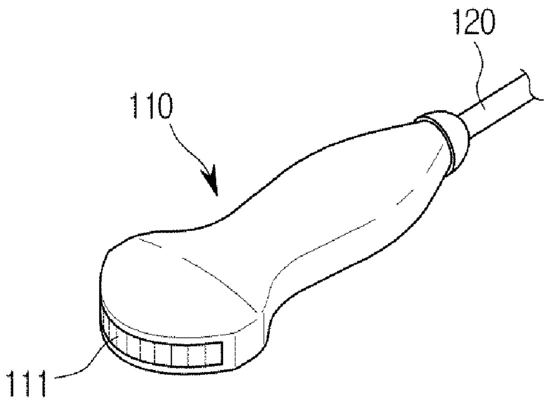


FIG. 3C

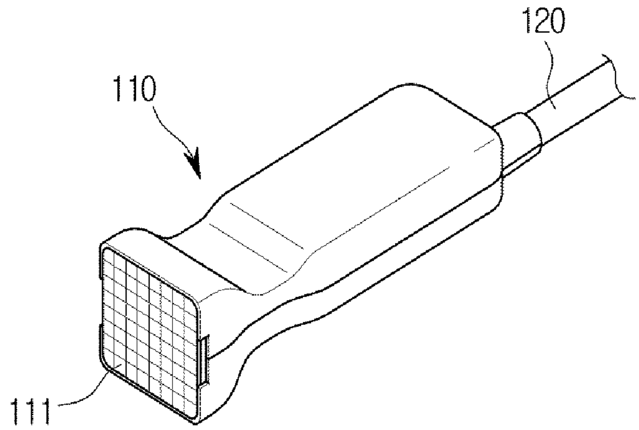


FIG. 4

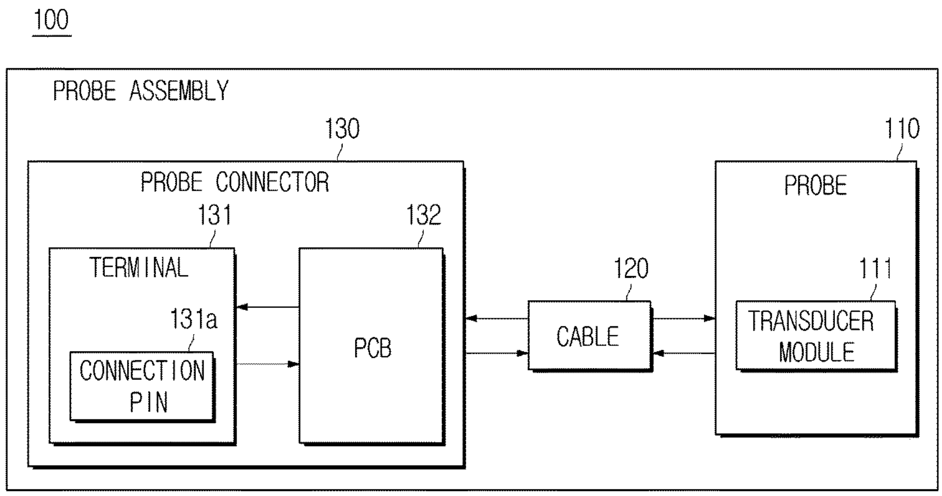

100
PROBE ASSEMBLY
130
PROBE CONNECTOR
131
TERMINAL
131a
CONNECTION PIN
132
PCB
120
CABLE
110
PROBE
111
TRANSDUCER MODULE

FIG. 5

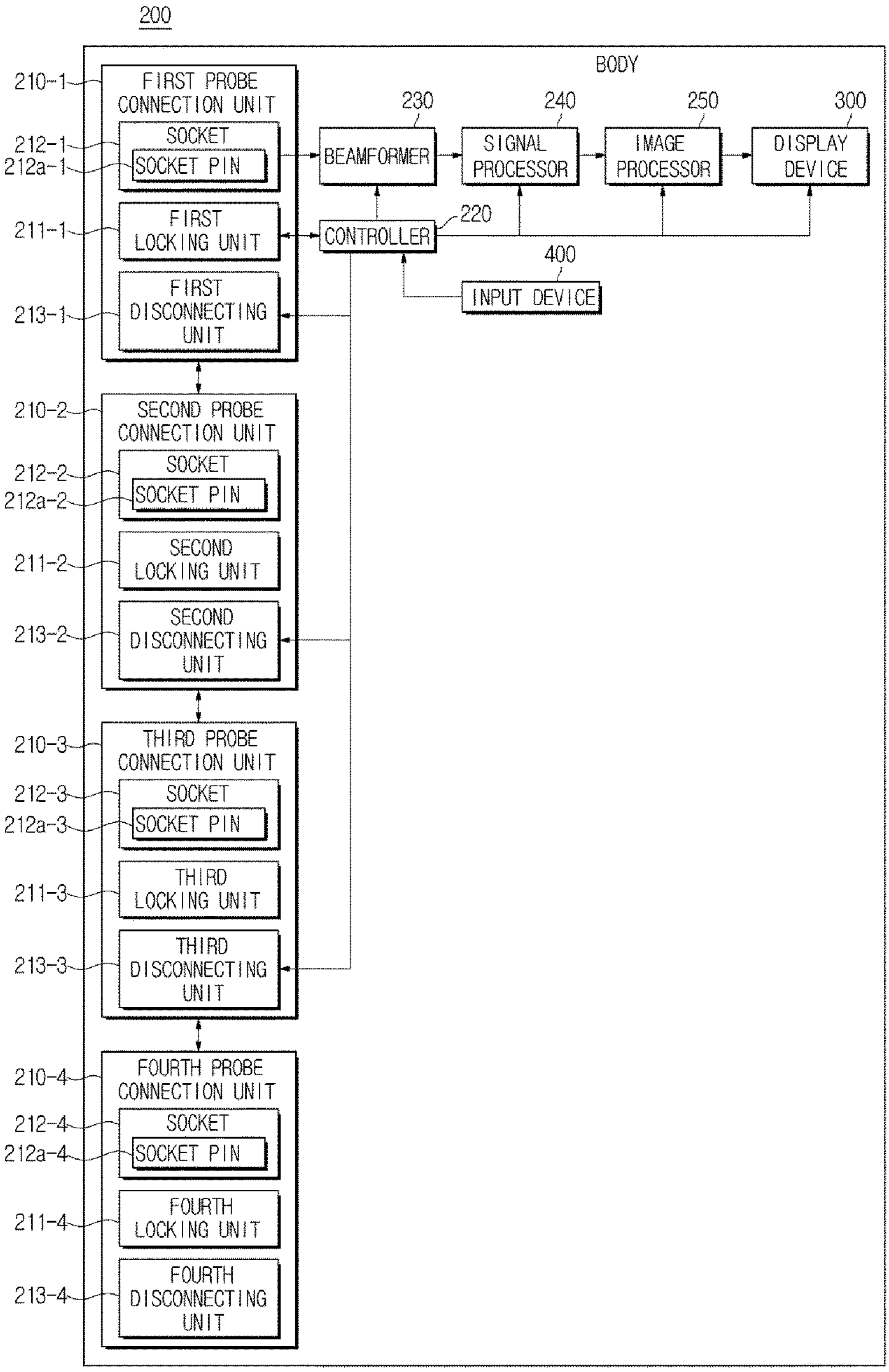

200
BODY
210-1
FIRST PROBE CONNECTION UNIT
212-1
SOCKET
212a-1
SOCKET PIN
211-1
FIRST LOCKING UNIT
213-1
FIRST DISCONNECTING UNIT
230
BEAMFORMER
240
SIGNAL PROCESSOR
250
IMAGE PROCESSOR
300
DISPLAY DEVICE
220
CONTROLLER
400
INPUT DEVICE
210-2
SECOND PROBE CONNECTION UNIT
212-2
SOCKET
212a-2
SOCKET PIN
211-2
SECOND LOCKING UNIT
213-2
SECOND DISCONNECTING UNIT
210-3
THIRD PROBE CONNECTION UNIT
212-3
SOCKET
212a-3
SOCKET PIN
211-3
THIRD LOCKING UNIT
213-3
THIRD DISCONNECTING UNIT
210-4
FOURTH PROBE CONNECTION UNIT
212-4
SOCKET
212a-4
SOCKET PIN
211-4
FOURTH LOCKING UNIT
213-4
FOURTH DISCONNECTING UNIT

