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(54) **ULTRASONIC GEL SHEET ASSEMBLY**

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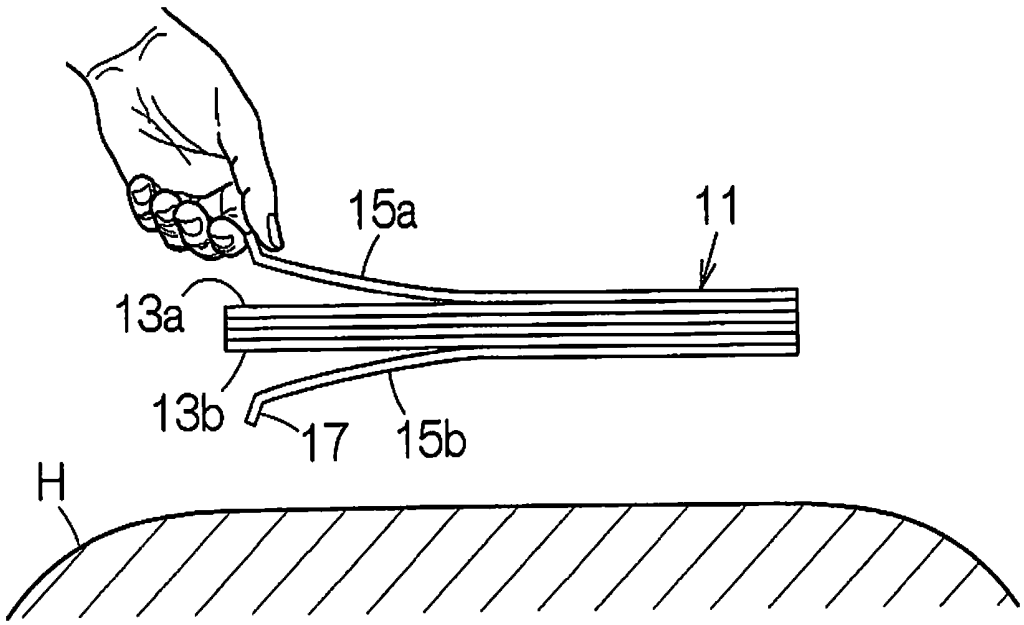
(57) **ABSTRACT**

The ultrasonic gel sheet assembly is used for acoustic matching between an ultrasonic device and an object to be tested. The ultrasonic gel sheet assembly includes a plurality of gel layers placed on top of each other. A partition sheet is placed between any adjacent ones of the gel layers. The partition sheet partitions a dispersion medium contained in the gel layers between the gel layers. Movement of water or any other dispersion medium is blocked by the partition sheet **14** between the adjacent gel layers.



