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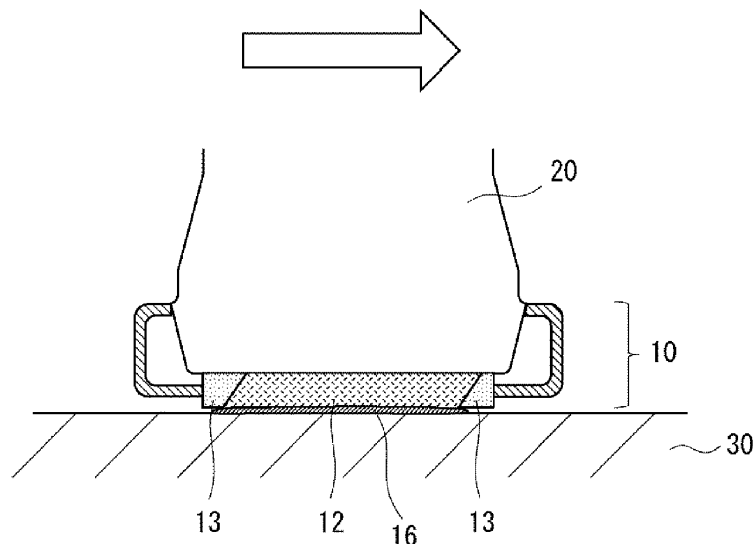
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(54) **ULTRASONIC PROBE ATTACHMENT, ULTRASONIC PROBE, ULTRASONIC INSPECTION APPARATUS AND ULTRASONIC INSPECTION METHOD**

(57) An attachment for ultrasound probe, an ultrasound probe, an ultrasound inspecting apparatus, and an ultrasound inspecting method are provided. The attachment for ultrasound probe includes an acoustic matching element provided on a transceiver of an ultrasound probe and deformed based on a surface of an inspection target when the ultrasound probe scans the

surface of the inspection target; a medium supplier provided near the acoustic matching element and configured to provide a medium between the inspection target and the acoustic matching element, based on the deformation of the acoustic matching element; and a body configured to fix the acoustic matching element and the medium supplier to the ultrasound probe.

FIG. 4



Description

TECHNICAL FIELD

[0001] The present invention relates to an attachment for ultrasound probe, an ultrasound probe, an ultrasound inspecting apparatus, and an ultrasound inspecting method.

BACKGROUND ART

[0002] Ultrasound inspecting apparatuses including an ultrasound probe are widely used for medical and industrial purposes. Patent reference 1 (Japanese Patent Application Publication No. 2012-176197) discloses the use of a film-shaped echo gel for acoustic coupling between a probe and a human body when an ultrasound inspecting apparatus performs an ultrasound diagnosis.

DETAILED DESCRIPTION OF THE INVENTION

TECHNICAL PROBLEM

[0003] The film-shaped echo gel has high ultrasonic transmission and is very flexible, thus leaving no sticky feeling after being peeled off. However, the film-shaped echo gel follows the irregular surface of the human body too closely, and thus a minute air layer may be formed between the probe and the echo gel. As a result, a jelly material for acoustic coupling between the probe and the human body by filling the air layer should be coated.

[0004] To address this problem, the present invention provides an attachment for ultrasound probe that does not form an air layer between a probe and an inspection target and does not need a jelly material, and an ultrasound probe, an ultrasound inspecting apparatus, and an ultrasound inspecting method.

TECHNICAL SOLUTION

[0005] An attachment for an ultrasound probe includes an acoustic matching element provided on a transceiver of the ultrasound probe and deformed based on a surface of an inspection target when the ultrasound probe scans the surface of the inspection target; a medium supplier provided near the acoustic matching element and configured to provide a medium between the inspection target and the acoustic matching element, based on the deformation of the acoustic matching element; and a body configured to fix the acoustic matching element and the medium supplier to the ultrasound probe. According to this structure, an air layer is not formed between the ultrasound probe and the inspection target, a jelly material is not necessary, and acoustic matching and acoustic coupling between the ultrasound probe and the inspection target are secured to thereby enable an ultrasound inspection to be favorably conducted.

[0006] The ultrasound probe includes an acoustic lens

which is deformed based on a surface of an inspection target when the ultrasound probe scans the surface of the inspection target, and a medium supplier which is near the acoustic lens and supplies a medium between the ultrasound probe and the inspection target, based on deformation of the acoustic lens. According to this structure, an air layer is not formed between the ultrasound probe and the inspection target, a jelly material is not necessary, and acoustic matching and acoustic coupling between the ultrasound probe and the inspection target are secured to thereby enable an ultrasound inspection to be favorably conducted.

[0007] An ultrasound inspecting method includes fixing an acoustic matching element and a medium supplier onto an ultrasound probe, the acoustic matching element being deformed based on a surface of an inspection target when the ultrasound probe scans the surface of the inspection target; supplying a medium between the inspection target and the acoustic matching element, based on the deformation of the acoustic matching element, wherein the supplying is performed by the medium supplier; and transmitting ultrasound waves to the inspection target and receiving reflected waves of the ultrasound waves from the inspection target, wherein the transmitting and the receiving is performed by the ultrasound probe. According to this method, an air layer is not formed between the ultrasound probe and the inspection target, a jelly material is not necessary, and acoustic matching and acoustic coupling between the ultrasound probe and the inspection target are secured to thereby enable an ultrasound inspection to be favorably conducted.

ADVANTAGEOUS EFFECTS

[0008] Disclosed embodiments provide an attachment for ultrasound probe that does not form an air layer between a probe and an inspection target and does not need a jelly material, an ultrasound probe, an ultrasound inspecting apparatus, and an ultrasound inspecting method.

DESCRIPTION OF THE DRAWINGS

[0009]

FIG. 1 illustrates an exterior of an attachment according to embodiment 1.

FIG. 2 illustrates exteriors of the attachment and a probe according to embodiment 1.

FIG. 3 is a cross-sectional view illustrating a schematic structure of the attachment according to embodiment 1 mounted on the probe.

FIG. 4 is a schematic cross-sectional view illustrating the probe according to embodiment 1 ultrasound-inspecting an inspection target by sending ultrasound waves to the inspection target.

FIG. 5 is a flowchart of a method in which the probe

according to embodiment 1 ultrasound-inspects the inspection target.

FIG. 6 is an exploded perspective view for explaining a method of assembling the attachment according to embodiment 1.

FIG. 7 illustrates an acoustic matching element applicable to the attachment according to embodiment 1, according to another example.

FIG. 8 illustrates a medium supplier applicable to the attachment according to embodiment 1, according to another example.

FIGS. 9-11 are views for explaining a method of assembling another example of the attachment according to embodiment 1.

FIG. 12 illustrates a body of the attachment according to embodiment 1, according to another example.

FIG. 13 illustrates the exterior of an attachment according to embodiment 2.

FIG. 14 is a cross-sectional view illustrating a schematic structure of the attachment according to embodiment 2 mounted on a probe.

FIG. 15 illustrates the exterior of a probe according to embodiment 3.

FIG. 16 is a cross-sectional view illustrating a schematic structure of the probe according to embodiment 3.

MODE OF THE INVENTION

[0010] An attachment for ultrasound probe, an ultrasound probe, an apparatus for inspecting ultrasound, and a method of inspecting ultrasound will now be described in detail with reference to the attached drawings. Like reference numerals in the drawings denote like elements, and, in the drawings, the sizes of elements may be exaggerated for clarity and for convenience of explanation. It will be understood that when a material layer is referred to as being "formed on" a substrate or another layer, it can be directly or indirectly formed on the substrate or the other layer. That is, for example, intervening layers may be present. Materials that constitute each layer in embodiments below are exemplary, and thus the other materials may be used. It will be understood that when a layer is referred to as being "on" another layer or substrate, it can be directly on the other layer or substrate, or intervening layers may also be present.

<Embodiment 1 >

[0011] An attachment for ultrasound probe according to the present embodiment 1 will now be described with reference to the attached drawings.

[0012] The attachment according to the present embodiment 1 is mounted on an ultrasound probe of an ultrasound inspecting apparatus. The attachment includes at least an acoustic matching element and a medium supplier. When the probe scans an inspection target, such as a human body, the acoustic matching element

is located between the probe and the inspection target and secures acoustic matching and acoustic coupling between the probe and the inspection target, and the medium supplier supplies a medium between the acoustic matching element and the inspection target to secure wettability and lubricity between the probe and the inspection target. Accordingly, an ultrasound inspection may be smoothly conducted.