FIG. 6

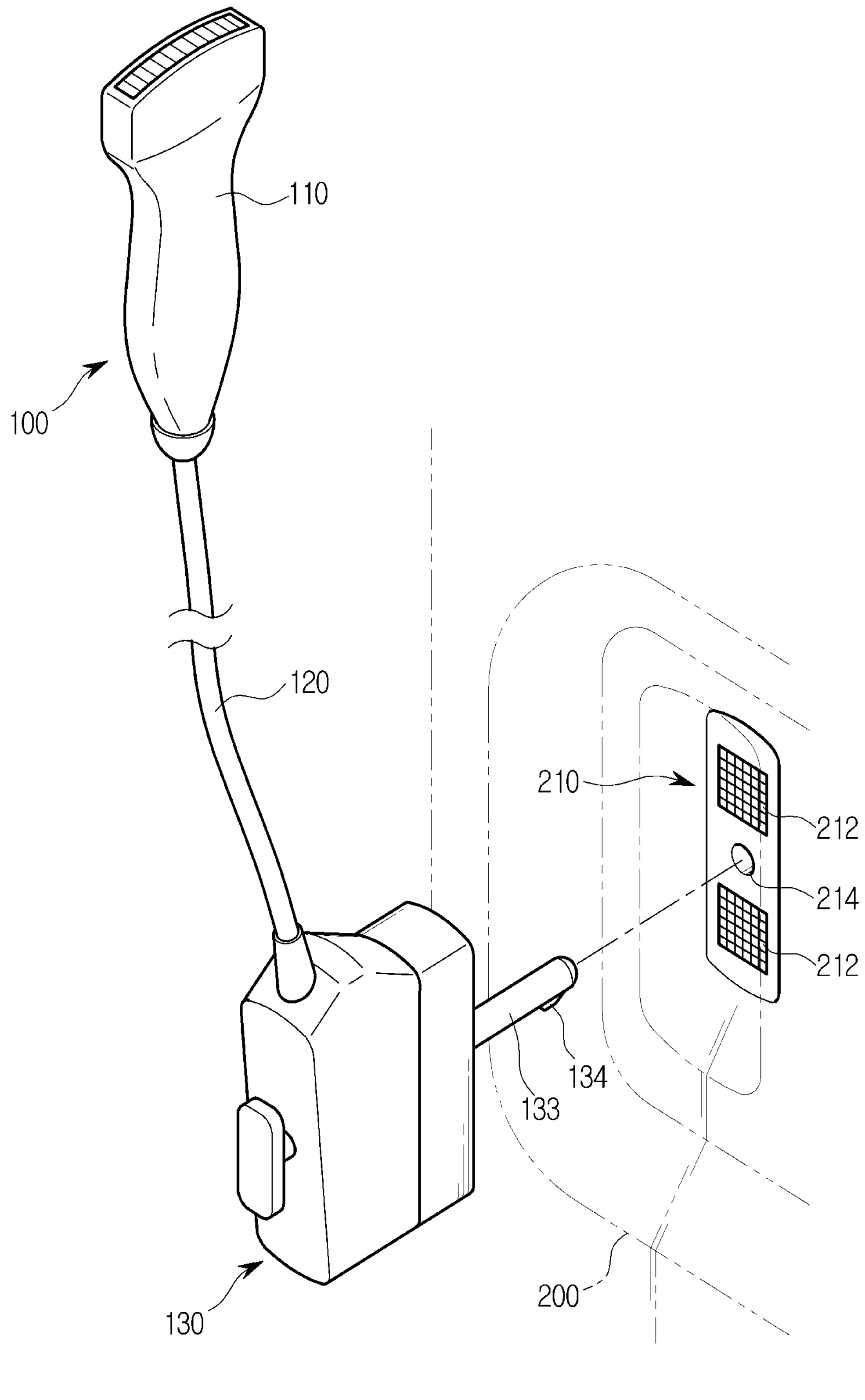


FIG. 7

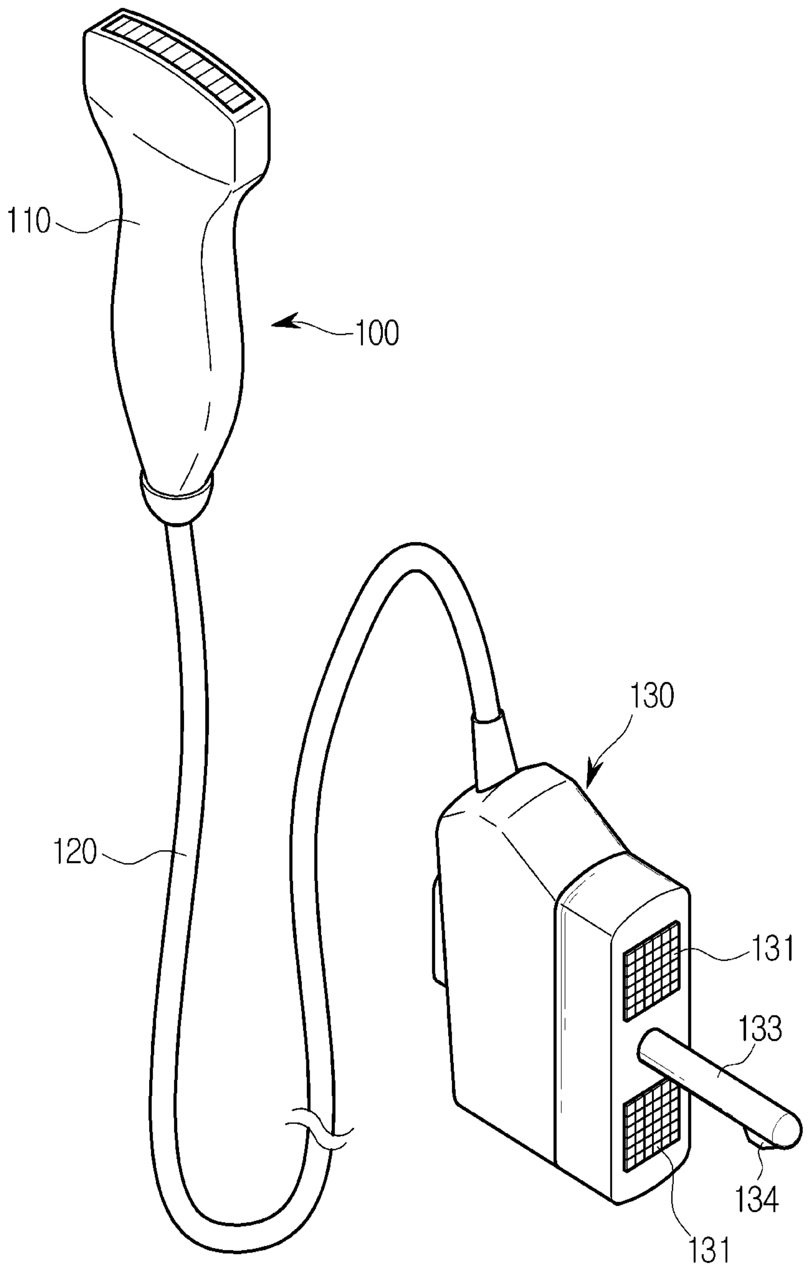


FIG. 8A

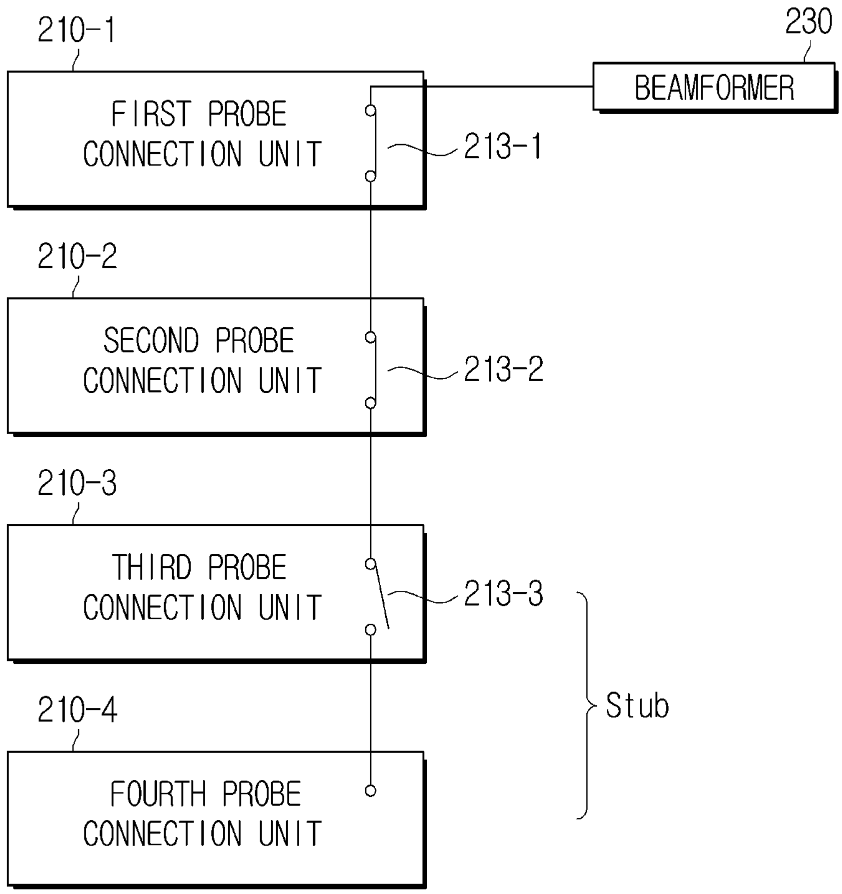
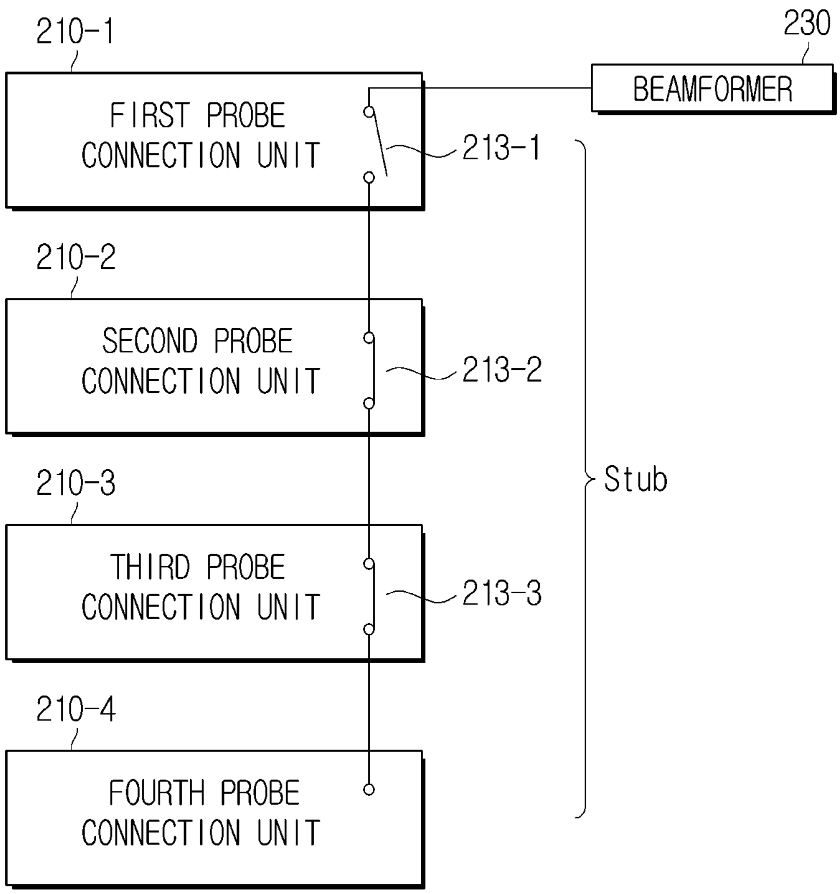

210-1
FIRST PROBE CONNECTION UNIT
230
BEAMFORMER
213-1
210-2
SECOND PROBE CONNECTION UNIT
213-2
210-3
THIRD PROBE CONNECTION UNIT
213-3
210-4
FOURTH PROBE CONNECTION UNIT
Stub

FIG. 8B



210-1
FIRST PROBE CONNECTION UNIT
230
BEAMFORMER
213-1
210-2
SECOND PROBE CONNECTION UNIT
213-2
Stub
210-3
THIRD PROBE CONNECTION UNIT
213-3
210-4
FOURTH PROBE CONNECTION UNIT

FIG. 8C

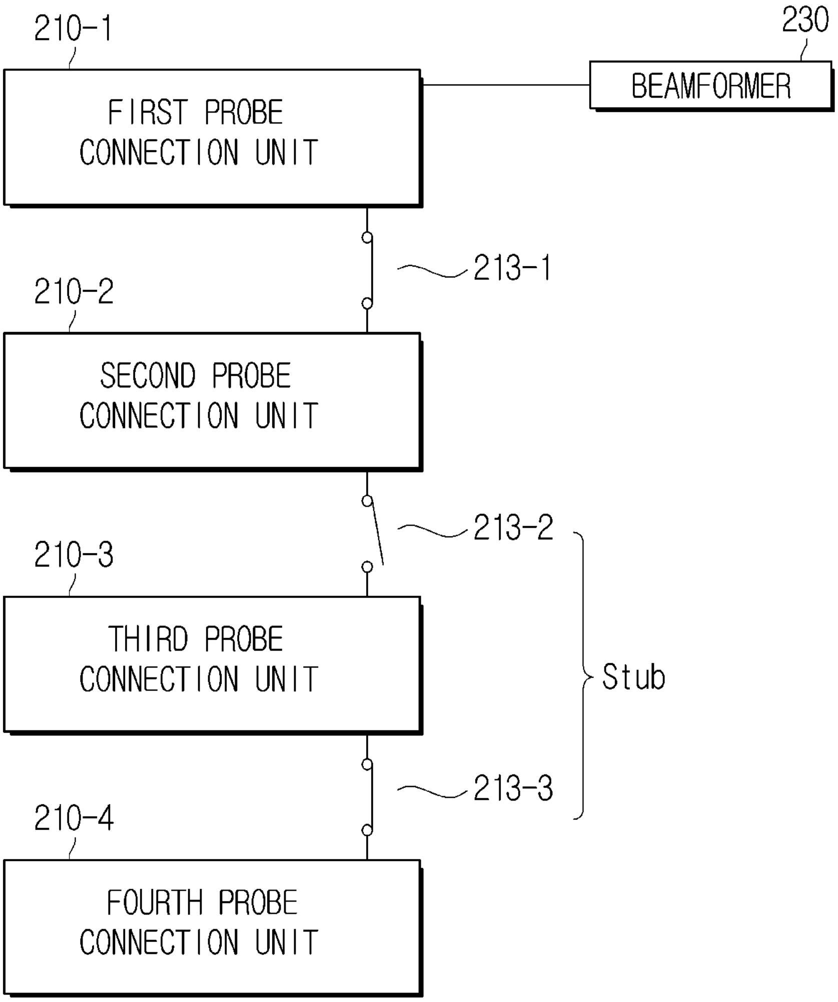

210-1
230
BEAMFORMER
FIRST PROBE CONNECTION UNIT
213-1
210-2
SECOND PROBE CONNECTION UNIT
213-2
210-3
THIRD PROBE CONNECTION UNIT
Stub
213-3
210-4
FOURTH PROBE CONNECTION UNIT

FIG. 8D

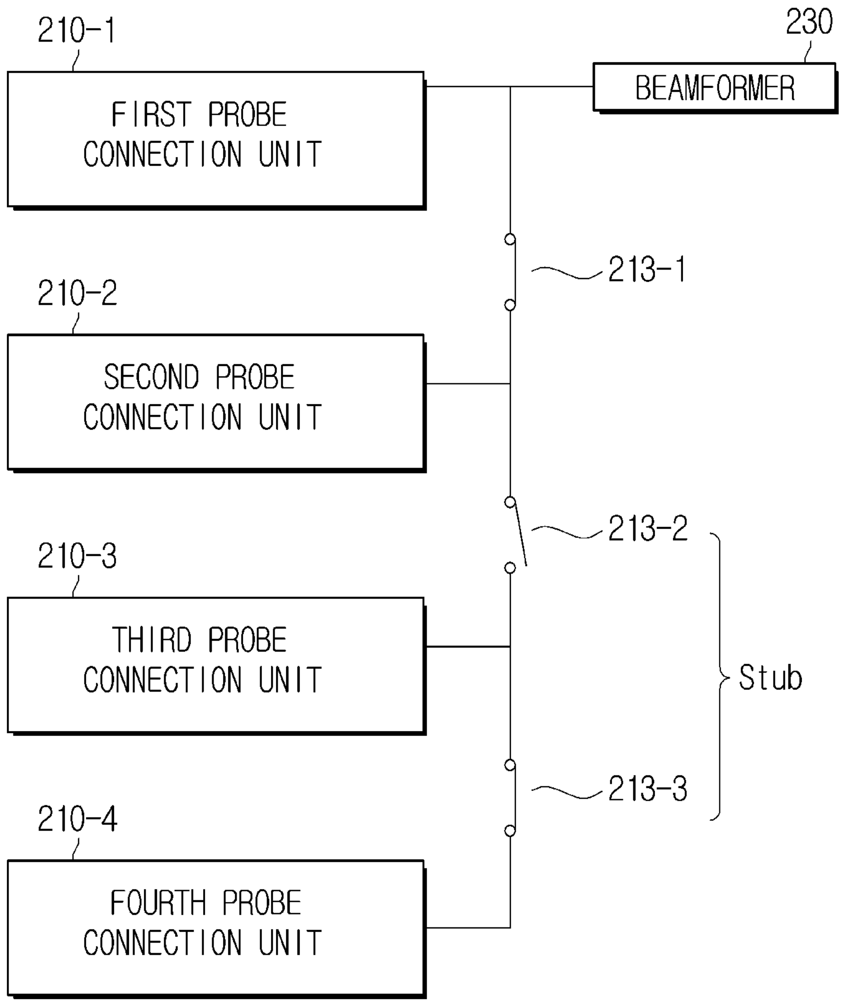

210-1
FIRST PROBE CONNECTION UNIT
230
BEAMFORMER
213-1
210-2
SECOND PROBE CONNECTION UNIT
213-2
210-3
THIRD PROBE CONNECTION UNIT
Stub
213-3
210-4
FOURTH PROBE CONNECTION UNIT

FIG. 9A

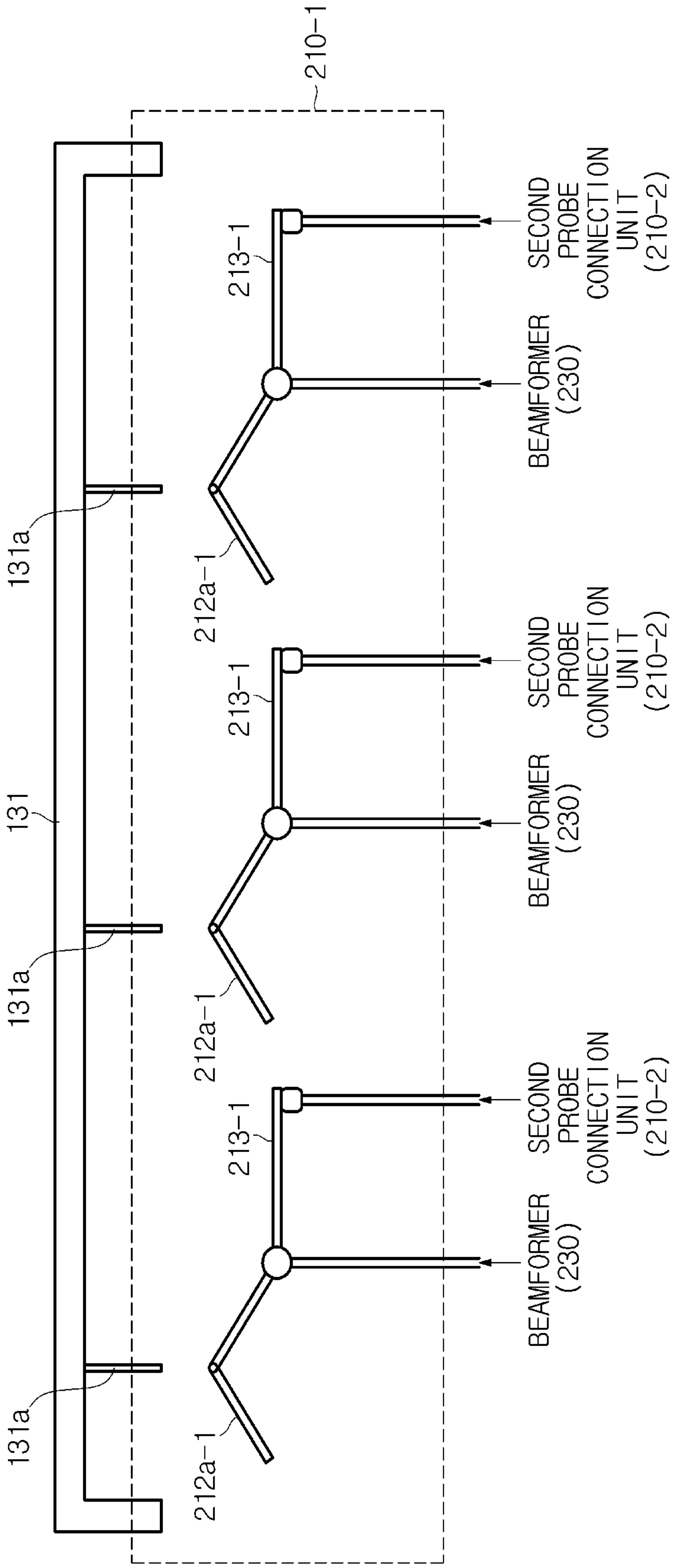

210-1
131
131a
131a
131a
212a-1
212a-1
212a-1
213-1
213-1
213-1
BEAMFORMER (230)
BEAMFORMER (230)
BEAMFORMER (230)
SECOND PROBE CONNECTION UNIT (210-2)
SECOND PROBE CONNECTION UNIT (210-2)
SECOND PROBE CONNECTION UNIT (210-2)

FIG. 9B

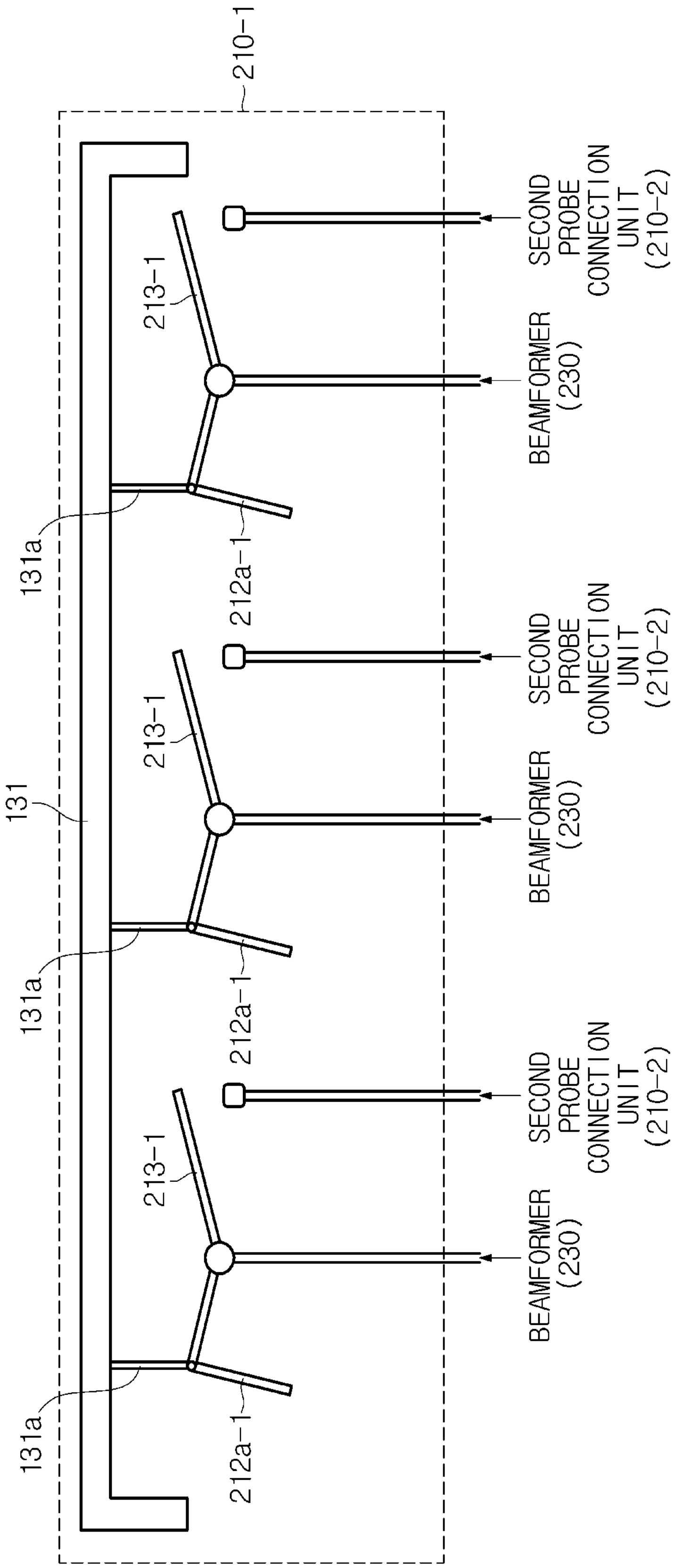

210-1
131
131a
131a
131a
213-1
213-1
213-1
212a-1
212a-1
212a-1
SECOND PROBE CONNECTION UNIT (210-2)
BEAMFORMER (230)
SECOND PROBE CONNECTION UNIT (210-2)
BEAMFORMER (230)
SECOND PROBE CONNECTION UNIT (210-2)
BEAMFORMER (230)