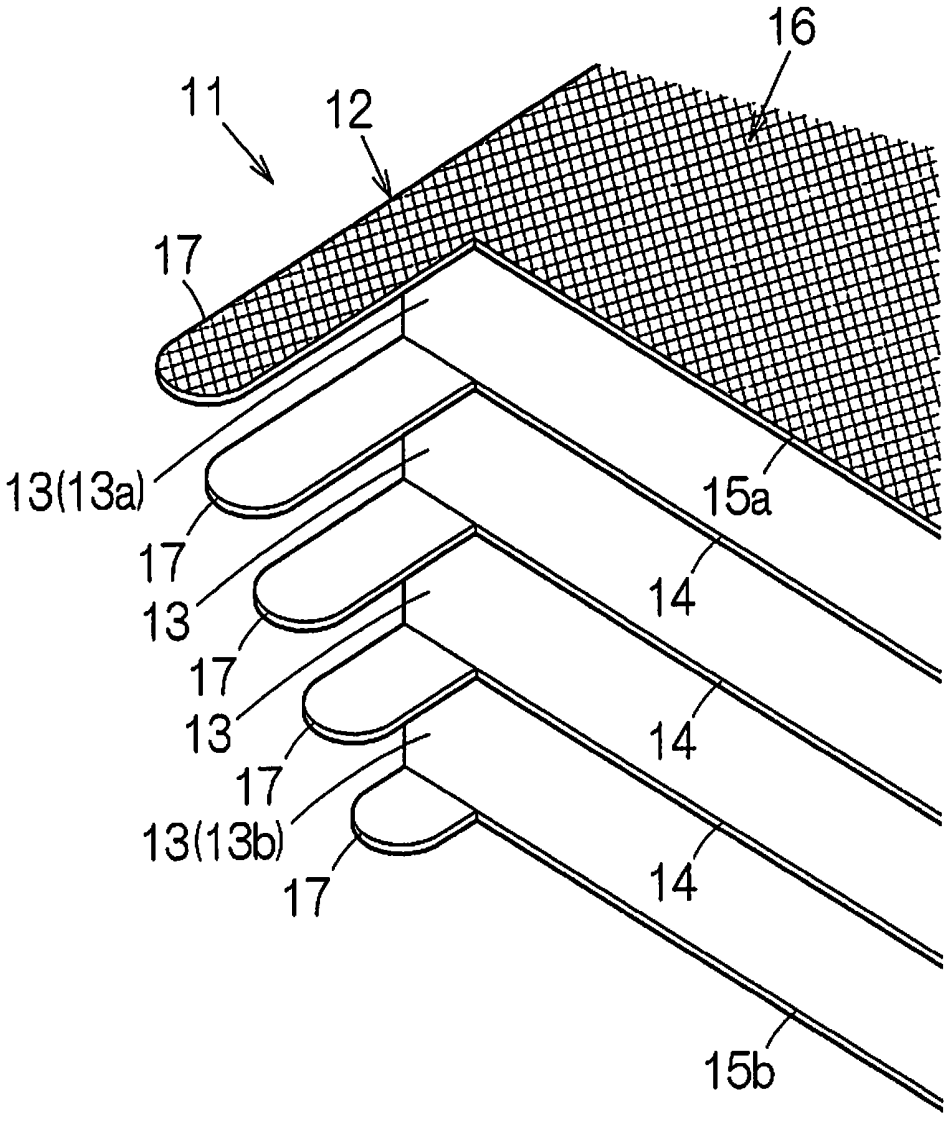


FIG. 1

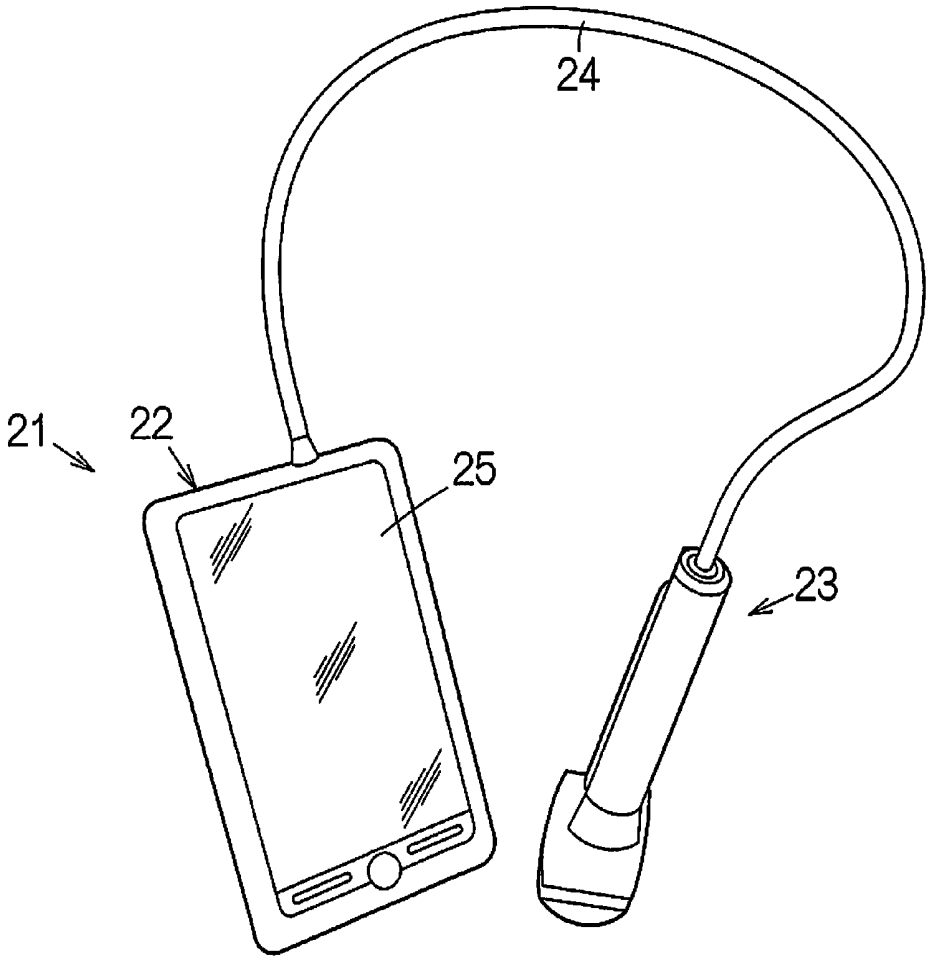


FIG. 2

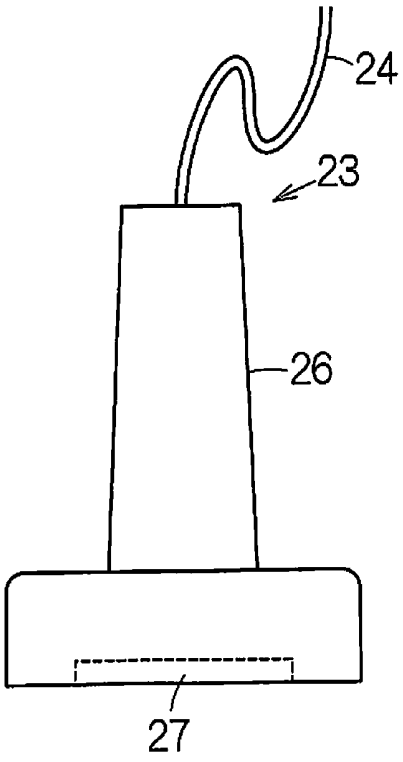