[0013] FIG. 1 illustrates the exterior of an attachment 10 according to the present embodiment 1. FIG. 1 illustrates the exterior of the attachment 10 when a surface of the attachment 10 that faces an inspection target faces upwards. The attachment 10 includes a body 11, an acoustic matching element 12 partially exposed via an approximately center portion of a surface of the body 11 facing the inspection target, and a medium supplier 13 partially exposed via a portion of the surface of the body 11 around the acoustic matching element 12.

[0014] The body 11 is used to fix the acoustic matching element 12 and the medium supplier 13 onto a probe, and may be formed of, for example, ABS (Acrylonitrile, Butadiene, Styrene) resin. Alternatively, the body 11 may be formed of a rigid paper material and thus may be crushed and downsized after being used. Moreover, the body 11 formed of a rigid paper material does not generate much poisonous gas when being incinerated, and thus may reduce medical waste.

[0015] The acoustic matching element 12 is used to reduce an acoustic mismatch caused due to a difference between acoustic impedances of the probe and the inspection target, and to secure acoustic coupling between the probe and the inspection target, and may be formed of, for example, polymer gel. The medium supplier 13 is used to hold a medium and supply the medium between the inspection target and the acoustic matching element 12, and may be formed of, for example, non-woven fabric. The medium maintains a surface of the acoustic matching element 12 in a wet condition to thereby form a lubrication space between the acoustic matching element 12 and the inspection target.

[0016] FIG. 2 illustrates the exteriors of the attachment 10 and a probe 20 according to the present embodiment 1. FIG. 2 illustrates the exteriors of the attachment 10 and the probe 20 when the attachment 10 and the probe 20 are viewed from the side. The attachment 10 has an opening 14 on a side of the body 11 opposite to the side thereof facing the inspection target, namely, on the side of the probe 20. The probe 20 is inserted into the attachment 10 via the opening 14 and thus the attachment 10 is fixed to the probe 20.

[0017] An ultrasound inspecting apparatus according to the present embodiment 1 includes the probe 20 and an image processing unit (not shown) to which the probe 20 is connected, and is used for various purposes, such as medical treatments and industrial applications. The probe 20 includes, on a leading end thereof, a transceiver 21 that transmits ultrasound waves and receives reflected waves of the transmitted ultrasound waves. The probe

20 may be a conventional probe. The image processing unit to which the probe 20 is connected processes a signal from the probe 20 to generate and display an ultrasound image that represents the internal status of the inspection target. Since the image processing unit may be a conventional image processing unit, illustration and descriptions thereof will be omitted.

[0018] FIG. 3 is a cross-sectional view illustrating a schematic structure of the attachment 10 according to the present embodiment 1 mounted on the probe 20. FIG. 3 illustrates a schematic structure of the attachment 10 when the surface of the attachment 10 facing the inspection target faces down and the attachment 10 mounted on the probe 20 is viewed from the side.

[0019] The body 11 of the attachment 10 accommodates the acoustic matching element 12 and the medium supplier 13, and portions of the acoustic matching element 12 and the medium supplier 13 protrude and are exposed via an opening 15 formed in the surface of the body 11 facing the inspection target. The probe 20 is inserted into the opening 14 of the body 11 of the attachment 10, and thus the attachment 10 is mounted on the probe 20. At this time, the acoustic matching element 12 is disposed on (below in FIG. 3) the transceiver 21 of the probe 20.

[0020] FIG. 4 is a schematic cross-sectional view illustrating the probe 20 according to the present embodiment 1 ultrasound-inspecting an inspection target 30 by scanning the inspection target 30. FIG. 5 is a flowchart of a method in which the probe 20 according to the present embodiment 1 ultrasound-inspects the inspection target 30.

[0021] First, when an ultrasound inspection starts, the probe 20 equipped with the attachment 10 presses down on the inspection target 30, in operation S10. In operation S20, the probe 20 scan the inspection target 30 from the left to the right in FIG. 4.

[0022] At this time, the acoustic matching element 12 contacts a surface of the inspection target 30 via a medium 16 or the like and is deformed based on the surface of the inspection target 30, in operation S30. Due to the deformation of the acoustic matching element 12, the medium supplier 13 is pressed by the acoustic matching element 12, in operation S40, and the medium 16 included in the medium supplier 13 gradually oozes out, in operation S50. In operation S60, the oozed-out medium 16 maintains the vicinity of the surface of the acoustic matching element 12 in a wet condition or a lubricated condition and reduces a friction between the acoustic matching element 12 and the inspection target 30. The probe 20 transmits ultrasound waves to the inspection target 30 and receives reflected waves of the ultrasound waves from the inspection target 30, in operation S70, and the image processing unit (not shown) generates an ultrasound image, in operation S80.

[0023] The medium supplier 13 is pressed by the deformed acoustic matching element 12 rather than by the surface of the inspection target 30. Accordingly, even

when the probe 20 strongly presses down and scans the surface of the inspection target 30, a force applied to the medium supplier 13 is limited, and the amount of the medium 16 oozing out of the medium supplier 13 seldom increases. The medium supplier 13 may stably supply the medium 16 between the acoustic matching element 12 and the surface of the inspection target 30.

[0024] FIG. 6 is an exploded perspective view for explaining a method of assembling the attachment 10 according to the present embodiment 1. FIG. 6 illustrates the surface of the attachment 10 contacting an inspection target. The attachment 10 may be assembled with the body 11, the acoustic matching element 12, and the medium supplier 13.

[0025] The body 11 may be formed of the aforementioned ABS resin or the like. The body 11 has the opening 15 in the surface facing the inspection target, and the opening 14 in the surface opposite to the surface facing the inspection target, namely, in the surface on the side via which the probe 20 is inserted.

[0026] The acoustic matching element 12 may be formed of the aforementioned polymer gel, or may be formed of hydrogel having a hydrophilic property by a hydrophilic group, such as a hydroxyl group. The acoustic matching element 12 may have a convex shape or a flange shape. The convex shape of the acoustic matching element 12 may be obtained by cutting both sides out of a polymer gel sheet, or by fusing or adhering polymer gel corresponding to a protrusion onto the polymer gel sheet, or by molding polymer gel.

[0027] When a soft material, such as polymer gel, is used to form the acoustic matching element 12, the surface of the inspection target is prevented from being deformed by being pressed by the probe 20, and thus a natural and clear ultrasound image of a structure of the vicinity of the surface of the inspection target may be obtained.

[0028] By using the hydrophilic acoustic matching element 12 and a medium including water, an extremely small amount of medium may maintain the surface of the acoustic matching element 12 and its vicinity in a wet condition. Since the supplied medium is extremely small, the medium is immediately evaporated from the surface of the inspection target after the probe 20 passes the surface of the inspection target, and a to-be-inspected person is not given much unpleasant feeling. An operation of cleaning the medium from the surface of the inspection target is not necessary, in contrast with when a jelly material is used.

[0029] The medium supplier 13 is formed of the aforementioned non-woven fabric, such as a material that includes the medium and is capable of oozing out the medium, and has a □-character shape having a rectangular opening or a ⊏-character shape having a rectangular opening of which one side is open. The material used to form the medium supplier 13 may be a fabric such as pulp, rayon or polyester which is used in a sheet mask. The medium supplier 13 may be formed of sponge.

[0030] The medium supplier 13 may have a □-character shape, a ⊏-character shape, or the like, and may surround at least some, preferably, two opposing lateral surfaces, of the lateral surfaces of the protrusion of the acoustic matching element 12, namely, the surfaces of the acoustic matching element 12 meeting with the surface of the acoustic matching element 12 facing the inspection target. In order for the medium supplier 13 to have a □-character shape, two medium suppliers 13 may be combined.

[0031] The attachment 10 is assembled by pushing the medium supplier 13 and the acoustic matching element 12 into the body 11 via the opening 14 of the body 11 in this stated order such that at least the protrusion of the acoustic matching element 12 protrudes from the opening 15 of the body 11. At this time, the medium supplier 13 and the acoustic matching element 12 are pushed into the body 11 such that a portion of the medium supplier 13 also protrudes from the opening 15 of the body 11. The acoustic matching element 12 and the medium supplier 13 may directly contact each other or may be adjacent to each other via a thin film or the like. The important thing is that the attachment 10 is assembled such that the medium supplier 13 allows the medium to ooze out by being pressed by the acoustic matching element 12 when the acoustic matching element 12 has been deformed due to scanning. By forming the acoustic matching element 12 to have a convex shape, shoulder portions of the acoustic matching element 12, which are defined by the protrusion of the acoustic matching element 12, are caught by the opening 15 of the body 11, and thus the positions of the acoustic matching element 12 and the medium supplier 13 within the body 11 are stabilized.