FIG. 10A

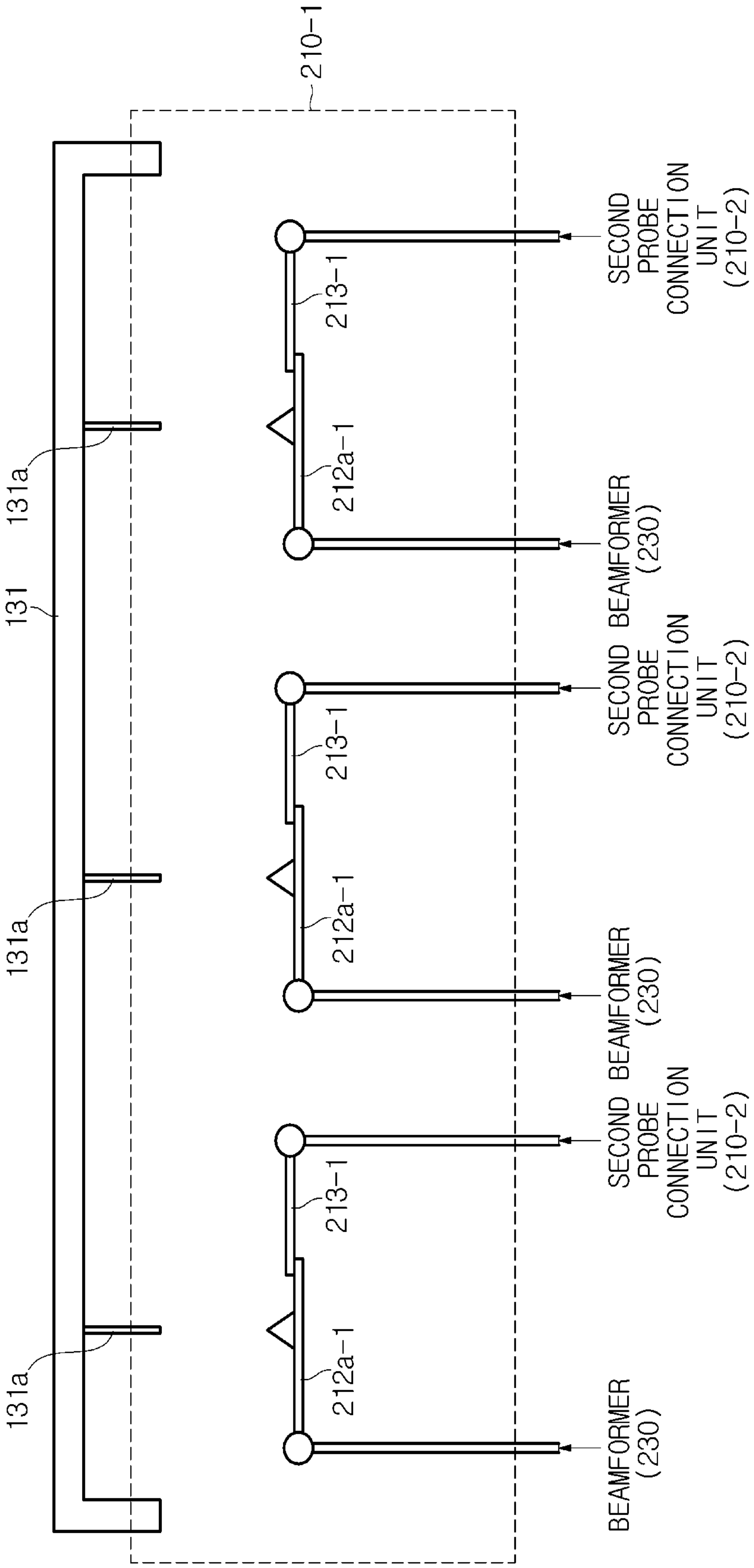
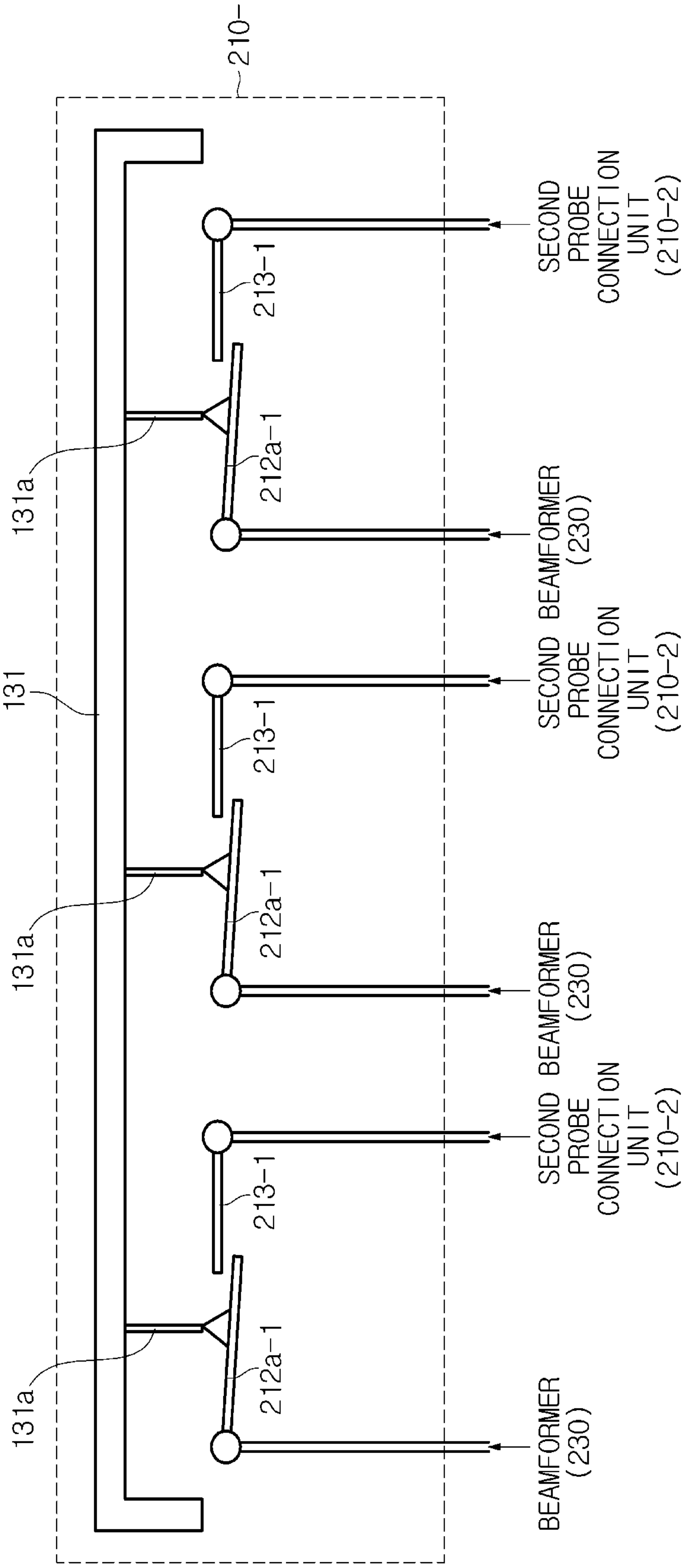

210-1
131
131a
131a
131a
212a-1
213-1
212a-1
213-1
212a-1
213-1
BEAMFORMER (230)
SECOND PROBE CONNECTION UNIT (210-2)
BEAMFORMER (230)
SECOND PROBE CONNECTION UNIT (210-2)
BEAMFORMER (230)
SECOND PROBE CONNECTION UNIT (210-2)

FIG. 10B


210-1
131
131a
131a
131a
212a-1
212a-1
212a-1
213-1
213-1
213-1
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BEAMFORMER (230)
SECOND PROBE CONNECTION UNIT (210-2)
BEAMFORMER (230)
SECOND PROBE CONNECTION UNIT (210-2)
BEAMFORMER (230)

FIG. 11A

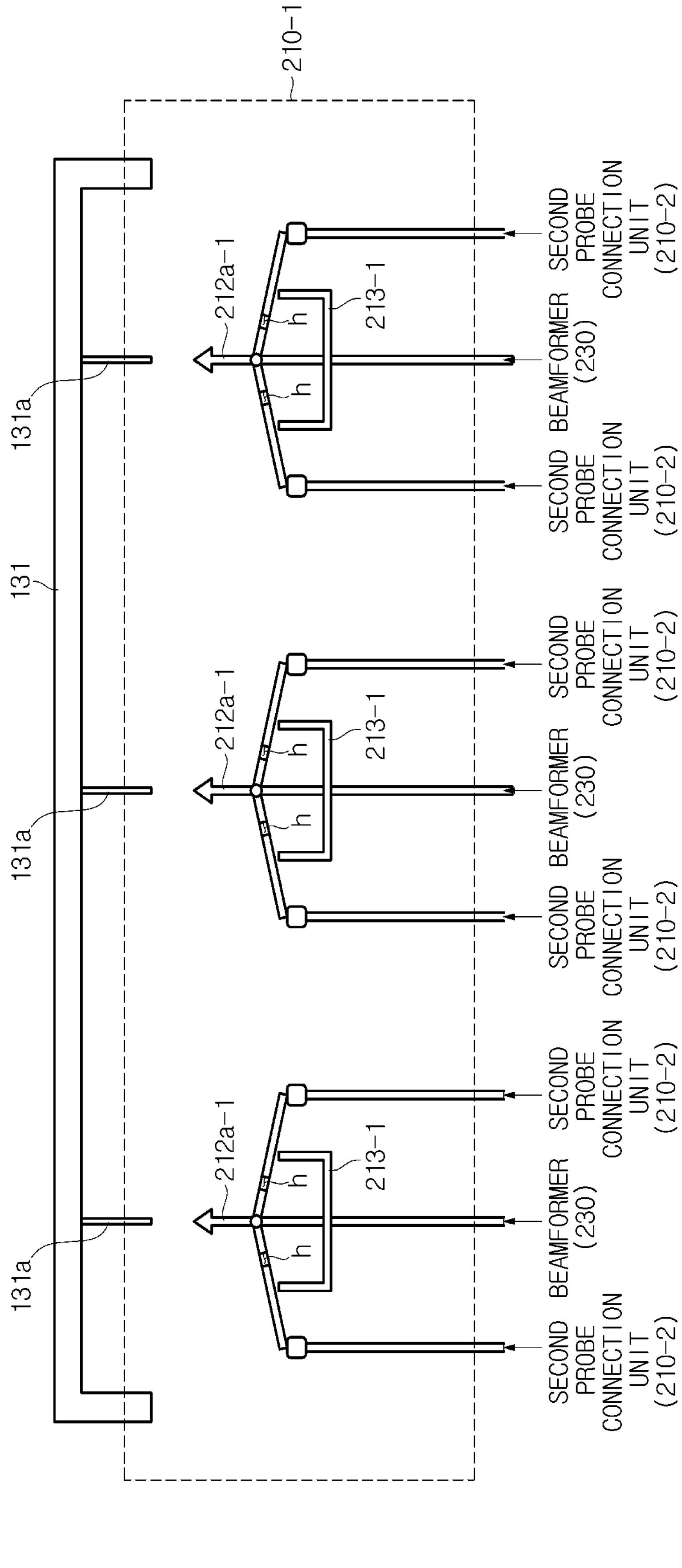

210-1
131
131a
131a
131a
212a-1
212a-1
212a-1
213-1
213-1
213-1
h
h
h
h
h
h
SECOND PROBE CONNECTION UNIT (210-2)
BEAMFORMER (230)
SECOND PROBE CONNECTION UNIT (210-2)
SECOND PROBE CONNECTION UNIT (210-2)
BEAMFORMER (230)
SECOND PROBE CONNECTION UNIT (210-2)
SECOND PROBE CONNECTION UNIT (210-2)
BEAMFORMER (230)
SECOND PROBE CONNECTION UNIT (210-2)

FIG. 11B

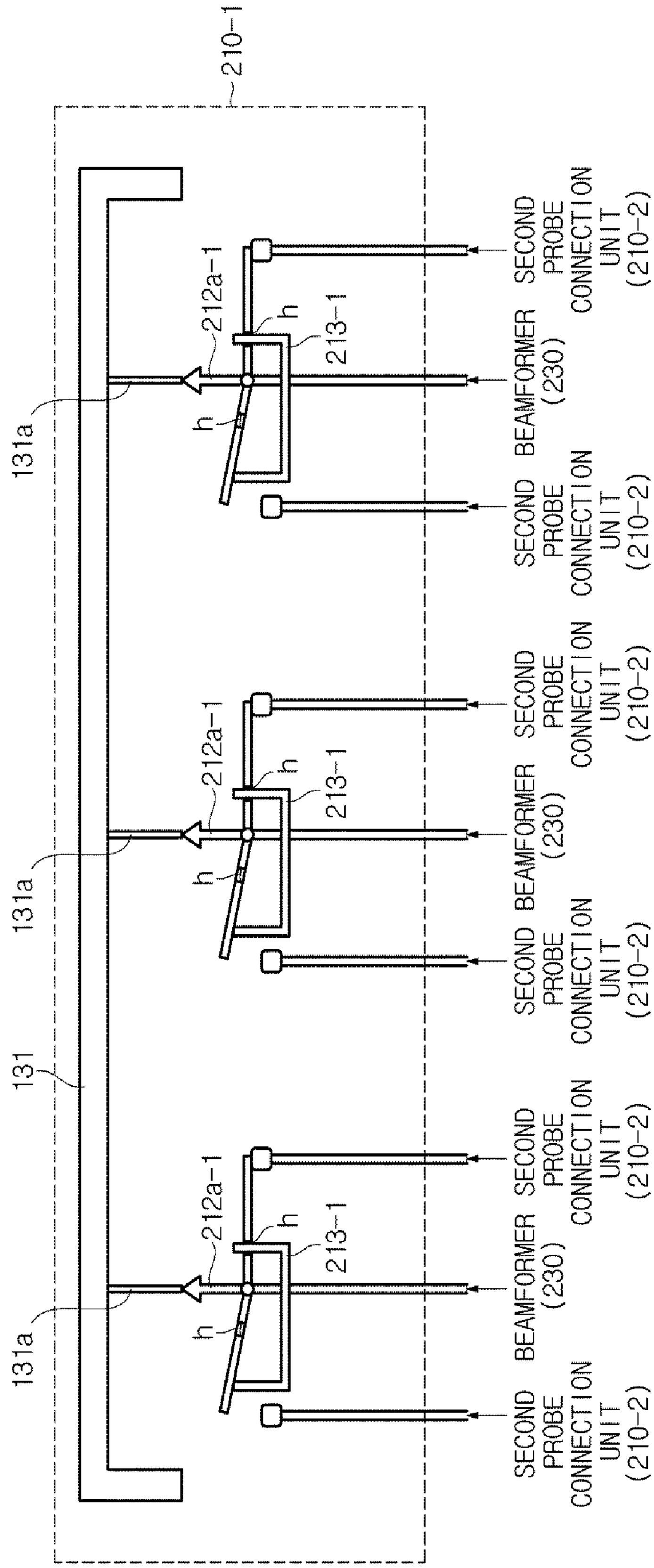

210-1
131
131a
131a
131a
212a-1
212a-1
212a-1
213-1
213-1
213-1
h
h
h
h
h
h
SECOND PROBE CONNECTION UNIT (210-2)
BEAMFORMER (230)
SECOND PROBE CONNECTION UNIT (210-2)
SECOND PROBE CONNECTION UNIT (210-2)
BEAMFORMER (230)
SECOND PROBE CONNECTION UNIT (210-2)
SECOND PROBE CONNECTION UNIT (210-2)
BEAMFORMER (230)
SECOND PROBE CONNECTION UNIT (210-2)