FIG. 3

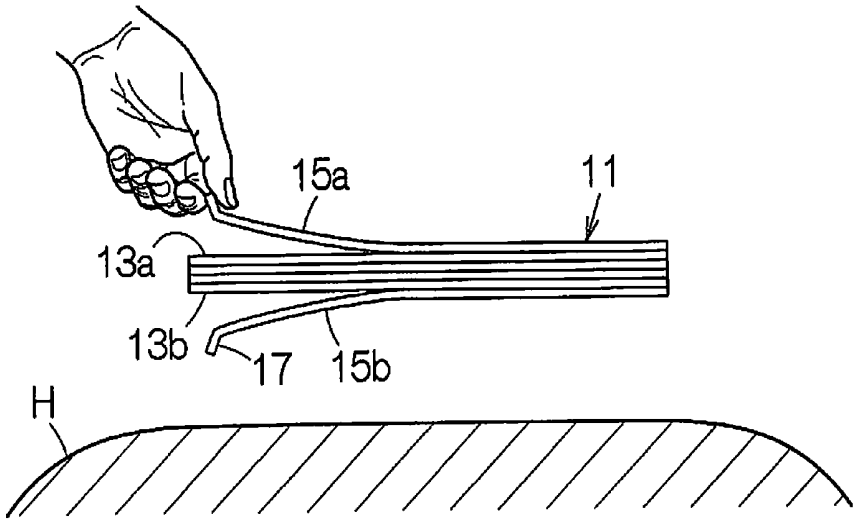


FIG. 4

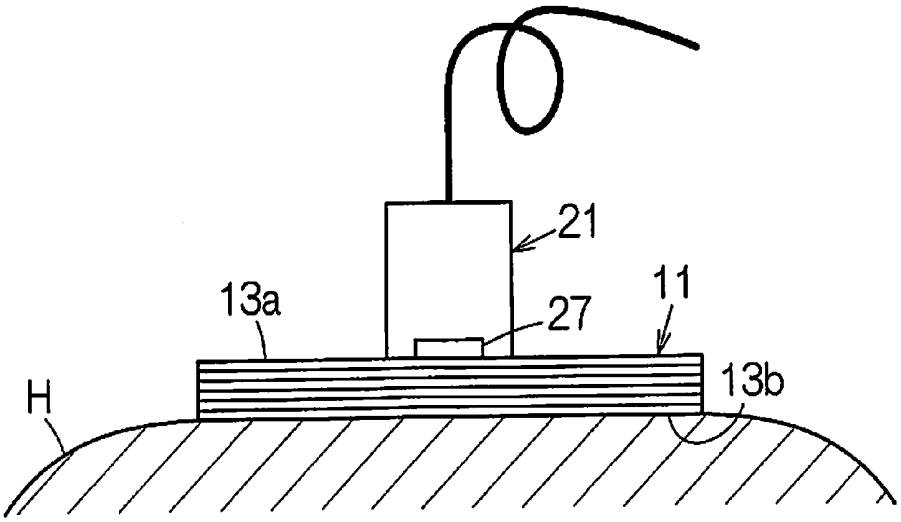


FIG. 5

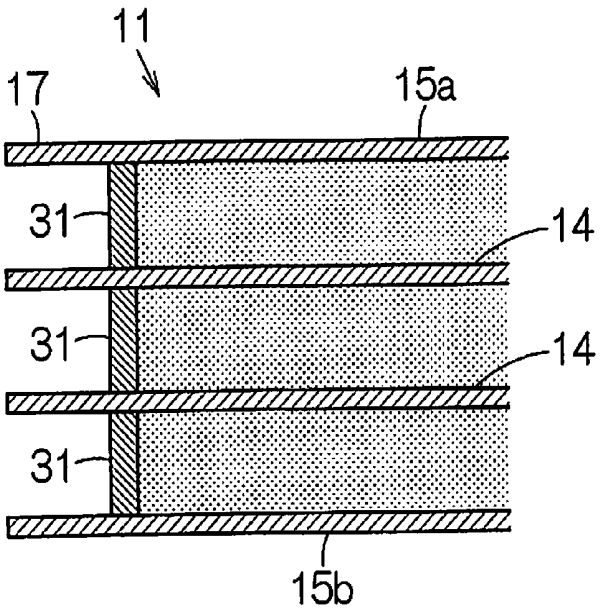