[0032] FIG. 7 illustrates an acoustic matching element 17, which is another example of the acoustic matching element 12 according to the present embodiment 1. Referring to FIG. 7, a protrusion of the acoustic matching element 17 may have an approximately oval shape by rounding a surface of the protrusion facing the inspection target. The edges of the protrusion may be chamfered. By having this shape, the acoustic matching element 17 may smoothly scan the surface of the inspection target. Moreover, the acoustic matching element 17 may have a shape that coincides with the shape of an acoustic lens of the probe 20.

[0033] FIG. 8 illustrates a medium supplier 18, which is another example of the medium supplier 13 according to the present embodiment 1. Referring to FIG. 8, the medium supplier 18 is divided into two sheets, each of which one end is rolled. The medium supplier 18 and the acoustic matching element 12 are pushed into the body 11 such that a rolled portion of each sheet is put on the shoulder portions of the acoustic matching element 12. In this case, the rolled portion of the medium supplier 18 may protrude from the opening 15 of the body 11.

[0034] FIGS. 9-11 are views for explaining a method of assembling another example of the attachment 10 ac-

cording to the present embodiment 1. FIGS. 9-11 illustrate the surface of the attachment 10 contacting an inspection target. The respective upper views of FIGS. 9-11 illustrate the exteriors of the attachment 10 in the assembling processes of the method. The respective lower views of FIGS. 9 and 10 illustrate cross-sections of the attachment 10 in a direction parallel to a shorter side of the surface of the attachment 10 facing the inspection target, and the lower view of FIG. 11 illustrates a cross-section of the attachment 10 in a direction parallel to a longer side of the surface of the attachment 10 facing the inspection target.

[0035] The attachment 10 is assembled with the body 11, the acoustic matching element 12, and a medium supplier 19. The medium supplier 19 has a sheet shape and has, at one end thereof, a core portion 19a in a rod shape formed of the same material as or a different material from the medium supplier 19.

[0036] First, as shown in FIG. 9, the other end of the medium supplier 19 previously rendered wet by a medium, which has no core portions 19a, is inserted into the body 11 via the opening 15. This operation is conducted on two sheets of medium suppliers 19. At this time, because the inserted medium supplier 19 is in a wet condition, the inserted medium supplier 19 adheres to an inner wall of the body 11.

[0037] Next, as shown in FIG. 10, the acoustic matching element 12 is inserted into the body 11 via the opening 14 such that the protrusion of the acoustic matching element 12 protrudes from the opening 15. At this time, the medium supplier 19 is inserted between the body 11 and the acoustic matching element 12. Each of the two sheets of medium suppliers 19 is rolled around the core portion 19a.

[0038] Finally, as shown in FIG. 11, each of the rolled-up medium suppliers 19 is inserted into the body 11 via a gap between the body 11 and the acoustic matching element 12, thereby completing the assembly of the attachment 10.

[0039] FIG. 12 illustrates another example of the body 11 according to the present embodiment 1. FIG. 12 illustrates the exterior of the body 11 when a surface of the body 11 facing an inspection target faces upwards. The opening 15 of the body 11 has a plurality of grooves 11a each ranging from the inner side of the body 11 to the outer side thereof. The grooves 11a are fine flow paths of a medium, and thus the medium easily permeates from the inner side of the body 11 to the outer side thereof due to a fine pipe phenomenon.

[0040] The body 11 may be constructed to be splittable into two or more parts. To prevent the body 11 from escaping from the probe 20, the body 11 may include a means for fitting the body 11 onto the probe 20 or a means such as a hook for enabling the body 11 to be hung up on the probe 20. The body 11 includes a fixer formed of a deformable material, such as a sponge or rubber, so that the body 11 may be stabilized without being shaken when being mounted on the probe 20 and may be mount-

ed on any type of probe 20 without depending on the shape of the probe 20.

[0041] The acoustic matching element 12 may be formed of a material other than polymer gel. For example, the acoustic matching element 12 may be formed of a material having a good ultrasonic transmission and a low attenuation so as to maintain a shape. A water bag may be used as the acoustic matching element 12.

[0042] A thin film or the like may be further provided on a surface of the acoustic matching element 12, and thus a medium supplier may supply a medium between the thin film and the inspection target.

[0043] As described above, the attachment 10 for ultrasound probe according to the present embodiment 1 is disposed on the transceiver 21 of the ultrasound probe 20, and includes the acoustic matching element 12 which is deformed based on a surface of the inspection target 30 when the ultrasound probe 20 scans the surface of the inspection target 30, the medium supplier 13 which is near the acoustic matching element 12 and supplies the medium 16 between the inspection target 30 and the acoustic matching element 12, based on deformation of the acoustic matching element 12, and the body 11 which fixes the acoustic matching element 12 and the medium supplier 13 to the ultrasound probe 20.

[0044] In the attachment 10 for ultrasound probe according to the present embodiment 1, the body 11 accommodates the acoustic matching element 12 and the medium supplier 13 and has the opening 15 in the surface of the body 11 facing the inspection target 30, and the portions of the acoustic matching element 12 and the medium supplier 13 may protrude from the opening 15.

[0045] In the attachment 10 for ultrasound probe according to the present embodiment 1, the acoustic matching element 12 has a convex shape having a protrusion, and the protrusion may protrude from the opening 15.

[0046] In the attachment 10 for ultrasound probe according to the present embodiment 1, the acoustic matching element 13 has a □-character shape or a ⊐-character shape, and may surround at least some of the lateral surfaces of the protrusion.

[0047] In the attachment 10 for ultrasound probe according to the present embodiment 1, the opening 15 may have the grooves 11 a each ranging from the inner side of the body 11 to the outer side thereof and serving as a flow path of the medium 16.

[0048] In the attachment 10 for ultrasound probe according to the present embodiment 1, the body 11 may be constructed to be splittable.

[0049] In the attachment 10 for ultrasound probe according to the present embodiment 1, the body 11 may include a deformable fixer that is disposed between the ultrasound probe 20 and the body 11 and fixes the ultrasound probe 20 to the body 11.

[0050] In the attachment 10 for ultrasound probe according to the present embodiment 1, the acoustic matching element 12 may have a hydrophilic property, and the medium 16 may be liquid including water.

[0051] In the attachment 10 for ultrasound probe according to the present embodiment 1, the acoustic matching element 12 may include polymer gel.

[0052] In the attachment 10 for ultrasound probe according to the present embodiment 1, the acoustic matching element 12 may be a water bag.

[0053] In the attachment 10 for ultrasound probe according to the present embodiment 1, the medium 16 may be water or hyaluronic acid.

[0054] In the attachment 10 for ultrasound probe according to the present embodiment 1, the medium supplier 13 may be pressed due to deformation of the acoustic matching element 12 and thus may supply the medium 16.

[0055] In the attachment 10 for ultrasound probe according to the present embodiment 1, the medium supplier 13 may be provided in contact with the acoustic matching element 12 and may be directly pressed by the acoustic matching element 12 due to deformation of the acoustic matching element 12.

[0056] In the attachment 10 for ultrasound probe according to the present embodiment 1, the medium supplier 13 may include non-woven fabric.

[0057] The ultrasound inspecting apparatus according to the present embodiment 1 may include the attachment 10 for ultrasound probe and the ultrasound probe 20.

[0058] In the ultrasound inspecting method according to the present embodiment 1, the acoustic matching element 12 and the medium supplier 13 are fixed onto the ultrasound probe 20, the acoustic matching element 12 is deformed based on a surface of the inspection target 30 when the ultrasound probe 20 scans the surface of the inspection target 30, the medium supplier 13 supplies the medium 16 between the inspection target 30 and the acoustic matching element 12, based on the deformation of the acoustic matching element 12, and the ultrasound probe 20 transmits ultrasound waves to the inspection target 30 and receives reflected waves of the ultrasound waves from the inspection target 30.

<Embodiment 2>

[0059] An attachment for ultrasound probe according to the present embodiment 2 will now be described with reference to the attached drawings.

[0060] The attachment according to the present embodiment 2 includes a means for actively pressing a medium supplier, in addition to the components of the attachment according to embodiment 1, and uses the means as a supply increaser to supply a larger amount of medium.