FIG. 11C

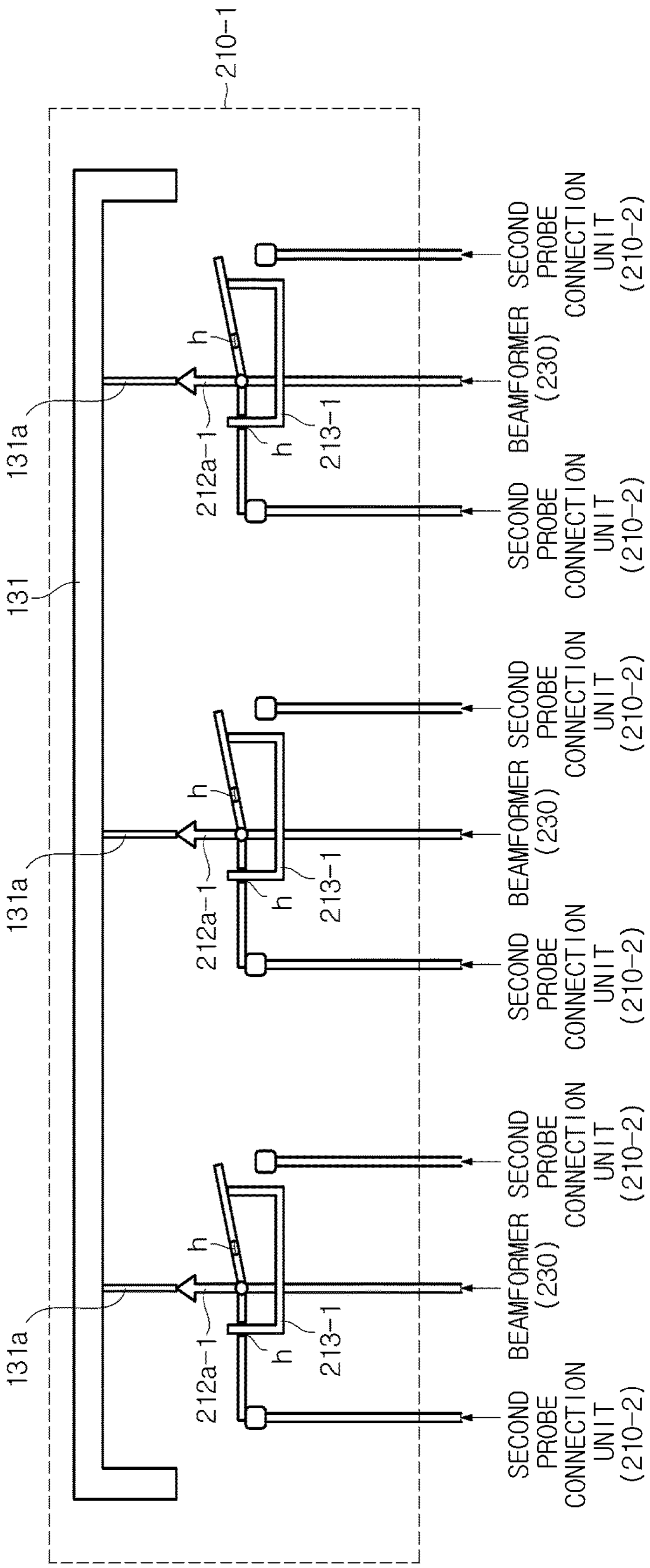

210-1
131a
131
131a
131a
h
h
212a-1
213-1
BEAMFORMER (230)
SECOND PROBE CONNECTION UNIT (210-2)

FIG. 12

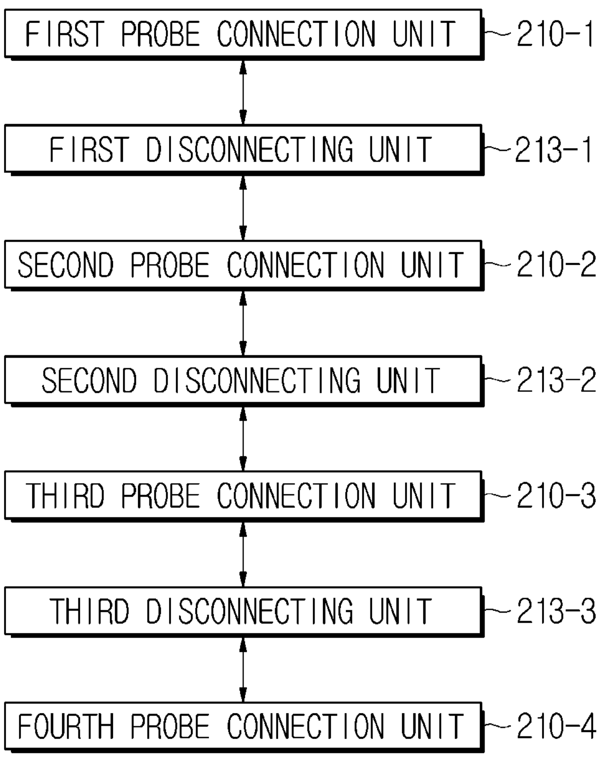

FIRST PROBE CONNECTION UNIT
210-1
FIRST DISCONNECTING UNIT
213-1
SECOND PROBE CONNECTION UNIT
210-2
SECOND DISCONNECTING UNIT
213-2
THIRD PROBE CONNECTION UNIT
210-3
THIRD DISCONNECTING UNIT
213-3
FOURTH PROBE CONNECTION UNIT
210-4

FIG. 13A

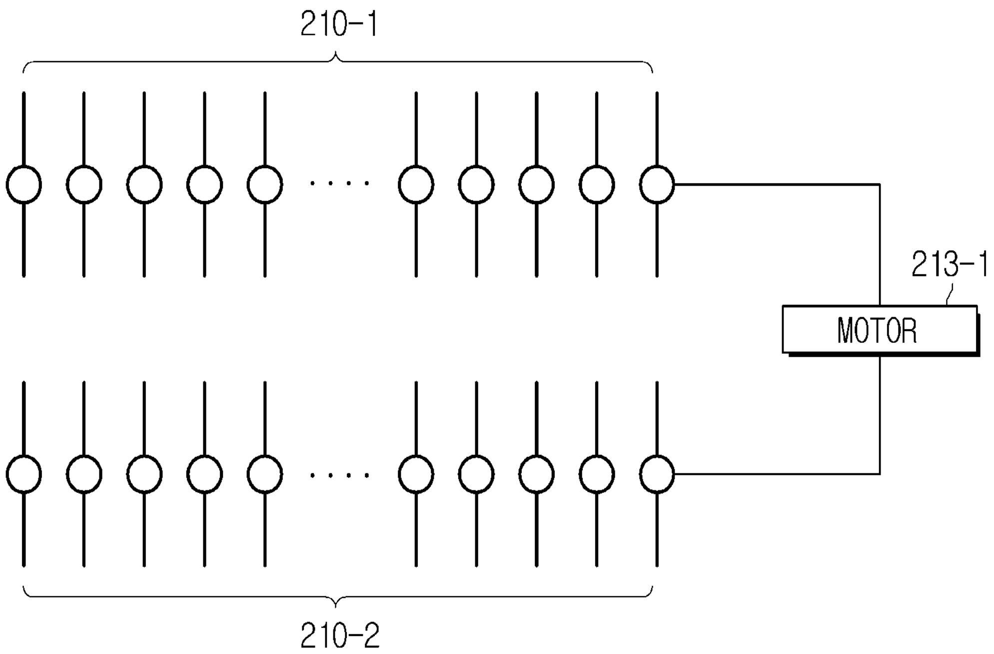


FIG. 13B

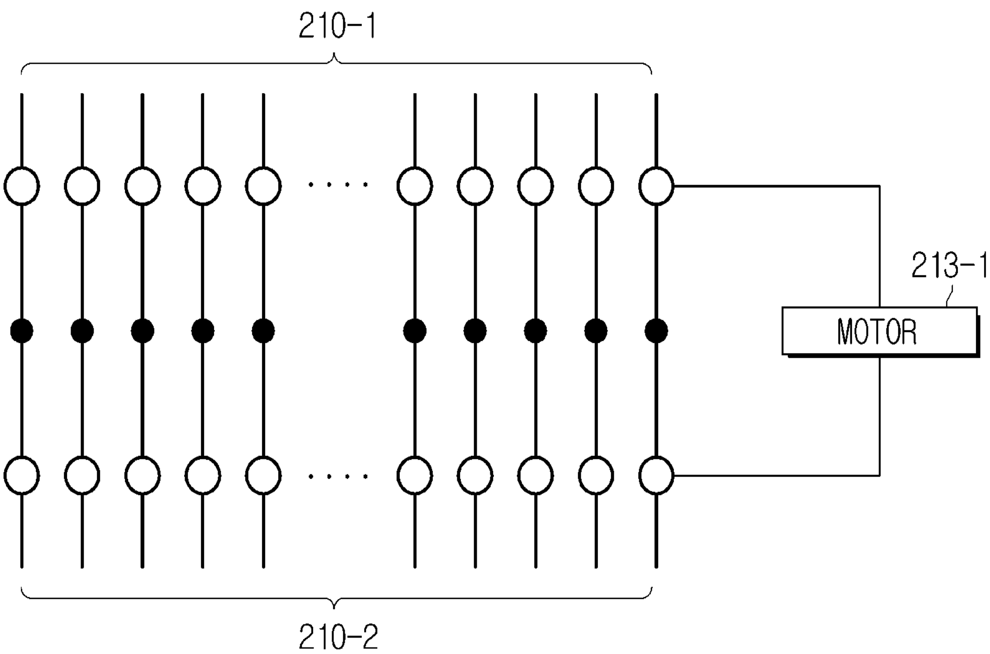


FIG. 14A

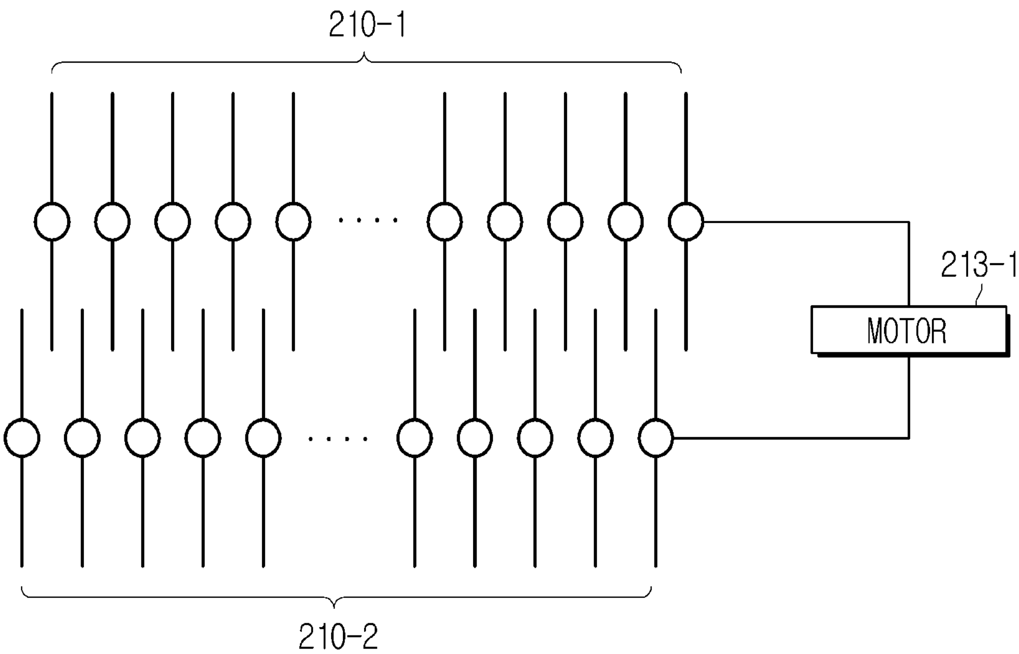


FIG. 14B

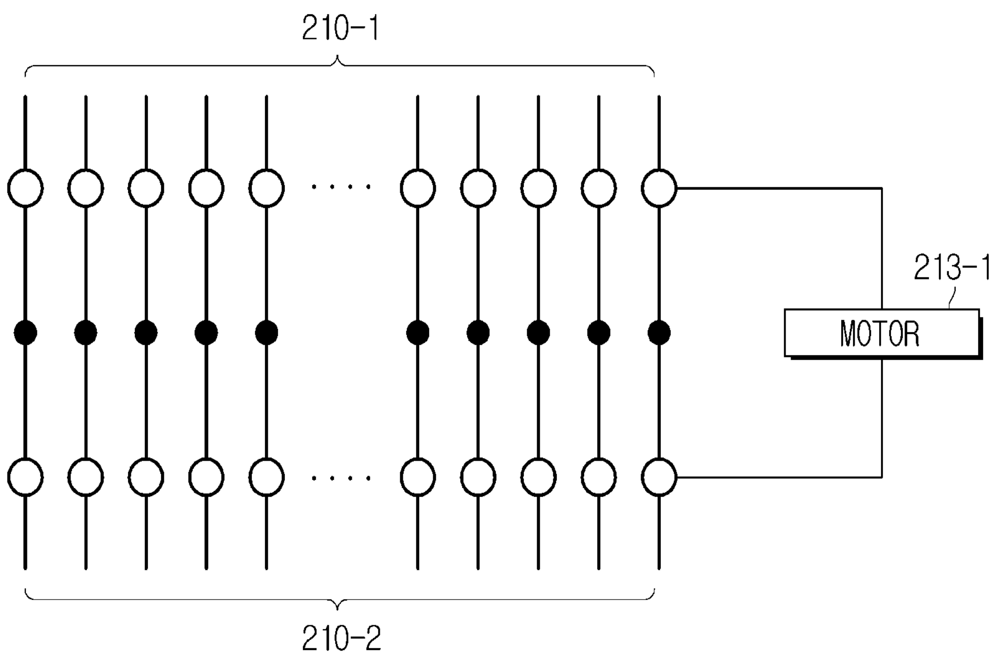
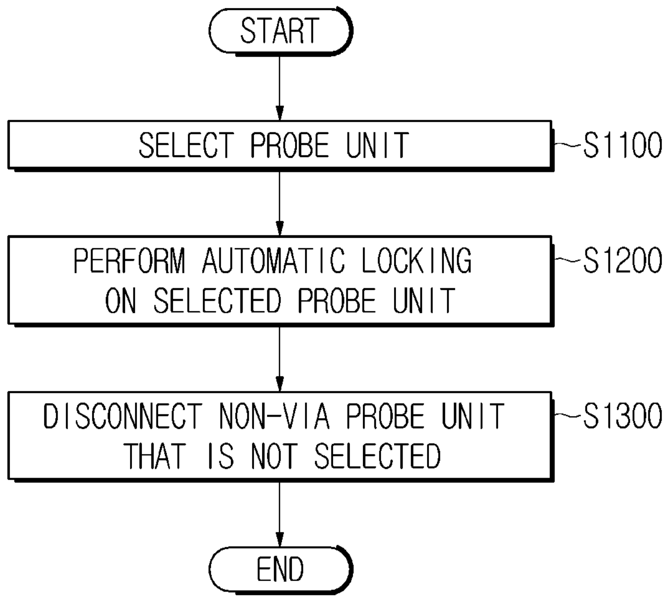


FIG. 15


START
SELECT PROBE UNIT
S1100
PERFORM AUTOMATIC LOCKING ON SELECTED PROBE UNIT
S1200
DISCONNECT NON-VIA PROBE UNIT THAT IS NOT SELECTED
S1300
END

ULTRASOUND IMAGING APPARATUS AND METHOD OF CONTROLLING THE SAME

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority from Korean Patent Application No. 10-2015-0021964, filed on Feb. 13, 2015 in the Korean Intellectual Property Office, the disclosure of which is incorporated herein in its entirety by reference.

BACKGROUND

1. Field

Apparatuses and methods consistent with exemplary embodiments relate to an ultrasound imaging apparatus for generating an ultrasound image, and a method of controlling the same.

2. Description of the Related Art

An ultrasound imaging apparatus provides information regarding a desired region of an object to be tested by transmitting an ultrasound signal from a surface of the object into the object and detecting an ultrasound signal reflected from the object, i.e., an ultrasound echo signal, so as to generate an image of the inner region of the object, such as a tomographic image of a soft tissue or an image of a blood flow.

The ultrasound imaging apparatus has a small size, is cheap, and has non-invasive and non-destructive characteristics, compared to other image diagnosis apparatuses such as an X-ray apparatus, a computerized tomography (CT) scanner, a magnetic resonance image (MRI) apparatus, a nuclear medicine diagnosis apparatus, etc. Thus, the ultrasound imaging apparatus has been used in various medical fields including an obstetric and gynecologic diagnosis, a cardiac diagnosis, an abdominal diagnosis, a urologic diagnosis, etc.

The ultrasound imaging apparatus includes a body configured to accommodate main components of the ultrasound imaging apparatus; and a probe assembly that includes a probe for transmitting an ultrasound signal to an object and receiving an ultrasound echo signal reflected from the object so as to obtain an ultrasound image of the object, and a probe connector connected to the body.

SUMMARY

Therefore, it is an aspect of the present invention to provide an ultrasound imaging apparatus in which an ultrasound signal is transmitted or received through electric connection to a probe connector selected by a user in a body in which a plurality of probe connectors are installed, and non-selected probe assemblies are disconnected, and a method of controlling the same.

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.

In accordance with one aspect of the present invention, an ultrasound imaging apparatus includes a beamformer to transmit or receive an ultrasound signal; a first probe connection unit in which a first probe connector is placed; and a second probe connection unit in which a second probe connector is placed. The second probe connection unit is connected to the beamformer via the first probe connection unit. The first probe connection unit includes a disconnecting unit to disconnect the first probe connection unit and the second probe connection unit from each other.

The ultrasound imaging apparatus may further include a controller to control the first and second probe connection units. The first probe connection unit may include a locking unit to lock the first probe connector into the first probe connection unit and the second probe connection unit may include a locking unit to lock the second probe connector into the second probe connection unit, based on a control signal generated by the controller.

When the first probe connector is locked into the first probe connection unit, the disconnecting unit may disconnect the first probe connection unit and the second probe connection unit from each other.

The first and second probe connectors may be locked into the first and second probe connection units, respectively, through a user's manual manipulation.