FIG. 6

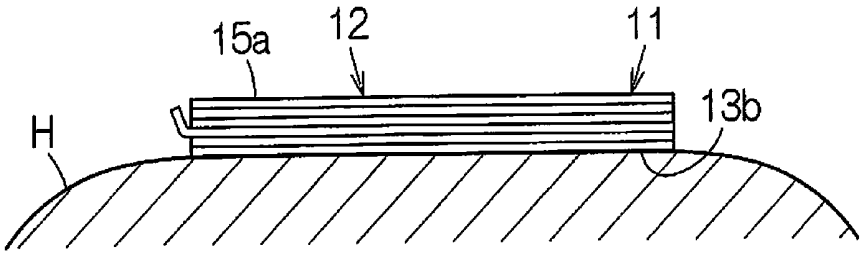


FIG. 7

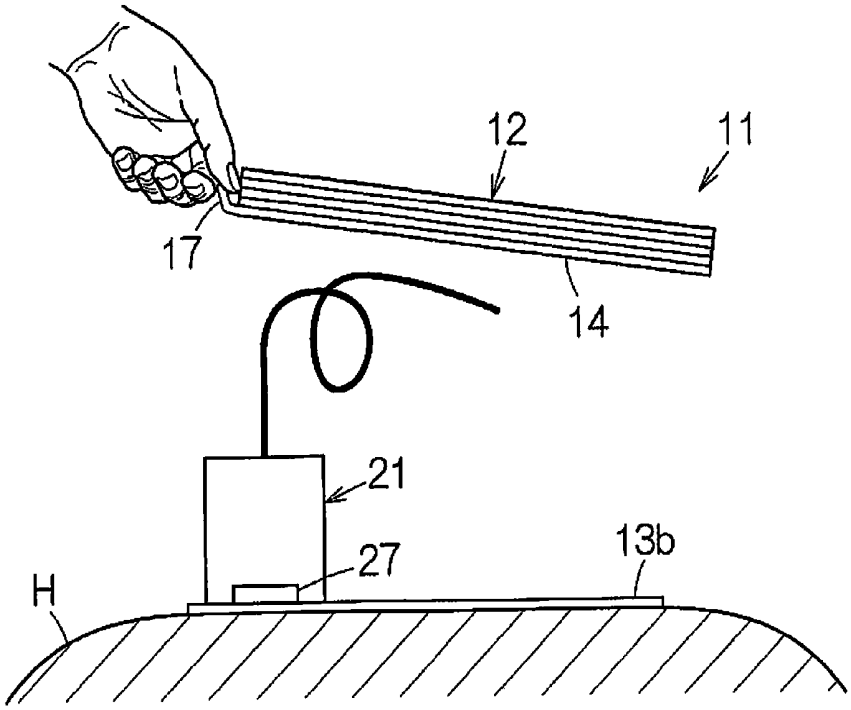


FIG. 8