[0061] FIG. 13 illustrates the exterior of an attachment 50 according to the present embodiment 2. FIG. 13 illustrates the exterior of the attachment 50 when a surface of the attachment 50 facing an inspection target faces upwards. The attachment 50 is the same as the attachment 10 according to embodiment 1 in that it includes a body 51, an acoustic matching element 12 partially ex-

posed via an approximately center portion of a surface of the body 51 facing the inspection target, and a medium supplier 13 partially exposed via a portion of the surface of the body 51 around the acoustic matching element 12. The attachment 50 is different from the attachment 10 according to embodiment 1 in that a pressure plate 52 serving as a supply increaser is provided on a lateral surface of the body 51, namely, on a surface of the body 51 that meets with the surface of the body 51 facing the inspection target, via a hinge 53.

[0062] FIG. 14 is a cross-sectional view illustrating a schematic structure of the attachment 50 according to the present embodiment 2 mounted on the probe 20. The pressure plate 52 is coupled to the body 51 via the hinge 53. The present embodiment 2 is the same as the embodiment 1 in that the probe 20 scans the inspection target 30, the acoustic matching element 12 is deformed, and the medium supplier 13 is pressed by the deformed acoustic matching element 12 and thus supplies a medium.

[0063] According to the present embodiment 2, an operator presses the medium supplier 13 by pushing the pressure plate 52 inwards with his or her fingers when continuously scanning the inspection target 30, thereby supplying a larger amount of medium from the medium supplier 13.

[0064] If the acoustic matching element 12 uses polymer gel and scanning is performed for a long time, the surface of the polymer gel may become dry and wettability or lubricity may disappear, and it may be difficult to propagate ultrasound. Thus, by forcibly supplying the medium from the medium supplier 13 by using the pressure plate 52, the surface of the polymer gel is securely maintained wet, and a lubrication space between the probe 20 and the inspection target 30 is securely formed.

[0065] As described above, the attachment 50 for ultrasound probe according to the present embodiment 2 may further include the pressure plate 52, which is a supply increaser for increasing supply of the medium 16 from the medium supplier 13.

<Embodiment 3>

[0066] An ultrasound probe according to the present embodiment 3 will now be described with reference to the attached drawings.

[0067] The ultrasound probe according to the present embodiment 3 is an integration of the attachment 10 and the probe 20 according to embodiment 1. The ultrasound probe according to the present embodiment 3 is obtained by using an acoustic lens formed of polymer gel instead of using the acoustic matching element 12 and accommodating the acoustic lens and a medium supplier within the probe.

[0068] FIG. 15 illustrates the exterior of a probe 60 according to the present embodiment 3. An acoustic lens 61 and a medium supplier 62 are exposed via a surface of the probe 60 facing an inspection target. The acoustic

lens 61 is formed of polymer gel or the like that is deformable by a pressure, and the medium supplier 62 is formed of non-woven fabric or the like from which a medium may ooze out.

[0069] FIG. 16 is a cross-sectional view illustrating a schematic structure of the probe 60 according to the present embodiment 3. FIG. 16 illustrates a schematic structure of the probe 60 when the surface of the probe 60 facing the inspection target 30 faces down and the probe 60 is viewed from the side. The probe 60 includes the acoustic lens 61 which constitutes a portion of the surface of the probe 60 facing the inspection target 30 and converges ultrasound by using the curve of the acoustic lens 61, an ultrasound oscillator 63 which transmits or receives ultrasound, and a backing member 64 which reflects, attenuates, and absorbs ultrasound emitted backwards from the ultrasound oscillator 63. The acoustic lens 61, the ultrasound oscillator 63, and the backing member 64 are disposed within the probe 60 in this stated order starting from the surface of the probe 60 facing the inspection target 30. The medium supplier 62 which constitutes a portion of the surface of the probe 60 facing the inspection target 30 and supplies a medium is disposed around the acoustic lens 61.

[0070] The acoustic lens 61 may have a function as an ultrasound matching layer. In this case, the acoustic impedance of the acoustic lens 61 gradually changes in a thickness direction of the acoustic lens 61. Of course, the acoustic lens 61 may have only a lens function, and a special ultrasound matching layer may be provided between the acoustic lens 61 and the ultrasound oscillator 63.

[0071] Operations of the acoustic lens 61 and the medium supplier 62 when the probe 60 scans a surface of the inspection target 30 is almost the same as operations of the acoustic matching element 12 and the medium supplier 13 according to embodiment 1. The acoustic lens 61 contacts the surface of the inspection target 30 and is thus deformed, and presses the medium supplier 62. The medium supplier 62 oozes out the medium and supplies the medium between the surface of the inspection target 30 and the acoustic lens 61. Accordingly, the surface of the acoustic lens 61 is maintained wet, and a lubrication space between the ultrasound oscillator 63 and the inspection target 30 is formed, whereby an ultrasound inspection is favorably conducted.

[0072] Also in the probe 60 according to the present embodiment 3, a thin film may be further provided on the surface of the acoustic lens 61, and thus the medium may be supplied between the surface of the inspection target 30 and the thin film.

[0073] As described above, the ultrasound probe 60 according to the present embodiment 3 includes the acoustic lens 61 which is deformed based on a surface of the inspection target 30 when the ultrasound probe 60 scans the surface of the inspection target 30, and the medium supplier 62 which is near the acoustic lens 61 and supplies the medium between the ultrasound probe

60 and the inspection target 30, based on deformation of the acoustic lens 61.

[0074] In the ultrasound probe 60 for ultrasound probe according to the present embodiment 3, the acoustic lens 61 and the medium supplier 62 are provided in the ultrasound probe 60 such that they constitute a portion of a surface of the ultrasound probe 60, and the medium supplier 62 may supply a medium between the acoustic lens 61 and the inspection target 30.

[0075] An ultrasound inspecting apparatus according to the present embodiment 3 may include the above-described ultrasound probe 60.

[0076] Although an attachment for ultrasound probe, an ultrasound probe, an ultrasound inspecting apparatus, and an ultrasound inspecting method according to the present invention have been described with reference to the embodiments illustrated in the drawings in order to facilitate understanding of the present invention, the illustrated embodiments are only examples, and various modifications to the illustrated embodiments and other equivalent embodiments may be possible. Therefore, the scope of the present invention should be determined by the accompanying claims.

Claims

1. An attachment for an ultrasound probe, the attachment comprising:

an acoustic matching element provided on a transceiver of the ultrasound probe and deformed based on a surface of an inspection target when the ultrasound probe scans the surface of the inspection target;

a medium supplier provided near the acoustic matching element and configured to provide a medium between the inspection target and the acoustic matching element, based on the deformation of the acoustic matching element; and
a body configured to fix the acoustic matching element and the medium supplier to the ultrasound probe.

2. The attachment of claim 1, wherein the body accommodates the acoustic matching element and the medium supplier and has an opening in a surface thereof facing the inspection target, portions of the acoustic matching element and the medium supplier protrude from the opening.
3. The attachment of claim 2, wherein the acoustic matching element has a convex shape having a protrusion, and the protrusion protrudes from the opening.
4. The attachment of claim 3, wherein the medium supplier has a

□-character shape or a □-character shape, and surrounds at least some of lateral surfaces of the protrusion.

- 5 5. The attachment of claim 2, wherein the opening has a groove that ranges from an inner side of the body to an outer side of the body and serves as a flow path of the medium.
- 10 6. The attachment of claim 1, wherein the body is split-table.
7. The attachment of claim 1, wherein the body further comprises a deformable fixer that is between the ultrasound probe and the body and fixes the ultrasound probe to the body.
- 15 8. The attachment of claim 1, wherein the acoustic matching element has a hydrophilic property, and the medium is liquid including water.
- 20 9. The attachment of claim 1, wherein the acoustic matching element comprises polymer gel.
- 25 10. The attachment of claim 1, wherein the acoustic matching element is a water bag that accommodates water.
- 30 11. The attachment of claim 1, wherein the medium is water or hyaluronic acid.
- 35 12. The attachment of claim 1, wherein the medium supplier is pressed due to the deformation of the acoustic matching element and supplies the medium.
- 40 13. The attachment of claim 1, wherein the medium supplier is in contact with the acoustic matching element and is directly pressed by the acoustic matching element due to the deformation of the acoustic matching element.
- 45 14. The attachment of claim 1, wherein the medium supplier includes non-woven fabric.
- 50 15. The attachment of claim 1, further comprising a supply increaser that increases supply of the medium from the medium supplier.
- 55 16. An ultrasound inspecting apparatus comprising:
an attachment for ultrasound probe of any one of claims 1 through 15; and
an ultrasound probe on which the attachment for ultrasound probe is mounted.
17. An ultrasound probe comprising:
an acoustic lens which is deformed based on a

surface of an inspection target when the ultrasound probe scans the surface of the inspection target, and

a medium supplier which is near the acoustic lens and supplies a medium between the ultrasound probe and the inspection target, based on deformation of the acoustic lens. 5