The disconnecting unit may include at least one among an analog switch, a field-effect transistor (FET), an integrated circuit, and micro-electromechanical systems (MEMS) to disconnect the first probe connection unit and the second probe connection unit.

The first probe connection unit may further include a socket pin configured to transmit or receive an ultrasound signal when the socket pin comes in contact with an connection pin of the first probe connector. The disconnecting unit may disconnect the first probe connection unit and the second probe connection unit when the connection pin comes in contact with the socket pin.

The socket pin may be formed in a convex shape, and connected to the beamformer and the disconnecting unit. The disconnecting unit may be connected to the socket pin, the beamformer, and the second probe connection unit, and disconnect the first probe connection unit and the second probe connection unit when a physical force is applied to a convex portion of the socket pin.

The socket pin may have a convex portion. One end of the socket pin may be connected to the beamformer. The socket pin may be connected to the disconnecting unit when another end of the socket pin comes in contact with the disconnecting unit. One end of the disconnecting unit may be connected to the second probe connection unit. The disconnecting unit may be connected to the socket pin when the socket pin comes in contact with the disconnecting unit. The other end of the socket pin may be separated from the other end of the disconnecting unit when a physical force is applied to the convex portion of the socket pin

The socket pin may have a central protruding portion, a central end of the socket pin may be connected to the beamformer, and both ends of the socket pin may be connected to the second probe connection unit. A plurality of holes may be formed in the both ends of the socket pin, through which the disconnecting unit passes. One end of the disconnecting unit may pass through one of the plurality of holes as the disconnecting unit is moved to the left or the right, and another end of the disconnecting unit may cause the socket pin to be separated from the second probe connection unit.

The ultrasound imaging apparatus may further include a controller to control the disconnecting unit. The disconnecting unit may be moved to the left or the right according to a control signal generated by the controller or through a user's manipulation.

The first probe connection unit may further include a driving device to cause the connection pin of the first probe connector and the socket pin to contact each other.

The driving device may include a motor or an actuator.

The ultrasound imaging apparatus may further include a controller to control the disconnecting unit. The disconnecting unit may change a direction in which the first probe connection unit and the second probe connection unit are to be disconnected from each other, according to a control signal generated by the controller or through a user's manipulation.

The ultrasound imaging apparatus may further include an input device to receive a command to select a first probe or a second probe from a user. When the first probe is selected, the disconnecting unit may disconnect the first probe connection unit and the second probe connection unit from each other.

The ultrasound imaging apparatus may further include an image processor to generate image data based on an ultrasound signal received from the first or second probe selected by the user; and a display device to display an ultrasound image based on the image data.

The ultrasound imaging apparatus may further include a third probe connection unit in which a third probe connector is placed. The third probe connection unit may be connected to the beamformer via the first and second probe connection units. The second probe connection unit may include a disconnecting unit to disconnect the second probe connection unit and the third probe connection unit from each other.

In accordance with another aspect of the present invention, an ultrasound imaging apparatus includes a beamformer to transmit or receive an ultrasound signal; a first probe connection unit in which a first probe connector is placed; a second probe connection unit in which a second probe connector is placed, the second probe connection unit connected to the beamformer via the first probe connection unit; and a disconnecting unit to disconnect the first probe connection unit and the second probe connection unit.

The ultrasound imaging apparatus may further include a controller to control the first and second probe connection units. The first probe connection unit may include a locking unit to lock the first probe connector into the first probe connection unit and the second probe connection unit may include a locking unit to lock the second probe connector into the second probe connection unit, based on a control signal generated by the controller.

The disconnecting unit may include at least one among an analog switch, a field-effect transistor (FET), an integrated circuit, and micro-electromechanical systems (MEMS) to disconnect the first probe connection unit and the second probe connection unit.

The disconnecting unit may cause a transmission line of the first probe connection unit and a transmission line of the second probe connection unit to be separated from each other or to contact each other.

The first and second probe connectors may be locked into the first and second probe connection units, respectively, through a user's manual manipulation.

In accordance with another aspect of the present invention, there is provided a method of controlling an ultrasound imaging apparatus which includes a first probe connection unit in which a first probe connector is placed and a second probe connection unit in which a second probe connector is placed, the method including receiving a command to select a first probe or a second probe from a user; locking the first probe connector including the first probe when the first probe is selected; and disconnecting the second probe connection unit, which is connected to the beamformer via the first probe connection unit, from the first probe connection unit.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and/or other aspects will become more apparent by describing certain exemplary embodiments with reference to the accompanying drawings, in which:

FIG. **1** is a perspective view of the exterior of an ultrasound imaging apparatus in accordance with one embodiment of the present invention;

FIG. **2** is a conceptual diagram of the exterior of a probe assembly;

FIGS. **3**A to **3**C illustrate shapes of various probe assemblies;

FIG. **4** is a control block diagram of a probe assembly in accordance with one embodiment of the present invention;

FIG. **5** is a control block diagram of a body in accordance with one embodiment of the present invention;

FIG. **6** is a front perspective view of the exteriors of a probe connector and a probe connection unit in accordance with one embodiment of the present invention;

FIG. **7** is a rear perspective view of the exterior of a probe connector in accordance with one embodiment of the present invention;

FIGS. **8**A and **8**B are conceptual diagrams illustrating disconnecting methods in accordance with embodiments of the present invention;

FIGS. **8**C and **8**D are conceptual diagrams illustrating disconnecting methods in accordance with other embodiments of the present invention;

FIGS. **9**A and **9**B illustrate probe connection units that include a disconnecting unit embodied as a mechanical device in accordance with embodiments of the present invention;

FIGS. **10**A and **10**B illustrate probe connection units that include a disconnecting unit embodied as a mechanical device in accordance with other embodiments of the present invention;

FIGS. **11**A to **11**C illustrate probe connection units that include a disconnecting unit embodied as a mechanical device and that are connected to one another in two directions in accordance with embodiments of the present invention;

FIG. **12** is a conceptual diagram illustrating a disconnecting unit installed outside a probe connection unit in accordance with another embodiment of the present invention;

FIGS. **13**A and **13**B illustrate a probe connection unit that includes a first disconnecting unit installed outside a first probe connection unit in accordance with one embodiment of the present invention;

FIGS. **14**A and **14**B illustrate a probe connection unit that includes a first disconnecting unit installed outside a first probe connection unit in accordance with another embodiment of the present invention; and

FIG. **15** is a flowchart of a method of controlling an ultrasound imaging apparatus in accordance with one embodiment of the present invention.

DETAILED DESCRIPTION

Reference will now be made in detail to exemplary embodiments with reference to the accompanying drawings, wherein like reference numerals refer to like elements throughout. In this regard, the exemplary embodiments may have different forms and should not be construed as being limited to the descriptions set forth herein. Accordingly, the exemplary embodiments are merely described below, by referring to the figures, to explain aspects of the present description.

Hereinafter, an ultrasound imaging apparatus and a controlling method thereof in accordance with exemplary embodiments of the present invention will be described in detail with reference to the accompanying drawings.

FIG. **1** is a perspective view of the exterior of an ultrasound imaging apparatus in accordance with one embodiment of the present invention. FIG. **2** is a conceptual diagram of the exterior of a probe assembly. FIGS. **3**A to **3**C illustrate shapes of various probe assemblies. FIG. **4** is a control block diagram of a probe assembly in accordance with one embodiment of the present invention.

Referring to FIGS. **1** and **2**, the ultrasound imaging apparatus **10** includes a probe assembly **100**, a body **200**, a display device **300**, and an input device **400**. The probe assembly **100** illustrated in FIG. **2** may correspond to one of first to fourth probe assemblies **100-1** to **100-4** illustrated in FIG. **1**.

The probe assembly **100** transmits ultrasound waves to an object, receives echo ultrasound waves reflected from the object, and converts the echo ultrasound waves into an electrical signal (hereinafter referred to as an "ultrasound signal").

The ultrasound imaging apparatus **10** may include a plurality of probe assemblies **100**. The plurality of probe assemblies **100** included in the ultrasound imaging apparatus **10** will be hereinafter described as first to fourth probe assemblies **100-1**, **100-2**, **100-3**, and **100-4**.

The body **200** forms an ultrasound image based on an ultrasound signal.

The body **200** may be a workstation connected to the first to fourth probe assemblies **100-1** to **100-4** and including the display device **300** and the input device **400**.

The structure and operations of the probe assembly **100**, e.g., one of the first to fourth probe assemblies **100-1** to **100-4**, will be described below.

The probe assembly **100** includes a probe **110** that is directly in contact with an object, a probe connector **130** configured to transmit a signal to or receive a signal from the body **200**, and a cable **120** configured to connect the probe **110** and the probe connector **130** with each other.

The probe **110** transmits ultrasound waves to or receives ultrasound waves from an object so as to obtain an ultrasound image of the inside of the object.

In detail, the probe **110** includes a transducer module **111** that converts an electric signal into vibration energy or vice versa. The transducer module **111** may transmit ultrasound waves to an object using a vibrator such as a piezoelectrics (not shown), and receive echo ultrasound waves reflected from the object.

When the number of such vibrators is, for example, 64 to 256, connecting members, the number of which is equal to the number of the vibrators are needed to connect the probe assembly **100** and the body **200**.

Here, the object may be a living body of a human or an animal or a tissue in the living body, such as a blood vessel, a bone, a muscle, etc. but is not limited thereto. The type of the object is not limited provided that an image of an inner structure thereof can be obtained using the ultrasound imaging apparatus **10**.

Referring to FIGS. **3**A to **3**C, according to the array of the transducer module **111**, the probe **110** may be prepared as a linear probe having a linear surface as illustrated in FIG. **3**A, prepared as a convex probe having a convex surface as illustrated in FIG. **3**B, or prepared as a matrix probe as illustrated in FIG. **3**C, but is not limited thereto. The probe **110** may be prepared as a different type probe which is well known in the art (such as a phased array probe, etc.) other than those illustrated in FIGS. **3**A to **3**C.

One end of the cable **120** may be connected to the probe **110**, and another end of the cable **120** may be connected to the probe connector **130**.

In accordance with an embodiment of the present invention, the probe connector **130** may be placed on the body **200** and automatically locked onto the body **200** through a locking mechanism.

The term 'locking' should be understood as including performing an access through a mechanical coupling between the probe connector **130** and the body **200** or controlling an access in a state in which the probe connector **130** and the body **200** have been mechanically coupled to each other. Here, 'locking' has a different meaning from mechanically placing the probe connector **130** on the body **200**.

Locking should be understood as including locking performed to cause a probe signal transceiver **131** of the probe connector **130** to access to a body signal transceiver **212** of a probe connection unit **210** (see FIG. **5**). Here, the "access" includes a contact access and a non-contact access.

Locking may be performed through a user's manual manipulation or automatically. For example, when the probe connection unit **210** includes an additional locking unit **211** (see FIG. **5**), locking may be performed by driving the locking unit **211**, as will be described in detail below.

The probe connector **130** may be embodied as an external connector to be coupled with the probe connection unit **210** of the body **200** which is embodied as an internal connector.

Referring to FIG. **4**, the probe connector **130** in accordance with an embodiment of the present invention includes the probe signal transceiver **131** and a printed circuit board (PCB) **132**.

When locking is performed, the probe signal transceiver **131** receives a control signal from the body signal transceiver **212** of the body **200** or transmits an ultrasound signal generated by the probe **110** to the body signal transceiver **212** of the body **200**.

The probe signal transceiver **131** of the probe connector **130** may be embodied as a terminal with a conductive connection pin **131***a* to transmit or receive a control signal or an ultrasound signal in a contact manner, or may be embodied as a wireless communication module to transmit or receive a control signal or an ultrasound signal in a non-contact manner. Here, it is assumed that the probe signal transceiver **131** is such a terminal.

The terminal **131** may include the connection pin **131***a* to be inserted into a socket of the body **200**. When locking is performed, the connection pin **131***a* may transmit an ultrasound signal to a socket pin **212***a* of the body **200** (see FIG. **5**) or receive a control signal from the socket pin **212***a* while being in contact with the socket pin **212***a*.

When locking is performed, the PCB **132** receives a control signal from the body **200** or drives the probe assembly **100** based on a received control signal.

Also, when locking is performed, the PCB **132** may transmit an ultrasound signal generated by the probe **110** to the terminal **131**.

The structure and operations of the body **200** will be described in detail with reference to FIG. **5** below.

FIG. **5** is a control block diagram of a body **200** in accordance with an embodiment of the present invention.

Referring to FIG. **5**, the body **200** includes a plurality of probe connection units, e.g., first to fourth probe connection units **210-1** to **210-4**, a controller **220**, a beamformer **230**, a signal processor **240**, an image processor **250**, a display device **300**, and an input device **400**.

Although FIG. **5** illustrates that the four probe connection units **210-1** to **210-4** are provided, for example, two, three, or five probe connection units may be provided on the body **200** according to the number of probe assemblies **100**. That is, the number of the plurality of probe connection units is not limited to four as illustrated in FIG. **5**.

Hereinafter, the probe connector **130** of the first probe assembly **100-1** placed in the first probe connection unit **210-1** will be referred to as the first probe connector **130-1**, the probe connector **130** of the second probe assembly **100-2** placed in the second probe connection unit **210-2** will be referred to as the second probe connector **130-2**, the probe connector **130** of the third probe assembly **100-3** placed in the third probe connection unit **210-3** will be referred to as the third probe connector **130-3**, and the probe connector **130** of the fourth probe assembly **100-4** placed in the fourth probe connection unit **210-4** will be referred to as the fourth probe connector **130-4**.

The first probe connection unit **210-1** may be automatically locked with the first probe connector **130-1** placed therein according to a control signal received from the controller **220**.

The first probe connection unit **210-1** may be an internal connector.

The first probe connection unit **210-1** includes a first locking unit **211-1**, a body signal transceiver **212-1**, and a first disconnecting unit **213-1**.

The first locking unit **211-1** locks the first probe connector **130-1** into the first probe connection unit **210-1** or unlocks the first probe connector **130-1** from the first probe connection unit **210-1** according to a control signal received from the controller **220**.

In detail, when a user selects the first probe connection unit **210-1**, the first locking unit **211-1** may cause a socket pin **212*a*-1** included in the body signal transceiver **212-1** to be in contact with the connection pin **131*a*** of the first probe connector **130-1** so as to exchange an ultrasound signal and a control signal between the first probe assembly **100-1** and the body **200**.

To this end, the first locking unit **211-1** may mechanically couple the first probe connector **130-1** placed in the first probe connection unit **210-1** and the first probe connection unit **210-1** to each other.

For example, the first locking unit **211-1** may include a rotary motor to rotationally insert the first probe connector **130-1** embodied as an external screw or bolt into a coupling groove of the first probe connection unit **210-1** embodied as an internal screw or nut.

Otherwise, the first locking unit **211-1** may be embodied as an electromagnet to be coupled with an electromagnet attached to the first probe connector **130-1** according to a control signal received from the controller **220**.

In addition, the first locking unit **211-1** may include a linear actuator, a motor, etc. to mechanically couple the first probe connector **130-1** placed in the probe connection unit **210-1** to the probe connection unit **210-1**, and may mechanically couple the first probe connector **130-1** and the first probe connection unit **210-1** to each other.

The first locking unit **211-1** may be omitted. In this case, a user may perform locking by manually coupling the first probe connector **130-1** to the first probe connection unit **210-1**.

The body signal transceiver **212-1** may be embodied as a socket with the socket pin **212*a*-1** having a conductive property to transmit or receive a control signal or an ultrasound signal in a contact manner, or may be embodied as a wireless communication module to exchange a control signal or an ultrasound signal with the probe signal transceiver **131** of the first probe connector **130-1** in a non-contact manner. Here, it is assumed that the body signal transceiver **212-1** is embodied as such a socket.

The socket **212-1** may include the socket pin **212*a*-1** into which the connection pin **131*a*** of the first probe connector **130-1** is inserted to be in contact with the connection pin **131*a***. The socket pin **212*a*-1** comes in contact with the connection pin **131*a*** of the first probe connector **130-1** to transmit or receive an ultrasound signal of the first probe assembly **100-1** when the first probe connector **130-1** and the first probe connection unit **210-1** are locked with each other.

In accordance with an embodiment of the present invention, the socket pins **212*a*-1** to **212*a*-4** included in the respective probe connection units **210-1** to **210-4** are electrically connected to one another. For example, the socket pin **212*a*-1** of the first probe connection unit **210-1** among the probe connection units **210-1** to **210-4** is directly connected to the beamformer **230**.

For example, when the socket pin **212*a*-1** of the first probe connection unit **210-1** is directly connected to the beamformer **230**, the socket pin **212*a*-2** of the second probe connection unit **210-2** is connected between the socket pin **212*a*-1** of the first probe connection unit **210-1** and the socket pin **212*a*-3** of the third probe connection unit **210-3**, the socket pin **212*a*-3** of the third probe connection unit **210-3** is connected between the socket pin **212*a*-2** of the second probe connection unit **210-2** and the socket pin **212*a*-4** of the fourth probe connection unit **210-4**, and the socket pin **212*a*-4** of the fourth probe connection unit **210-4** may be directly connected to the socket pin **212*a*-3** of the third probe connection unit **210-3**.