18. The ultrasound probe of claim 17, wherein the acoustic lens and the medium supplier are provided in the ultrasound probe such that the acoustic lens and the medium supplier constitute a portion of a surface of the ultrasound probe, and the medium supplier supplies the medium between the acoustic lens and the inspection target. 10 15

19. The ultrasound inspecting apparatus comprising an ultrasound probe of claim 17 or 18.

20. An ultrasound inspecting method comprising: 20

fixing an acoustic matching element and a medium supplier onto an ultrasound probe, the acoustic matching element being deformed based on a surface of an inspection target when the ultrasound probe scans the surface of the inspection target; 25

supplying a medium between the inspection target and the acoustic matching element, based on the deformation of the acoustic matching element, wherein the supplying is performed by the medium supplier; and 30

transmitting ultrasound waves to the inspection target and receiving reflected waves of the ultrasound waves from the inspection target, wherein the transmitting and the receiving is performed by the ultrasound probe. 35 40

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FIG. 1

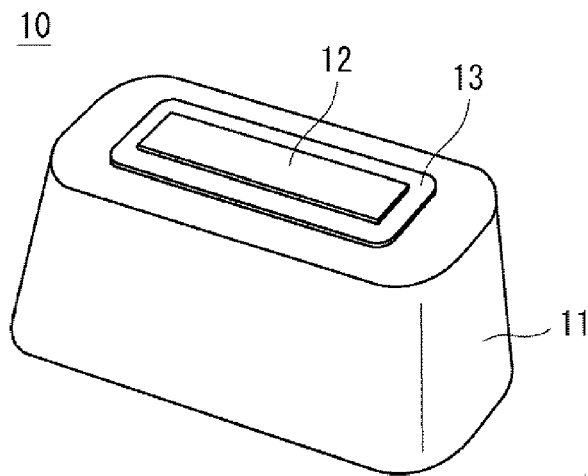


FIG. 2

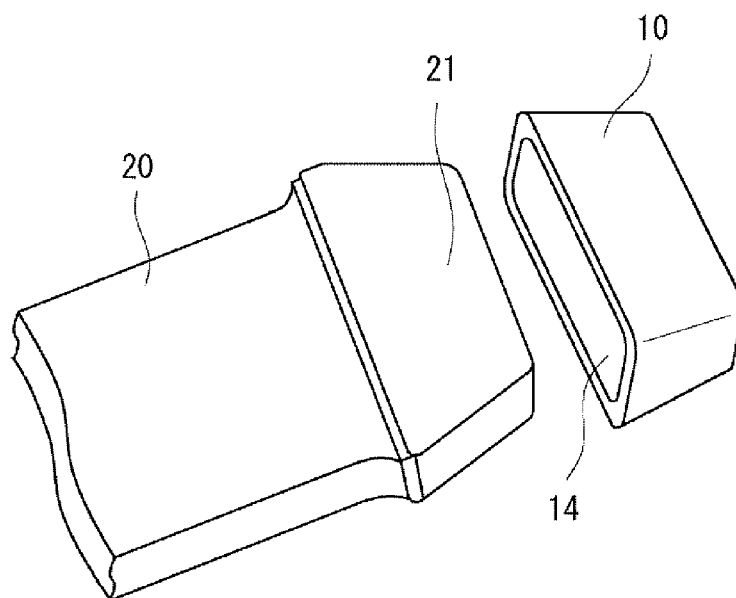


FIG. 3

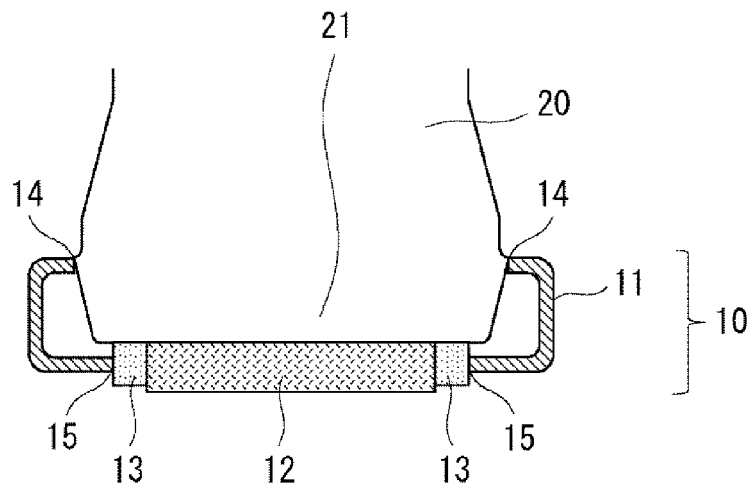


FIG. 4

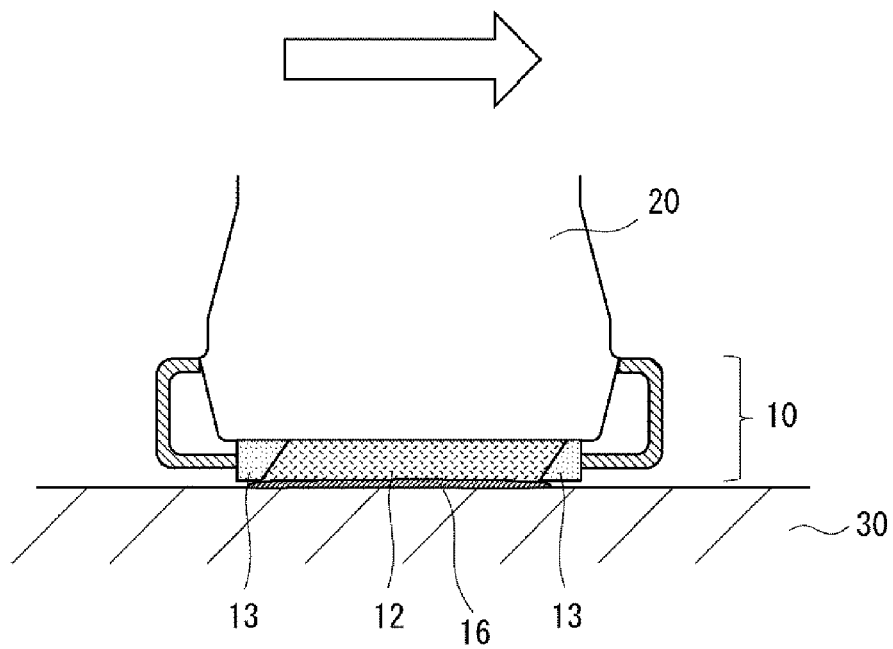


FIG. 5

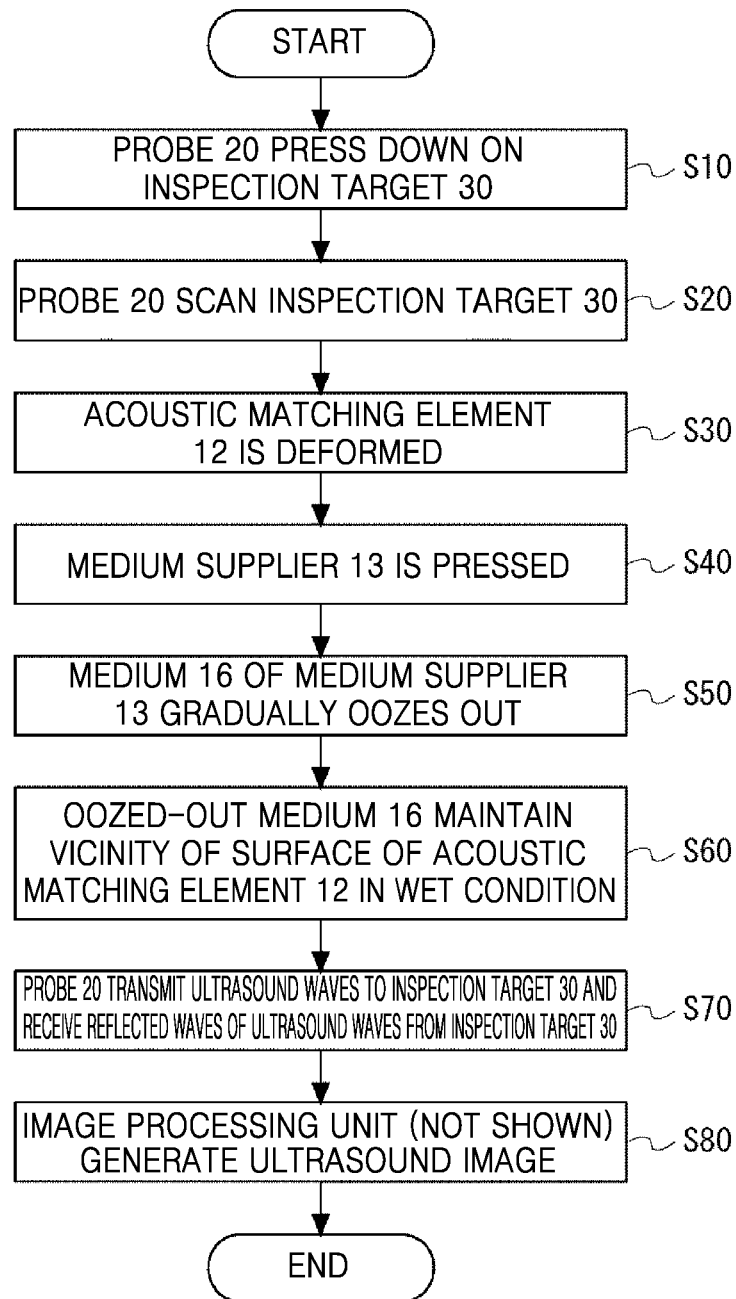


FIG. 6

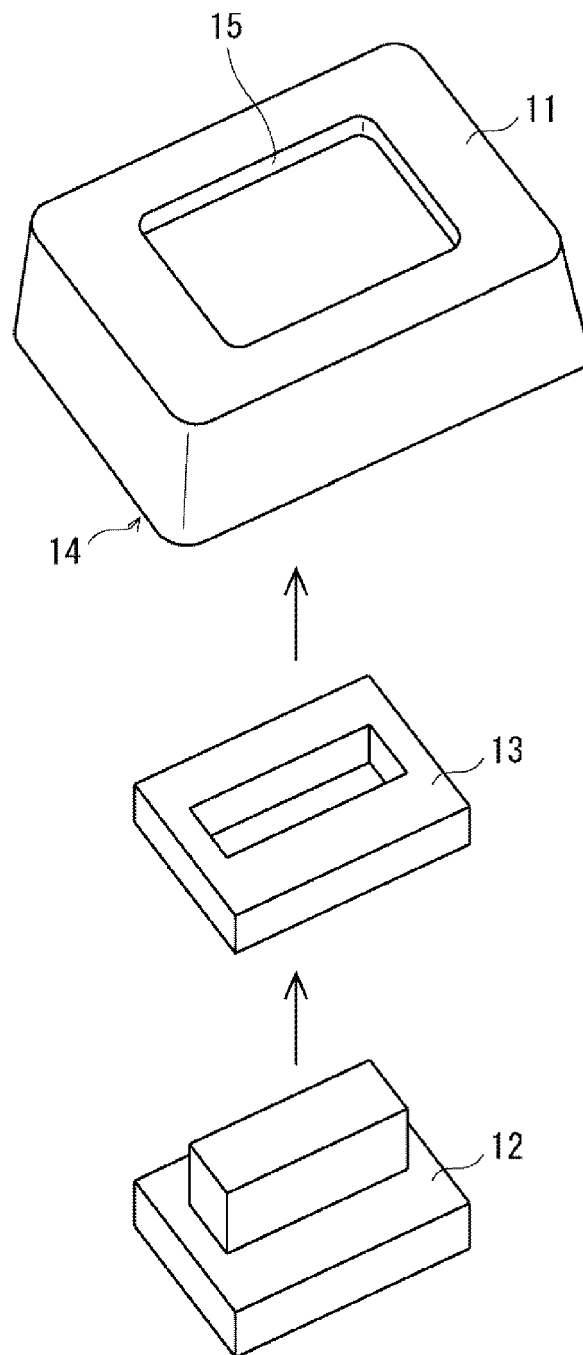


FIG. 7

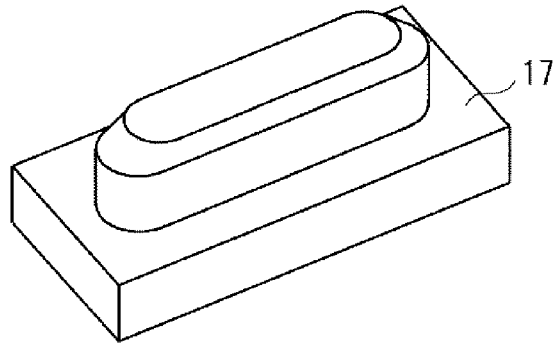


FIG. 8

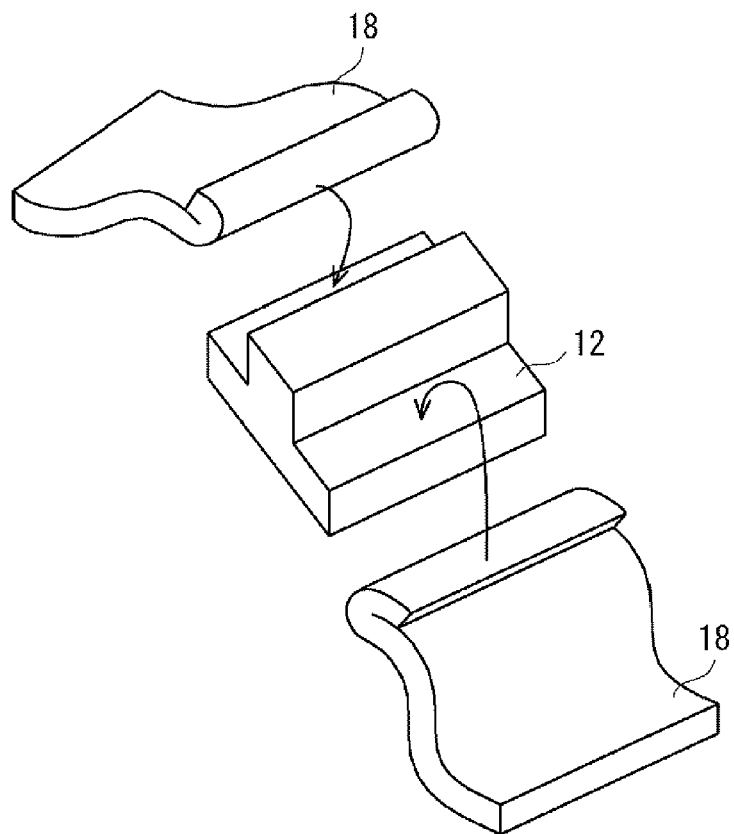


FIG. 9

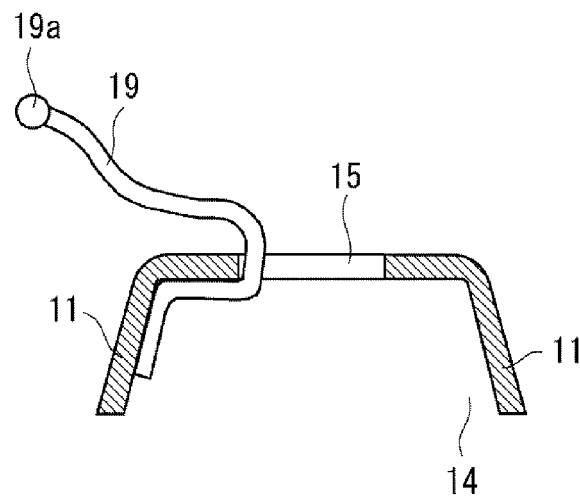
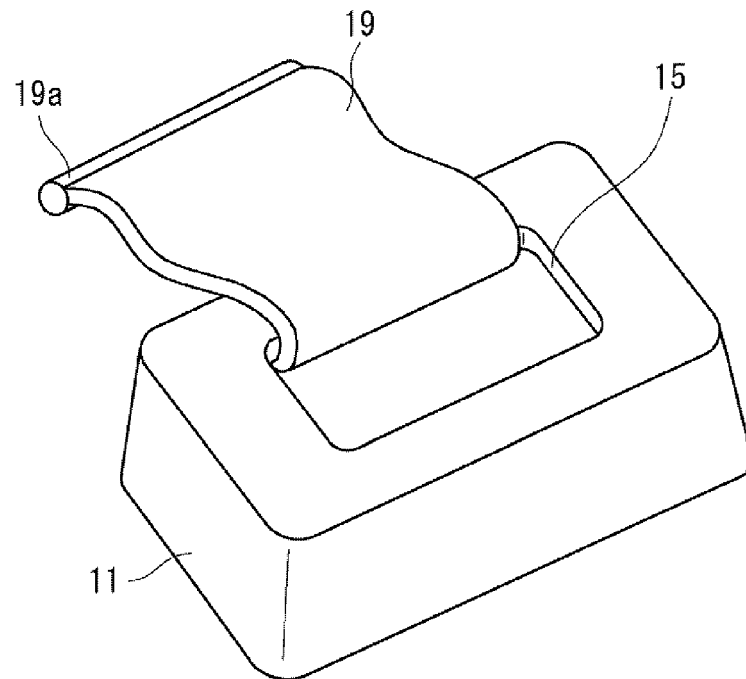