Here, that A is "directly connected to" B means that A and B are electrically connected to each other while any probe connection unit **210** is not present therebetween.

Also, that A and B are "electrically connected to" each other means that A and B are connected via a circuit, a bus, etc. to exchange an electric signal with each other.

That is, an ultrasound signal generated by the first probe assembly **100-1** may be transmitted to the beamformer **230** via the socket pin **212*a*-1** of the first probe connection unit **210-1**, and an ultrasound signal generated by the second probe assembly **100-2** may be transmitted to the beamformer **230** via the socket pins **212*a*-2** and **212*a*-1** of the second probe connection unit **210-2** and the first probe connection unit **210-1**.

Also, an ultrasound signal generated by the third probe assembly **100-3** may be transmitted to the beamformer **230** via the socket pins **212*a*-3**, **212*a*-2**, and **212*a*-1** of the third, second, and first probe connection units **210-3**, **210-2**, and **210-1**. An ultrasound signal generated by the fourth probe assembly **100-4** may be transmitted to the beamformer **230** via the socket pins **212*a*-4**, **212*a*-3**, **212*a*-2**, and **212*a*-1** of the fourth, third, second, and first probe connection units **210-4**, **210-3**, **210-2**, and **210-1**.

Although FIG. **5** illustrates that the four probe connection units **210-1** to **210-4** are connected in one direction, they may be connected in two directions, as will be described with reference to FIG. **10** below.

The first disconnecting unit **213-1** disconnects the first probe connection unit **210-1** and the second probe connection unit **210-2** from each other.

Hereinafter, that "an A probe connection unit and a B probe connection unit are connected to or disconnected from each other" means that "a socket of the A probe connection unit and a socket of the B probe connection unit are connected to or disconnected from each other".

The first disconnecting unit **213-1** may be embodied as, for example, an analog switch, a field-effect transistor (FET), an integrated circuit, micro-electromechanical systems (MEMS), etc. to disconnect the first probe connection unit **210-1** and the second probe connection unit **210-2** from each other.

In accordance with an embodiment of the present invention, the first disconnecting unit **213-1** may be embodied as a mechanical device to disconnect the first probe connection unit **210-1** and the second probe connection unit **210-2** from each other, as will be described with reference to FIGS. **8**A to **10** below.

The second probe connection unit **210-2** may be also automatically locked with the second probe connector **130-2** placed therein according to a control signal received from the controller **220**.

Similarly, the second probe connection unit **210-2** includes a second locking unit **211-2**, a body signal transceiver **212-2**, and a second disconnecting unit **213-2**. The second locking unit **211-2** and the socket **212-2** are as described above with respect to the first probe connection unit **210-1** and are thus not described again here.

The second disconnecting unit **213-2** disconnects the second probe connection unit **210-2** and the third probe connection unit **210-3** from each other.

The second disconnecting unit **213-2** may be also embodied as an analog switch, a FET, an integrated circuit, MEMS, etc. or may be embodied as a mechanical device.

The third probe connection unit **210-3** may be automatically locked with the third probe connector **130-3** placed thereon according to a control signal received from the controller **220**.

Similarly, the third probe connection unit **210-3** includes a third locking unit **211-3**, a body signal transceiver **212-3**, and a third disconnecting unit **213-3**. The third locking unit **211-3** and the socket **212-3** are as described above with respect to the first probe connection unit **210-1** and are thus not described again here.

The third disconnecting unit **213-3** disconnects the third probe connection unit **210-3** and the fourth probe connection unit **210-4** from each other.

The fourth probe connection unit **210-4** may be automatically locked with the fourth probe assembly **100-4** placed thereon according to a control signal received from the controller **220**.

Similarly, the fourth probe connection unit **210-4** includes a fourth locking unit **211-4**, a body signal transceiver **212-4**, and a fourth disconnecting unit **210-4**. The fourth locking unit **211-4** and the body signal transceiver **212-4** are as described above with respect to the first probe connection unit **210-1** and are thus not described again here.

However, when a fifth probe connection unit (not shown) is not present, the fourth disconnecting unit **213-4** need not perform disconnection and receive a control signal from the controller **220**. Thus, the fourth disconnecting unit **213-4** may be omitted.

The controller **220** controls overall operations of elements of the ultrasound imaging apparatus **10**, e.g., the first to fourth probe connection units **210-1** to **210-4**, the beamformer **230**, the signal processor **240**, the image processor **250**, the display device **300**, the probe assembly **100**, etc.

In detail, when a command to select a probe assembly, e.g., the first probe assembly **100-1**, among the first to fourth probe assemblies **100-1** to **100-4** is received from a user via the input device **400**, the controller **220** controls the first locking unit **211-1** to automatically lock the first probe assembly **100-1** with the first probe connector **130-1**.

In this case, the controller **220** controls the second to fourth probe connection units **210-2** to **210-4** (hereinafter referred to as non-via probe connection units) among the probe connection units **210-1** to **210-4** on the body **200** to be disconnected from the first probe connection unit **210-1**.

The non-via probe connection units mean probe connection units forming a stub.

To this end, the controller **220** transmits a control signal to the first disconnecting unit **213-1** included in the selected first probe connection unit **210-1** so as to control the first disconnecting unit **213-1** to disconnect the first probe connection unit **210-1** and the second probe connection unit **210-2** from each other. As a result, the first probe connection unit **210-1** is disconnected from not only the second probe connection unit **210-2** but also the third and fourth probe connection units **210-3** and **210-4**.

When a command to select the second probe assembly **100-2** is received via the input device **400**, the controller **220** controls the second locking unit **211-2** to automatically lock the second probe assembly **100-2**.

In this case, the controller **220** transmits a control signal to the second locking unit **211-2** so as to control the second locking unit **211-2** to lock the second probe connector **130-2** into the second probe connection unit **210-2**.

Also, the controller **220** controls non-via probe connection units (i.e., the third and fourth probe connection units **210-3** and **210-4**) to be disconnected from the second probe connection unit **210-2** among the probe connection units **210-1** to **210-4** on the body **200** except for a via probe connection unit (i.e., the first probe connection unit **210-1**) connected between the beamformer **230** and the second probe connection unit **210-2**.

To this end, the controller **220** transmits a control signal to the second disconnecting unit **213-2** included in the second probe connection unit **210-2** so as to control the second disconnecting unit **213-2** to disconnect the second probe connection unit **210-2** and the third probe connection unit **210-3** from each other. As a result, the second probe connection unit **210-2** is disconnected from not only the third probe connection unit **210-3** but also the fourth probe connection unit **210-4**.

When a command to select the third probe assembly **100-3** is received from the input device **400**, the controller **220** controls the third locking unit **211-3** to automatically lock the third probe assembly **100-3**.

In this case, the controller **220** transmits a control signal to the third locking unit **211-3** so as to control the third locking unit **211-3** to lock the third probe connector **130-3** into the third probe connection unit **210-3**.

Also, the controller **220** controls a non-via probe connection unit (i.e., the fourth probe connection unit **210-4**) to be disconnected from the first probe connection unit **210-1** and the third probe connection unit **210-3** among the probe connection units **210-1** to **210-4** on the body **200** except for via probe connection units (i.e., the first and second probe connection units **210-1** and **210-2**) that connect the controller **220** and the third probe connection unit **210-3**.

To this end, the controller **220** transmits a control signal to the third disconnecting unit **213-3** included in the selected third probe connection unit **210-3** so as to control the third disconnecting unit **213-3** to disconnect the third probe connection unit **210-3** and the fourth probe connection unit **210-4** from each other.

Thus, the third probe connection unit **210-3** is disconnected from the fourth probe connection unit **210-4**.

Also, when the fourth probe assembly **100-4** is selected by a user, the controller **220** controls the fourth locking unit **211-4** to perform automatic locking.

In this case, the controller **220** transmits a control signal to the fourth locking unit **211-4** so as to control the fourth locking unit **211-4** to lock the fourth probe connector **130-4** into the fourth probe connection unit **210-4**.

When the fourth probe assembly **100-4** is selected, a non-via probe assembly is not present and thus a mechanism for performing disconnection is omitted.

Next, the controller **220** may transmit a control signal to the PCB **132** connected to the access in **131***a* of at least one locked probe connector (at least one among the probe connectors **130-1** to **130-4**) to drive the probe assembly **100** corresponding to the at least one locked probe connector, receive an ultrasound signal from the probe assembly **100**, or process or display various information obtained by the probe assembly **100**.

Although not shown, the controller **220** may include a processor, a read-only memory (ROM) that stores a control program for controlling the ultrasound imaging apparatus **10**, and a random access memory (RAM) that stores a signal or ultrasound image data received from the probe assembly **100** or the input device **400** of the ultrasound imaging apparatus **10** or that is used as a storage region corresponding to various operations performed by the ultrasound imaging apparatus **10**.

Otherwise, a graphic processing board including a processor, a RAM, or a ROM may be included in an additional PCB electrically connected to the controller **220**. The processor, the RAM, and the ROM may be connected via an internal bus.

Also, the controller **220** may be used as a term indicating a component that includes a processor, a RAM, and a ROM. Also, the controller **220** may be used as a term indicating a component that includes a processor, a RAM, a ROM, and a processing board.

The beamformer **230** is a device that delays transmitted ultrasound waves or received echo ultrasound waves for an appropriate time so that ultrasound waves generated by the probe **110** may be focused on a target point on an object at the same desired point of time or delayed time of echo ultrasound waves reflected from the target point on the object may be modified at the probe **110**.

The beamformer **230** delays an ultrasound signal to be transmitted or received by a probe (at least one among the probes **110-1** to **110-4**) included in at least one locked probe assembly (at least one among the probe assemblies **100-1** to **100-4**).

The beamformer **230** may be included in the body **200** corresponding to a back end of the ultrasound imaging apparatus **10** as illustrated in FIG. **5** or included in the probe assembly **100** corresponding to a front end of the ultrasound imaging apparatus **10**. However, exemplary embodiments of the beamformer **230** are not limited thereto. Although all or some of the elements of the beamformer **230** may be included in the front end or back end of the ultrasound imaging apparatus **10**, it is assumed that the beamformer **230** is included in the body **200** for convenience of explanation.

In accordance with an embodiment of the present invention, the beamformer **230** is directly connected to the socket pin **212***a***-1** of the first probe connection unit **210-1**. The beamformer **230** may exchange an ultrasound signal with the first probe assembly **100-1** via the socket pin **212***a***-1** of the first probe connection unit **210-1**, exchange an ultrasound signal with the second probe assembly **100-2** via the socket pins **212***a***-1** and **212***a***-2** of the first probe connection unit **210-1** and the second probe connection unit **210-2**, exchange an ultrasound signal with the third probe assembly **100-3** via the socket pins **212***a***-1** to **212***a***-3** of the first to third probe connection units **210-1** to **210-3**, and exchange an ultrasound signal with the fourth probe assembly **100-4** via the socket pins **212***a***-1** to **212***a***-4** of the first to fourth probe connection units **210-1** to **210-4**.

The signal processor **240** converts a signal received from the beamformer **230** into a format appropriate for image processing. For example, the signal processor **240** may perform filtering to remove a noise signal other than a desired frequency band.

The signal processor **240** may be embodied as a digital signal processor (DSP), and generate ultrasound image data by performing envelope detection to detect the intensity of echo ultrasound waves, based on a signal received from the beamformer **230**.

The image processor **250** generates an image based on the ultrasound image data generated by the signal processor **240** such that a user, e.g., a doctor or a patient, may visually check an object, e.g., the inside of a human body.

The image processor **250** transmits an ultrasound image generated from the ultrasound image data to the display device **300**.

In one embodiment of the present invention, the image processor **250** may further perform additional image processing on the ultrasound image. For example, the image processor **250** may further perform image post-processing, e.g., may correct or readjust the contrast, brightness, or sharpness of the ultrasound image.

The additional image processing may be performed by the image processor **250** according to predetermined settings or an instruction or command received from a user via the input device **400**.

The display device **300** may display the ultrasound image generated by the image processor **250** so that a user may visually check the inner structure of the object, a tissue included in the object, or the like.

The input device **400** receives an instruction or command to control the ultrasound imaging apparatus **10** from a user. The input device **400** may include a user interface, for example, a keyboard, a mouse, a trackball, a touch screen, a paddle, or the like.

The structures of and the relationship between a probe connector **130**, i.e., one of the probe connectors **130-1** to **130-4**, and a probe connection unit **210**, i.e., one of the probe connection units **210-1** to **210-4**, in accordance with an embodiment of the present invention will be described in more detail with reference to FIGS. **6** to **10** below.

However, the structures and shapes of the probe connector **130** and the probe connection unit **210** are not limited to those illustrated in FIGS. **6** and **7** and may be embodied variously.

FIG. **6** is a front perspective view of the exteriors of a probe connector **130** and a probe connection unit **210** in accordance with one embodiment of the present invention. FIG. **7** is a rear perspective view of the exterior of the probe connector **130** in accordance with one embodiment of the present invention.

Referring to FIGS. **6** and **7**, the probe connector **130** may include a locking shaft **133** protruding from the inside of the probe connector **130** to the outside of the probe connector **130** so as to mechanically place the probe connector **130** in the probe connection unit **210** of the body **200**, and a locking member **134** for locking the probe connector **130** and the probe connection unit **210** with each other.

In the probe connection unit **210**, a coupling groove **214** in which the locking shaft **133** is placed may be formed. In this case, the locking unit **211** may be embodied as a motor so as to rotate the locking shaft **133** placed in the coupling groove **214** such that the probe connection unit **210** and the probe connector **130** are coupled to each other.

In detail, a user may place the probe connector **130** in the probe connection unit **210** by inserting the locking shaft **133** into the coupling groove **214** of the probe connection unit **210**. In this case, the terminal **131** of the probe connector **130** may be inserted into the socket **212** of the body **200**.

However, since the connection pin **131***a* provided on the terminal **131** of the probe connector **130** and the socket pin **212***a* provided on the socket **212** of the body **200** are not complete in contact with each other through mechanical "placement", the probe connector **130** is not electrically connected to the probe connection unit **210**. Thus, "locking" should be performed to electrically connect the probe connector **130** and the probe connection unit **210**.

To this end, the locking member **134** may be provided on the locking shaft **133** and the locking shaft **133** may be rotated by the motor included in the locking unit **211** to place the locking member **134** into a locking groove (not shown) of the probe connection unit **210**. Thus, the probe connector **130** and the probe connection unit **210** may be locked with each other.

That is, as the probe connector **130** is placed into the probe connection unit **210**, the terminal **131** is inserted into the socket **212** and the probe connector **130** and the probe connection unit **210** are locked with each other. Thus, the connection pin **131***a* comes in contact with the socket pin **212***a* of the socket **212**, so that a control signal of the body **200** may be input to a plurality of connection pins **131***a* or an ultrasound signal may be transmitted to the body **200**.

Although it has been described that the locking unit **211** includes the motor for rotating the locking shaft **133** of the probe connector **130** placed in the coupling groove **214** so as to perform locking, embodiments of the present invention are not limited thereto and locking may be performed by various means capable of automatically coupling the probe connector **130** to the probe connection unit **210** according to a control signal.

For example, locking may be performed by forming the probe connector **130** in the form of an external screw or bolt to be inserted into the probe connection unit **210** and to be coupled to the probe connection unit **210** embodied as an internal screw or nut, as a rotary motor rotates.

The probe connector **130** may further include an electromagnet to be locked with the probe connection unit **210** that also includes an electromagnet.

A method of disconnecting a probe connection unit **210** which is a non-via probe connection unit and a probe connection unit **210** of the probe assembly **100** selected by a user through a disconnecting unit **213**, e.g., one of the first to third disconnecting units **213-1** to **213-3**, will be described with reference to FIGS. **8**A to **10** below.

FIGS. **8**A and **8**B are conceptual diagrams illustrating disconnecting methods in accordance with embodiments of the present invention.

Referring to FIG. **8**A, for example, when a user selects the third probe assembly **100-3**, the third disconnecting unit **213-3** included in the third probe connection unit **210-3** in accordance with an embodiment of the present invention may disconnect the third probe connection unit **210-3** and the fourth probe connection unit **210-4** from each other.

Thus, a stub caused by a transmission line of the fourth probe connection unit **210-4** may be removed.

Referring to FIG. **8**B, when a user selects, for example, the first probe assembly **100-1**, the first disconnecting unit **213-1** included in the first probe connection unit **210-1** in accordance with an embodiment of the present invention may also disconnect the first probe connection unit **210-1** and the second probe connection unit **210-2** from each other.

The second disconnecting unit **213-2** included in the second probe connection unit **210-2** may also disconnect the second probe connection unit **210-2** and the third probe connection unit **210-3** from each other.

Thus, a stub caused by transmission lines of the second to fourth probe connection units **210-2** to **210-4** may be removed.

A disconnecting method in accordance with an embodiment of the present invention is not, however, limited to those of FIGS. **8**A and **8**B. FIGS. **8**C and **8**D are conceptual diagrams illustrating disconnecting methods in accordance with other embodiments of the present invention.