FIG. 10

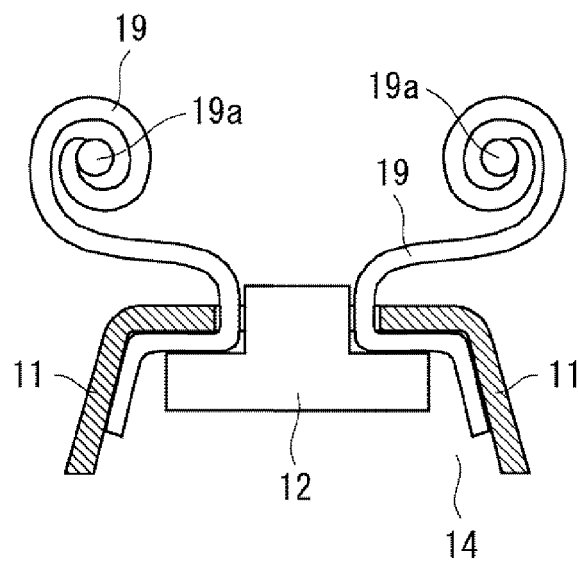
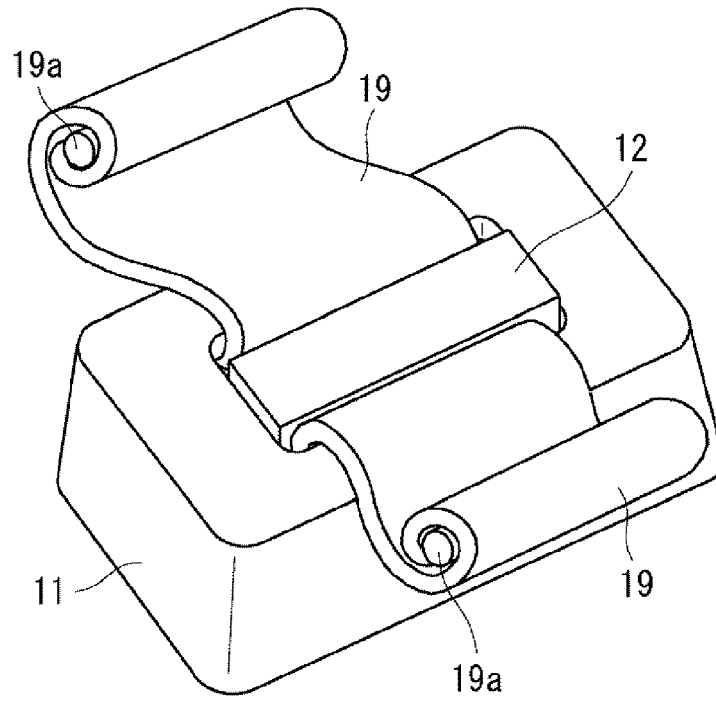