Referring to FIG. **8**C, the first disconnecting unit **213-1** that disconnects the first probe connection unit **210-1** and the second probe connection unit **210-2** may be installed outside the first probe connection unit **210-1**, the second disconnecting unit **213-2** that disconnects the second probe connection unit **210-2** and the third probe connection unit **210-3** may be installed outside the second probe connection unit **210-2**, and the third disconnecting unit **213-3** that disconnects the third probe connection unit **210-3** and the fourth probe connection unit **210-4** may be installed outside the third probe connection unit **210-3**.

For example, when a user selects the second probe assembly **100-2**, the second disconnecting unit **213-2** installed outside the second probe connection unit **210-2** in accordance with an embodiment of the present invention may disconnect the second probe connection unit **210-2** and the third probe connection unit **210-3** from each other.

Thus, a stub caused by transmission lines of the third and fourth probe connection units **210-3** and **210-4** may be removed.

Referring to FIG. **8**D, the first disconnecting unit **213-1** that disconnects the first probe connection unit **210-1** and the second probe connection unit **210-2** may be installed outside the first probe connection unit **210-1**, the second disconnecting unit **213-2** that disconnects the second probe connection unit **210-2** and the third probe connection unit **210-3** may be installed outside the second probe connection unit **210-2**, and the third disconnecting unit **213-3** that disconnects the third probe connection unit **210-3** and the fourth probe connection unit **210-4** may be installed outside the third probe connection unit **210-3**. In this case, the first disconnecting unit **213-1** may disconnect not only the first probe connection unit **210-1** and the second probe connection unit **210-2** but also the beamformer **230** and the second probe connection unit **210-2**, the second disconnecting unit **213-2** may disconnect not only the second probe connection unit **210-2** and the third probe connection unit **210-3** but also the first disconnecting unit **213-1** and the third probe connection unit **210-3**, and the third disconnecting unit **213-3** may disconnect not only the third probe connection unit **210-3** and the fourth probe connection unit **210-4** but also the second disconnecting unit **213-2** and the fourth probe connection unit **210-4**.

For example, when a user selects the second probe assembly **100-2**, the second disconnecting unit **213-2** installed outside the second probe connection unit **210-2** in accordance with an embodiment of the present invention may disconnect the second probe connection unit **210-2** and the third probe connection unit **210-3** and disconnect the first disconnecting unit **213-1** and the third probe connection unit **210-3**.

Thus, a stub caused by transmission lines of the third and fourth probe connection units **210-3** and **210-4** may be removed.

FIGS. **9**A and **9**B illustrate probe connection units that include a disconnecting unit such as that shown in FIG. **8**A or **8**B which is embodied as a mechanical device in accordance with embodiments of the present invention. The embodiments of the FIGS. **9**A and **9**B will be described with respect to the first probe connection unit **210-1** and the first probe connector **130-1** below

Referring to FIG. **9**A, a socket pin **212***a***-1** of a first probe connection unit **210-1** in accordance with an embodiment of the present invention may have a convex shape, and may be connected to a beamformer **230** and a first disconnecting unit **213-1** having a conductive property.

The first disconnecting unit **213-1** may be connected to the socket pin **212***a***-1**, the beamformer **230**, and the second probe connection unit **210-2**, and may be disconnected from the second probe connection unit **210-2** according to the principle of a lever when a physical force is applied onto a top convex surface of the socket pin **212***a***-1** due to insertion of the connection pin **131***a* of the first probe connector **130-1** into the socket pin **212***a***-1**.

Referring to FIG. **9**B, when the connection pin **131***a* of the first probe connector **130-1** is inserted to be in contact with the socket pin **212***a***-1** due to locking of the first probe connector **130-1**, a physical force is applied to the top convex surface of the socket pin **212***a***-1** and thus the first disconnecting unit **213-1** is disconnected from the second probe connection unit **210-2** according to the principle of the lever.

In accordance with another embodiment of the present invention, a physical force may be applied not only when the connection pin **131***a* is inserted due to locking but also when an additional driving device (e.g., a linear actuator, a motor, etc.) is operated to cause the socket pin **212***a***-1** and the first disconnecting unit **213-1** to protrude toward the connection pin **131***a*. In this case, the additional driving device may apply a physical force according to a control signal received from the controller **220**.

Although FIGS. **9**A and **9**B illustrate three socket pins **212***a***-1** and three disconnecting units **213-1**, the first probe connection unit **210-1** may include one or more socket pins **212***a***-1** and one or more disconnecting units **213-1**. Thus, when the first probe connector **130-1** is locked, one or more connection pins **131***a* of the first probe connector **130-1** may be inserted to be in contact with one or more socket pins **212***a***-1**.

Although not shown, the socket pin **212***a***-2** of the second probe connection unit **210-2** may also have a convex shape and be connected to the first probe connection unit **210-1** and the second disconnecting unit **213-2**.

However, the second disconnecting unit **213-2** of the second probe connection unit **210-2** may be connected to the socket pin **212***a***-2** and the first probe connection unit **210-1**, and may be connected to or disconnected from the third probe connection unit **210-3** according to a physical force applied to the socket pin **212***a***-2**.

The socket pin **212***a***-3** of the third probe connection unit **210-3** may also have a convex shape, and be connected to the second probe connection unit **210-2** and the third disconnecting unit **213-3**.

However, the third disconnecting unit **213-3** of the third probe connection unit **210-3** may be connected to the socket pin **212***a***-3** and the third probe connection unit **210-3**, and may be connected to or disconnected from the fourth probe connection unit **210-4** according to a physical force applied to the socket pin **212***a***-3**.

FIGS. **10**A and **10**B illustrate probe connection units that include a disconnecting unit such as that shown in FIG. **8**A or **8**B which is embodied as a mechanical device in accordance with other embodiments of the present invention. Similarly, the embodiments of the FIGS. **10**A and **10**B will be described with respect to the first probe connection unit **210-1** and the first probe connector **130-1** below.

Referring to FIG. **10**A, a socket pin **212***a***-1** of a first probe connection unit **210-1** in accordance with another embodiment of the present invention has a convex portion. One end of the socket pin **212***a***-1** is connected to the beamformer **230**, and the socket pin **212***a***-1** may be connected to the first disconnecting unit **213-1** when another end of the socket pin **212***a***-1** comes in contact with a bottom surface of the first disconnecting unit **213-1**.

One end of the first disconnecting unit **213-1** is connected to the second probe connection unit **210-2**, and the first disconnecting unit **213-1** may be connected to the socket pin **212***a***-1** when the socket pin **212***a***-1** comes in contact with another bottom end of the first disconnecting unit **213-1**.

Referring to FIG. **10**B, when the first probe connector **130-1** is locked to insert an connection pin **131***a* of the first probe connector **130-1** to be in contact with the socket pin **212***a***-1**, a physical force is applied to the socket pin **212***a***-1** to cause the socket pin **212***a***-1** to be separated from the first disconnecting unit **213-1**, thereby disconnecting the first disconnecting unit **213-1** from the second probe connection unit **210-2**. In this case, in accordance with another embodiment of the present invention, a physical force may be applied not only when the connection pin **131***a* is inserted due to the locking of the first probe connector **130-1** but also when an additional driving device (e.g., a linear actuator, a motor, etc.) is operated to cause the socket pin **212***a***-2** and the first disconnecting unit **213-1** to protrude toward the connection pin **131***a*.

Although FIGS. **10**A and **10**B illustrate three socket pins **212***a***-1** and three disconnecting units **213-1**, the first probe connection unit **210-1** may include one or more socket pins **212***a***-1** and one or more disconnecting units **213-1**. Thus, when the first probe connector **130-1** is locked, one or more connection pins **131***a* of the first probe connector **130-1** may be inserted to be in contact with one or more socket pins **212***a***-1**.

Although not shown, the socket pin **212***a***-2** of the second probe connection unit **210-2** may include a convex portion and be connected to the first probe connection unit **210-1**. Also, the socket pin **212***a***-2** may be also connected to the second disconnecting unit **213-2** when the socket pin **212***a***-2** comes in contact with a bottom surface of the second disconnecting unit **213-2**.

The second disconnecting unit **213-2** included in the second probe connection unit **210-2** is connected to the third probe connection unit **210-3** and may be also connected to the socket pin **212***a***-2** when the socket pin **212***a***-2** comes in contact with a bottom surface of the second disconnecting unit **213-2**.

Similarly, when the connection pin **131***a* of the second probe connector **130-2** comes in contact with the socket pin **212***a***-2**, a physical force is applied to the socket pin **212***a***-2** to cause the socket pin **212***a***-2** to be separated from the second disconnecting unit **213-2**, thereby disconnecting the second disconnecting unit **213-2** from the third probe connection unit **210-3**.

Similarly, the socket pin **212*a*-3** of the third probe connection unit **210-3** may have a convex portion and be connected to the second probe connection unit **210-2**. Also, the socket pin **212*a*-3** may be connected to the third disconnecting unit **213-3** when the socket pin **212*a*-3** comes in contact with a bottom surface of the third disconnecting unit **213-3**.

The third disconnecting unit **213-3** of the third probe connection unit **210-3** is connected to the fourth probe connection unit **210-4**, and may be also connected to the socket pin **212*a*-3** when the socket pin **212*a*-3** comes in contact with the bottom surface of the third disconnecting unit **213-3**.

Similarly, when the connection pin **131*a*** of the third probe connector **130-3** comes in contact with the socket pin **212*a*-3**, a physical force may be applied to the socket pin **212*a*-3** to cause the socket pin **212*a*-3** to be separated from the third disconnecting unit **213-3**, thereby disconnecting the third disconnecting unit **213-3** from the fourth probe connection unit **210-4**.

Meanwhile, since the fourth probe connection unit **210-4** need not include a disconnecting unit, the structure of the fourth probe connection unit **210-4** is not limited to those of the first to third probe connection units **210-1** to **210-3** of FIGS. **9**A to **10**B.

FIGS. **9**A to **10**B illustrate structures in which the first to fourth probe connection units **210-1** to **210-4** are connected in one direction, but the first to fourth probe connection units **210-1** to **210-4** in accordance with another embodiment of the present invention may be connected in two directions.

As described above, when the first to fourth probe connection units **210-1** to **210-4** are connected in two directions, the first probe connection unit **210-1** is directly connected to the beamformer **230** and the second probe connection unit **210-2**, the second probe connection unit **210-2** is directly connected to the first probe connection unit **210-1** and the third probe connection unit **210-3**, the third probe connection unit **210-3** is directly connected to the second probe connection unit **210-2** and the fourth probe connection unit **210-4**, and the fourth probe connection unit **210-4** is directly connected to the third probe connection unit **210-3**.

When the first to fourth probe connection units **210-1** to **210-4** are connected in one direction, the first probe connection unit **210-1** is connected to the beamformer **230** via one transmission line and is connected to the second probe connection unit **210-2** via one transmission line.

However, when the first to fourth probe connection units **210-1** to **210-4** are connected in two directions, the first probe connection unit **210-1** may be i) connected to the beamformer **230** via a plurality of transmission lines and connected to the second probe connection unit **210-2** via one transmission line, ii) connected to the beamformer **230** via one transmission line and connected to the second probe connection unit **210-2** via a plurality of transmission lines, or iii) connected to the beamformer **230** via a plurality of transmission lines and connected to the second probe connection unit **210-2** via a plurality of transmission lines.

Similarly, when the first to fourth probe connection units **210-1** to **210-4** are connected in one direction, the second probe connection unit **210-2** is connected to the first probe connection unit **210-1** via one transmission line and connected to the third probe connection unit **210-3** via one transmission line.

However, when the first to fourth probe connection units **210-1** to **210-4** are connected in two directions, the second probe connection unit **210-2** may be i) connected to the first probe connection unit **210-1** via a plurality of transmission lines and connected to the third probe connection unit **210-3** via one transmission line, ii) connected to the first probe connection unit **210-1** via one transmission line and connected to the third probe connection unit **210-3** via a plurality of transmission lines, or iii) connected to the first probe connection unit **210-1** via a plurality of transmission lines and connected to the third probe connection unit **210-3** via a plurality of transmission lines.

Similarly, when the first to fourth probe connection units **210-1** to **210-4** are connected in one direction, the third probe connection unit **210-3** is connected to the second probe connection unit **210-2** via one transmission line and connected to the fourth probe connection unit **210-4** via one transmission line.

However, when the first to fourth probe connection units **210-1** to **210-4** are connected in two directions, the third probe connection unit **210-3** may be i) connected to the second probe connection unit **210-2** via a plurality of transmission lines and connected to the fourth probe connection unit **210-4** via one transmission line, ii) connected to the second probe connection unit **210-2** via one transmission line and connected to the fourth probe connection unit **210-4** via a plurality of transmission lines, or iii) connected to the second probe connection unit **210-2** via a plurality of transmission lines and connected to the fourth probe connection unit **210-4** via a plurality of transmission lines.

The fourth probe connection unit **210-4** may be connected to the third probe connection unit **210-3** via one transmission line when the first to fourth probe connection units **210-1** to **210-4** are connected in one direction, and connected to the third probe connection unit **210-3** via a plurality of transmission lines When the first to fourth probe connection units **210-1** to **210-4** are connected in two directions.

FIGS. **11**A to **11**C illustrate probe connection units that include a disconnecting unit embodied as a mechanical device and that are connected to one another in two directions in accordance with embodiments of the present invention. The embodiments of FIGS. **11**A to **11**C will be described with respect to a first probe connection unit **210-1** connected to the beamformer **230** via one transmission line and connected to the second probe connection unit **210-2** via two transmission lines, and a first probe connector **130-1** placed in the first probe connection unit **210-1**.

Referring to FIG. **11**A, a socket pin **212*a*-1** of the first probe connection unit **210-1** according to another embodiment of the present invention may have a central protruding portion and a central end thereof may be connected to one transmission line connected to a beamformer **230**.

Also, both ends of the socket pin **212*a*-1** may be in contact with upper surfaces of two transmission lines connected to the second probe connection unit **210-2**, respectively, to be electrically connected to the second probe connection unit **210-2**.

A hole h is formed in both ends of the socket pin **212*a*-1**, through which one end of the first disconnecting unit **213-1** may pass.

The first disconnecting unit **213-1** may include a rectangular shaped mechanical device without a sideline, and an additional driving device (not shown) such as a motor or a linear actuator for automatically transferring the first disconnecting unit **213-1** according to a control signal received from the controller **220**.

Also, the first disconnecting unit **213-1** may include an additional manual device for moving the rectangular shaped mechanical device without the sideline to the left or the right, instead of the driving device. In this case, the rectangular shaped mechanical device without the sideline may be moved to the left or the right through a user's manual manipulation.

The first disconnecting unit **213-1** configured to be moved to the left or right according to a control signal received from the controller **220** will be described below.

One or both ends of the rectangular shaped mechanical device without the sideline may pass through the hole h in the socket pin **212***a***-1** as the rectangular shaped mechanical device without the sideline is moved to the left or the right.

Referring to FIG. **11**B, when locking is performed, a central portion of the—rectangular shaped mechanical device without the sideline comes in contact with the connection pin **131***a*, and the driving device of the first disconnecting unit **213-1** may move the rectangular shaped mechanical device without the sideline to the left according to a control signal received from the controller **220**.

In this case, a right end of the rectangular shaped mechanical device without the sideline passes through the hole h formed in a right end of the socket pin **212***a***-1** and a left end of the rectangular shaped mechanical device without the sideline separates a left end of the socket pin **212***a***-1** from a transmission line of the second probe connection unit **210-2**. As a result, the left end of the socket pin **212***a***-1** may be disconnected from the transmission line of the second probe connection unit **210-2** and the right end of the socket pin **212***a***-1** may be electrically connected to the transmission line of the second probe connection unit **210-2** and a transmission line of the beamformer **230**.

Referring to FIG. **11**C, when locking is performed, the driving device of the first disconnecting unit **213-1** may move the rectangular shaped mechanical device without the sideline to the right according to a control signal received from the controller **220**.

In this case, the left end of the mechanical device passes through the hole h formed in the left end of the socket pin **212***a***-1**, and the right end of the mechanical device separates the right end of the socket pin **212***a***-1** from the transmission line of the second probe connection unit **210-2**. As a result, the right end of the socket pin **212***a***-1** may be disconnected from the transmission line of the second probe connection unit **210-2** and the left end of the socket pin **212***a***-1** may be electrically connected to the transmission line of the second probe connection unit **210-2** and the transmission line of the beamformer **230**.

That is, a direction in which the second probe connection unit **210-2** and the first probe connection unit **210-1** are disconnected from each other may vary according to a control signal received from the controller **220**.

Although not shown, a socket pin **212***a***-2** of the second probe connection unit **210-2** may also have a central protruding portion and a central end thereof may be connected to a transmission line connected to the first probe connection unit **210-1**.

When both ends of the socket pin **212***a***-2** come in contact with top surfaces of two transmission lines connected to the third probe connection unit **210-3**, respectively, the socket pin **212***a***-2** may be also electrically connected to the third probe connection unit **210-3**. A hole h may be formed in both ends of the socket pin **212***a***-2**, through which the second disconnecting unit **213-2** may pass.