FIG. 11

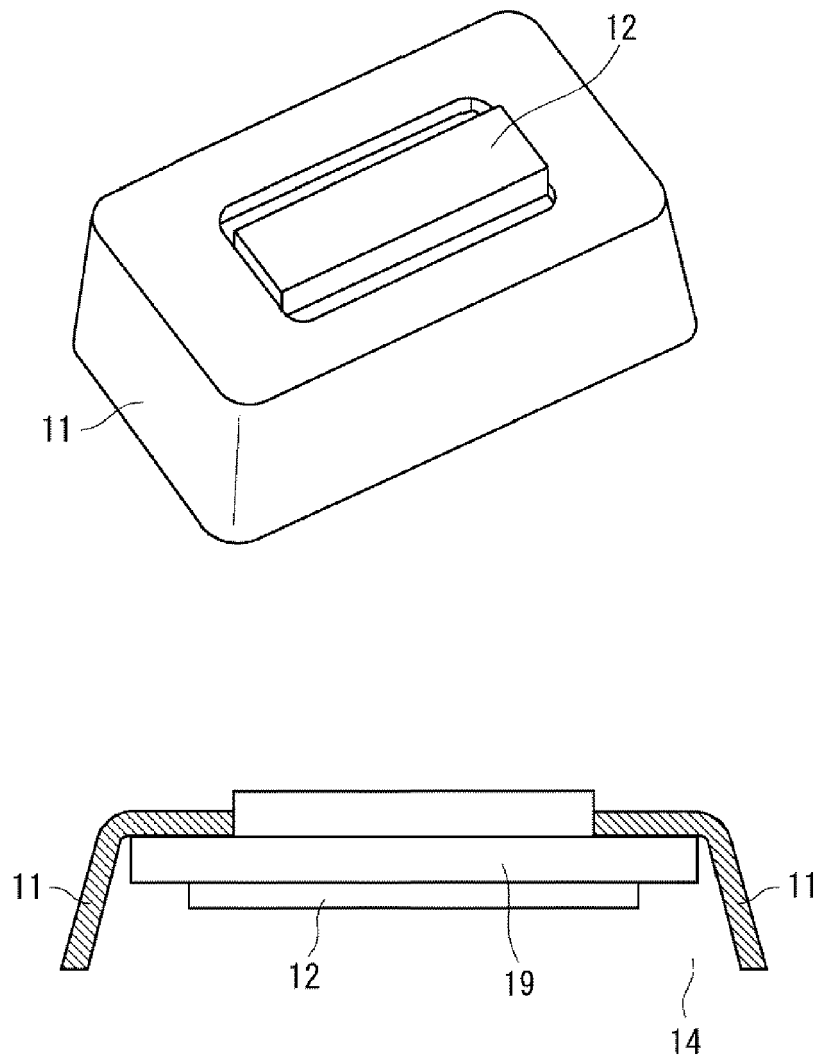


FIG. 12

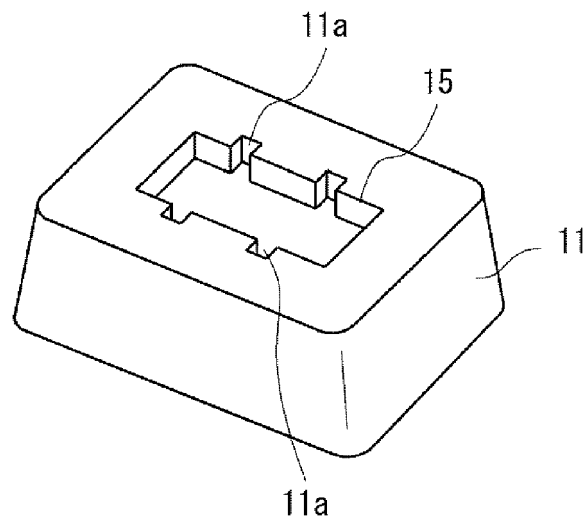


FIG. 13

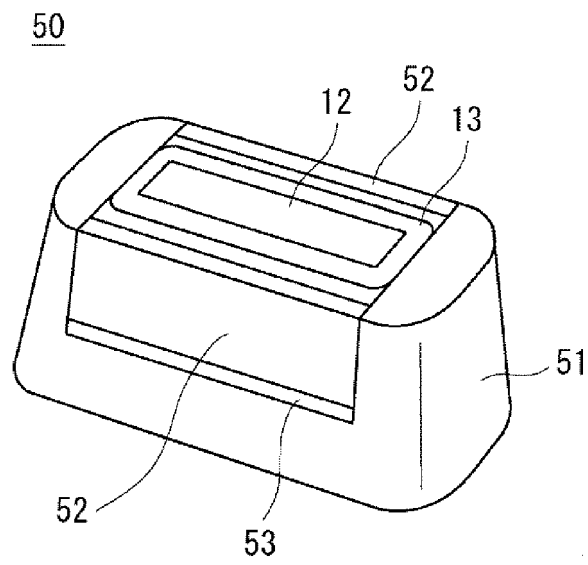


FIG. 14

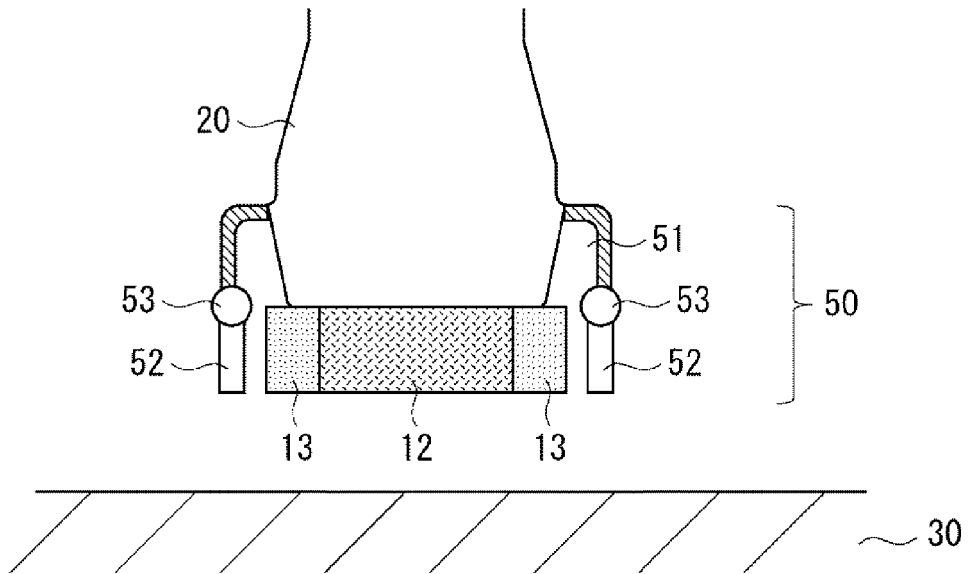


FIG. 15

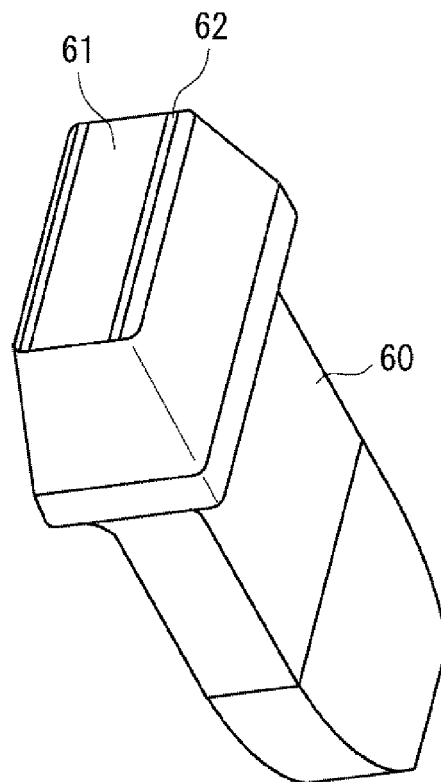
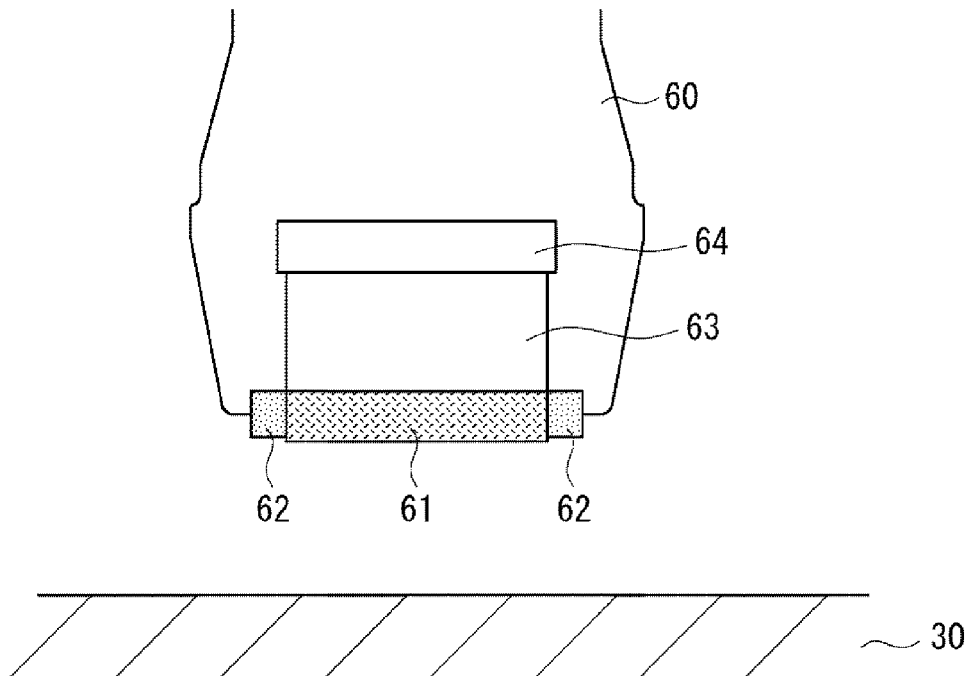


FIG. 16



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2015/010438

A. CLASSIFICATION OF SUBJECT MATTER

A61B 8/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A61B 8/00; A61B 17/22; A61B 8/08; G01N 29/24

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Utility models and applications for Utility models: IPC as above
Japanese Utility models and applications for Utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS (KIPO internal) & Keywords: ultrasonic wave, deformation, acoustic matching, medium

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 104068892 A (SEIKO EPSON CORPORATION) 01 October 2014 See paragraphs [0048]-[0072] and figures 2-16.	1-19
A	JP 2013-085565 A (UNIV. OF TOKYO et al.) 13 May 2013 See abstract, paragraphs [0041]-[0048] and figures 9-12.	1-19
A	JP 2007-014606 A (TOSHIBA CORP. et al.) 25 January 2007 See abstract, paragraphs [0024]-[0031] and claims 1-8.	1-19
A	JP 05-220156 A (SIEMENS AG.) 31 August 1993 See abstract, claims 1-8 and figures 1, 2.	1-19
A	JP 2011-004807 A (ALOKA CO., LTD.) 13 January 2011 See abstract, paragraphs [0023]-[0040] and figures 1-4.	1-19

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

15 JANUARY 2016 (15.01.2016)

Date of mailing of the international search report

15 JANUARY 2016 (15.01.2016)

Name and mailing address of the ISA/KR



Korean Intellectual Property Office
Government Complex-Daejeon, 189 Seonsa-ro, Daejeon 302-701,
Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2015/010438

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☒ Claims Nos.: **20**
because they relate to subject matter not required to be searched by this Authority, namely:
Claim 20 pertains to a method for diagnosis of the human body, and thus pertains to subject matter on which the International Searching Authority is not required to carry out an international search under the provisions of PCT Article 17(2)(a)(i) and PCT Rule 39.1(iv).
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/KR2015/010438

Patent document cited in search report	Publication date	Patent family member	Publication date
CN 104068892 A	01/10/2014	NONE	
JP 2013-085565 A	13/05/2013	NONE	
JP 2007-014606 A	25/01/2007	NONE	
JP 05-220156 A	31/08/1993	DE 4136004 C1	28/01/1993
		FR 2684834 A1	11/06/1993
		FR 2684834 B1	29/04/1994
		US 5305731 A	26/04/1994
JP 2011-004807 A	13/01/2011	NONE	

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2012176197 A [0002]

专利名称(译)	超声波探头附件，超声波探头，超声波检查装置和超声波检查方法		
公开(公告)号	EP3202326A1	公开(公告)日	2017-08-09
申请号	EP2015847218	申请日	2015-10-02
[标]申请(专利权)人(译)	三星电子株式会社		
申请(专利权)人(译)	SAMSUNG ELECTRONICS CO. , LTD.		
当前申请(专利权)人(译)	SAMSUNG ELECTRONICS CO. , LTD.		
[标]发明人	IIJIMA KAZUO		
发明人	IIJIMA, KAZUO		
IPC分类号	A61B8/00		
CPC分类号	A61B8/4281 A61B8/4272 A61B8/4444 G01S7/52079		
优先权	2014204136 2014-10-02 JP		
其他公开文献	EP3202326B1 EP3202326A4		
外部链接	Espacenet		

摘要(译)

提供了一种用于超声探头的附件，超声探头，超声检查设备和超声检查方法。超声波探头的附件包括设置在超声波探头的收发器上的声学匹配元件，并且当超声波探头扫描检查目标的表面时，基于检查目标的表面变形。介质供应器，其设置在声学匹配元件附近，并且被配置为基于声学匹配元件的变形在检查目标和声学匹配元件之间提供介质；以及配置为将声匹配元件和介质供应器固定到超声探头的主体。

FIG. 4