The second disconnecting unit **213-2** may also have a rectangular shaped mechanical device without a sideline, and an additional driving device or manual device, such as a motor or a linear actuator, which is configured to move the second disconnecting unit **213-2**.

Similarly, the socket pin **212***a***-3** of the third probe connection unit **210-3** may have a central protruding portion and a central end thereof may be connected to a transmission line connected to the second probe connection unit **210-2**.

When both ends of the socket pin **212***a***-3** come in contact with top surfaces of two transmission lines connected to the fourth probe connection unit **210-4**, respectively, the socket pin **212***a***-3** may be electrically connected to the fourth probe connection unit **210-4**. A hole h may be formed in both ends of the socket pin **212***a***-3**, through which the third disconnecting unit **213-3** may pass.

The third disconnecting unit **213-3** may also have a rectangular shaped mechanical device without a sideline, and an additional driving device or manual device, such as a motor or a linear actuator, which is configured to move the third disconnecting unit **213-3**.

The structures and operations of the socket pins **212***a***-2** and **212***a***-3** and the disconnecting units **213-1** and **213-2** of the second probe connection unit **210-2** and the third probe connection unit **210-3** are as described above with respect to the first probe connection unit **210-1** and are thus not described here again.

Since the fourth probe connection unit **210-4** need not include a disconnecting unit, the structure of the fourth probe connection unit **210-4** is not limited to those of the first to third probe connection units **210-1** to **210-3** illustrated in FIGS. **11**A to **11**C.

Although FIGS. **11**A to **11**C each illustrate one socket pin **212***a***-1**, a plurality of socket pins **212***a***-1** may be present and a plurality of connection pins **131***a* may come in contact with the plurality of socket pins **212***a***-1**.

Although the first to third disconnecting unit **213-1** to **213-3** included in the first to third probe connection units **210-1** to **210-3** have been described above, the first to third disconnecting units **213-1** to **213-3** may be installed outside the first to third probe connection units **210-1** to **210-3**.

FIG. **12** is a conceptual diagram illustrating a disconnecting unit installed outside a probe connection unit in accordance with another embodiment of the present invention. FIG. **12** is another embodiment of FIG. **8**C or **8**D.

Referring to FIG. **12**, a first disconnecting unit **213-1** which disconnects a first probe connection unit **210-1** and a second probe connection unit **210-2** is installed outside the first probe connection unit **210-1**, a second disconnecting unit **213-2** which disconnects the second probe connection unit **210-2** and a third probe connection unit **210-3** is installed outside the second probe connection unit **210-2**, and a third disconnecting unit **213-3** which disconnects the third probe connection unit **210-3** and a fourth probe connection unit **210-4** is installed outside the third probe connection unit **210-3**.

However, all the first to third disconnecting units **213-1** to **213-3** may be included in the body **200**, and embodied as an analog switch, a FET, an integrated circuit, MEMS, or a mechanical device.

The first disconnecting unit **213-1** embodied as a mechanical device will now be described as an example of a disconnecting unit **213** corresponding to one of the first to third disconnecting unit **213-1** to **213-3**.

FIGS. **13**A and **13**B illustrate a probe connection unit that includes a first disconnecting unit installed outside a first probe connection unit in accordance with another embodiment of the present invention. FIGS. **13**A and **13**B are other embodiments of FIG. **12**. FIGS. **14**A and **14**B illustrate a probe connection unit that includes a first disconnecting unit installed outside a first probe connection unit in accordance with another embodiment of the present invention. FIGS. **14**A and **14**B are other embodiments of FIG. **12**.

Referring to FIGS. **13**A and **13**B, a first disconnecting unit **213-1** in accordance with an embodiment of the present invention may be a driving device that vertically moves at least one transmission line connected to the first probe connection unit **210-1** and at least one transmission line connected to the second probe connection unit **210-2** to be separated from each other (see FIG. **13**A) or to be attached to each other (see FIG. **13**B).

To this end, the first disconnecting unit **213-1** may be embodied as a motor or a linear actuator.

For example, when a user selects the first probe assembly **100-1**, the controller **220** may transmit a control signal to the first disconnecting unit **213-1** to separate the first probe connection unit **210-1** and the second probe connection unit **210-2** from each other.

Referring to FIGS. **14**A and **14**B, a first disconnecting unit **213-1** in accordance with another embodiment of the present invention may be a driving device that moves at least one transmission line connected to the first probe connection unit **210-1** and at least one transmission line connected to the second probe connection unit **210-2** to the left or the right to be separated from each other (see FIG. **13**A) or to be attached to each other (see FIG. **13**B).

Similarly, in this case, the first disconnecting unit **213-1** may be embodied as a motor or a linear actuator.

In addition, the first to third disconnecting units **213** may be disconnected from the probe connection units **210-1** to **210-4** or the beamformer **230** in various ways and thus disconnecting means are not limited to that as described above.

FIG. **15** is a flowchart of a method of controlling an ultrasound imaging apparatus in accordance with one embodiment of the present invention.

In accordance with one embodiment of the present invention, an ultrasound imaging apparatus includes a plurality of probe connection units in which a plurality of probe assemblies are placed, respectively.

For example, when four probe connection units are provided in the ultrasound imaging apparatus, a first probe connection unit is directly connected to a beamformer of the ultrasound imaging apparatus and a second probe connection unit, the second probe connection unit is directly connected to the first probe connection unit and a third probe connection unit, the third probe connection unit is directly connected to the second probe connection unit and a fourth probe connection unit, and the fourth probe connection unit is directly connected to the third probe connection unit.

An ultrasound signal transmitted or received by the beamformer with respect to the second probe connection unit is transmitted via the first probe connection unit. An ultrasound signal transmitted or received by the beamformer with respect to the third probe connection unit is transmitted via the first probe connection unit and the second probe connection unit. An ultrasound signal transmitted or received by the beamformer with respect to the fourth probe connection unit is transmitted via the first to third probe connection units.

A method of controlling the ultrasound imaging apparatus will be described below.

First, an input device receives a command to select one of a plurality of probe assemblies from a user (operation **S1100**).

Next, for automatically locking the selected probe assembly, a controller transmits a control signal to a locking unit of a probe connection unit in which the selected probe assembly is placed, and the locking unit receiving the control signal locks the selected probe assembly (operation **S1200**).

In contrast, in order to be continuously electrically connected to the selected probe assembly and to unlock non-selected probe assemblies in a state in which a plurality of probe assemblies have been already locked, the controller may transmit a control signal to locking units of probe connection units in which the non-selected probe assemblies are placed and the locking units receiving the control signal may unlock the non-selected probe assemblies.

A method of performing locking and unlocking is as described above and is thus not described here.

Next, the controller controls a non-via probe connection unit to be disconnected from the probe connection unit in which the selected probe assembly is placed (operation **S1300**).

Here, a via probe connection unit means a probe connection unit via which a signal is exchanged between the beamformer and the probe connection unit corresponding to the selected probe assembly. For example, when a third probe assembly is selected, via probe connection units are the first and second probe connection units.

Here, the non-via probe connection unit means a probe connection unit among probe connection units corresponding to non-selected probe assemblies except for a via probe connection unit. For example, when the third probe assembly is selected, the fourth probe connection unit is a non-via probe connection unit.

For disconnection, the ultrasound imaging apparatus may further include disconnecting units inside or outside a plurality of probe connection units. The disconnecting units may be embodied as, for example, analog switches, FETs, integrated circuits, MEMS, mechanical devices, etc., and disconnect probe connection units from each other.

For example, when a first probe assembly is selected, the controller may transmit a control signal to a first disconnecting unit so as to disconnect the first probe connection unit and the second probe connection unit. When a second probe assembly is selected, a control signal may be transmitted to a second disconnecting unit so as to disconnect the second probe connection unit and the third probe connection unit. When the third probe assembly is selected, a control signal may be transmitted to a third disconnecting unit so as to disconnect the third probe connection unit and the fourth probe connection unit. However, when a fourth probe assembly is selected, non-via probe connection units are not present and thus the process of transmitting a control signal described above may be omitted.

Meanwhile, the first to fourth disconnecting units may be disconnected through a user's manual manipulation and need not thus be disconnected according to a control signal received from the controller.

The disconnecting units are as described above and are not described again here.

Although referring to FIG. **15**, the selected probe assembly is automatically locked and then non-via probe assemblies that are not selected are disconnected, embodiments of the present invention are not limited to the order and the selected probe assembly may be automatically locked after the non-via probe assemblies that are not selected are disconnected (operation **S1300**).

As is apparent from the above description, in an ultrasound imaging apparatus and a method of controlling the same in accordance with one embodiment of the present invention, a non-selected probe connector is disconnected to decrease the length of a stub which is a short branch line connected in parallel to a transmission line.

Also, according to the embodiments set forth herein, in an ultrasound imaging apparatus and a method of controlling the same in accordance with one aspect, a non-selected probe connector is disconnected to decrease negative effects due to signal attenuation caused by an impedance of an unnecessary transmission line.

The above methods of controlling an ultrasound imaging apparatus can be embodied as computer readable code in a computer readable medium. The computer readable medium may be any recording apparatus capable of storing data that is read by a computer system, e.g., a read-only memory (ROM), a random access memory (RAM), a magnetic tape, a magnetic disk, a flash memory, an optical data storage device, and so on. The computer readable medium can be distributed among computer systems that are interconnected through a computer communication network, and the present invention may be placed and implemented as computer readable code in the distributed system.

While the present invention has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those of ordinary skill 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. The exemplary embodiments should be considered in descriptive sense only and not for purposes of limitation. For example, each component described as a single form may be divided and dispersed, and components described as being dispersed may be combined in a single form.

Although a few embodiments of the present invention 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.

What is claimed is:

1. An ultrasound imaging apparatus comprising:

a beamformer to transmit or receive an ultrasound signal;

a first probe connection unit in which a first probe connector connected to a first probe is placed; and

a second probe connection unit in which a second probe connector connected to a second probe is placed and configured to be connected to the first probe connection unit,

wherein the second probe connection unit is connected to the beamformer via the first probe connection unit, and

the first probe connection unit comprises a disconnecting unit to disconnect the first probe connection unit and the second probe connection unit from each other.

2. The ultrasound imaging apparatus according to claim **1**, further comprising a controller to control the first and second probe connection units, and

wherein the first probe connection unit comprises a locking unit to lock the first probe connector into the first probe connection unit and the second probe connection unit comprises a locking unit to lock the second probe connector into the second probe connection unit, based on a control signal generated by the controller.

3. The ultrasound imaging apparatus according to claim **2**, wherein, when the first probe connector is locked into the first probe connection unit, the disconnecting unit disconnects the first probe connection unit and the second probe connection unit from each other.

4. The ultrasound imaging apparatus according to claim **1**, wherein the first and second probe connectors are locked into the first and second probe connection units, respectively, through a user's manual manipulation.

5. The ultrasound imaging apparatus according to claim **1**, wherein the disconnecting unit comprises at least one among an analog switch, a field-effect transistor (FET), an integrated circuit, and micro-electromechanical systems (MEMS) to disconnect the first probe connection unit and the second probe connection unit.

6. The ultrasound imaging apparatus according to claim **1**, wherein the first probe connection unit further comprises a socket pin configured to transmit or receive an ultrasound signal when the socket pin comes in contact with an connection pin of the first probe connector, and

the disconnecting unit disconnects the first probe connection unit and the second probe connection unit when the connection pin comes in contact with the socket pin.

7. The ultrasound imaging apparatus according to claim **6**, wherein the socket pin is formed in a convex shape and connected to the beamformer and the disconnecting unit, and

the disconnecting unit is connected to the socket pin, the beamformer, and the second probe connection unit, and disconnects the first probe connection unit and the second probe connection unit when a physical force is applied to a convex portion of the socket pin.

8. The ultrasound imaging apparatus according to claim **6**, wherein the socket pin has a convex portion, one end of the socket pin is connected to the beamformer, and the socket pin is connected to the disconnecting unit when another end of the socket pin comes in contact with the disconnecting unit,

one end of the disconnecting unit is connected to the second probe connection unit, and the disconnecting unit is connected to the socket pin when the socket pin comes in contact with the disconnecting unit, and

the other end of the socket pin is separated from the other end of the disconnecting unit when a physical force is applied to the convex portion of the socket pin.

9. The ultrasound imaging apparatus according to claim **6**, wherein the socket pin has a central protruding portion, a central end of the socket pin is connected to the beamformer, both ends of the socket pin are connected to the second probe connection unit, and a plurality of holes are formed in the both ends of the socket pin, through which the disconnecting unit passes, and

one end of the disconnecting unit passes through one of the plurality of holes as the disconnecting unit is moved to the left or the right, and another end of the disconnecting unit causes the socket pin to be separated from the second probe connection unit.

10. The ultrasound imaging apparatus according to claim **9**, further comprising a controller to control the disconnecting unit, and

wherein the disconnecting unit is moved to the left or the right according to a control signal generated by the controller or through a user's manipulation.

11. The ultrasound imaging apparatus according to claim **6**, wherein the first probe connection unit further comprises a driving device to cause the connection pin of the first probe connector and the socket pin to contact each other.

12. The ultrasound imaging apparatus according to claim **1**, further comprising a controller to control the disconnecting unit, and

wherein the disconnecting unit changes a direction in which the first probe connection unit and the second probe connection unit are to be disconnected from each other, according to a control signal generated by the controller or through a user's manipulation.

13. The ultrasound imaging apparatus according to claim **1**, further comprising an input device to receive a command to select the first probe or the second probe from a user,

wherein, when the first probe is selected, the disconnecting unit disconnects the first probe connection unit and the second probe connection unit from each other.

14. The ultrasound imaging apparatus according to claim **1**, further comprising a third probe connection unit in which a third probe connector is placed,

wherein the third probe connection unit is connected to the beamformer via the first and second probe connection units, and

the second probe connection unit comprises a disconnecting unit to disconnect the second probe connection unit and the third probe connection unit from each other.

15. The ultrasound imaging apparatus according to claim **1**, further comprising a third probe connection unit in which a third probe connector is placed,

wherein the third probe connection unit is connected to the beamformer via the first and second probe connection units, and

the second probe connection unit comprises a disconnecting unit to disconnect the second probe connection unit and the third probe connection unit from each ot.

16. A method of controlling an ultrasound imaging apparatus which includes a first probe connection unit in which a first probe connector connected to a first probe is placed and a second probe connection unit in which a second probe connector connected to a second probe is placed and configured to be connected to the first probe connection unit, the method comprising:

receiving a command to select the first probe or the second probe from a user;

locking the first probe connector including the first probe when the first probe is selected; and

disconnecting the second probe connection unit, which is connected to the beamformer via the first probe connection unit, from the first probe connection unit.

17. An ultrasound imaging apparatus comprising:

a beamformer to transmit or receive an ultrasound signal;

a first probe connection unit in which a first probe connector connected to a first probe is placed;

a second probe connection unit in which a second probe connector connected to a second probe is placed and configured to be connected to the first probe connection unit, the second probe connection unit connected to the beamformer via the first probe connection unit; and

a disconnecting unit to disconnect the first probe connection unit and the second probe connection unit.

18. The ultrasound imaging apparatus according to claim **17**, further comprising a controller to control the first and second probe connection units, and

wherein the first probe connection unit comprises a locking unit to lock the first probe connector into the first probe connection unit and the second probe connection unit comprises a locking unit to lock the second probe connector into the second probe connection unit, based on a control signal generated by the controller.

19. The ultrasound imaging apparatus according to claim **17**, wherein the disconnecting unit comprises at least one among an analog switch, a field-effect transistor (FET), an integrated circuit, and micro-electromechanical systems (MEMS) to disconnect the first probe connection unit and the second probe connection unit.

20. The ultrasound imaging apparatus according to claim **17**, wherein the disconnecting unit causes a transmission line of the first probe connection unit and a transmission line of the second probe connection unit to be separated from each other or to contact each other.

21. The ultrasound imaging apparatus according to claim **17**, wherein the first and second probe connectors are locked into the first and second probe connection units, respectively, through a user's manual manipulation.

22. A method of controlling an ultrasound imaging apparatus which includes a first probe connection unit in which a first probe connector is placed and a second probe connection unit in which a second probe connector is placed, the method comprising:

receiving a command to select a first probe or a second probe from a user;

locking the first probe connector including the first probe when the first probe is selected; and

disconnecting the second probe connection unit, which is connected to the beamformer via the first probe connection unit, from the first probe connection unit,

wherein the first probe connector is connected to the first probe, and

wherein the second probe connector is connected to the second probe and is configured to be connected to the first probe connection unit.

* * * * *

专利名称(译)	超声成像设备及其控制方法		
公开(公告)号	US10094807	公开(公告)日	2018-10-09
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[标]申请(专利权)人(译)	三星麦迪森株式会社		
申请(专利权)人(译)	三星MEDISON CO.，LTD.		
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摘要(译)

本发明公开了一种超声成像设备，包括用于发送或接收超声信号的波束形成器;第一探针连接单元，其中放置第一探针连接器;和第二探针连接单元，其中放置第二探针连接器。第二探针连接单元经由第一探针连接单元连接到波束形成器，并且第一探针连接单元包括断开单元，以将第一探针连接单元和第二探针连接单元彼此断开。