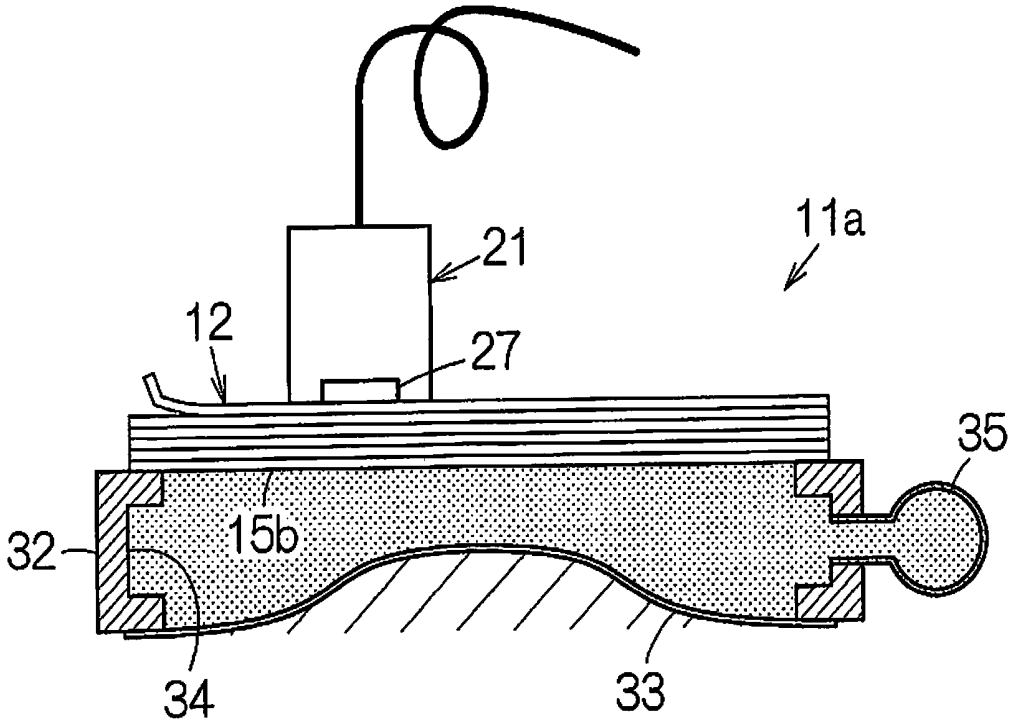


FIG. 9

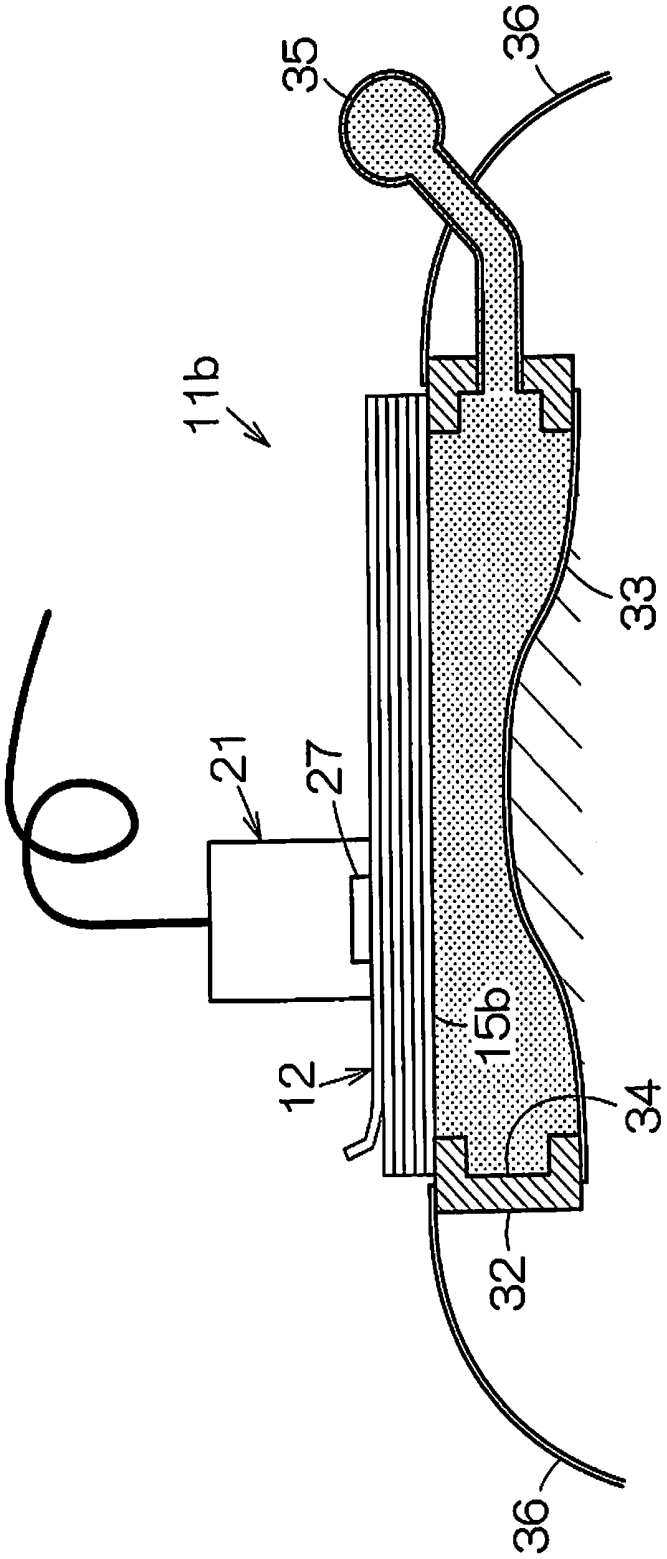


FIG.10

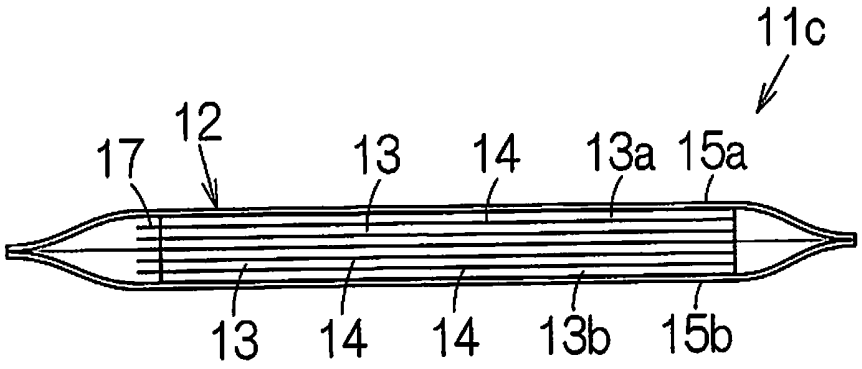


FIG.11

ULTRASONIC GEL SHEET ASSEMBLY

BACKGROUND

Technical Field

[0001] The present invention relates to an ultrasonic gel sheet assembly and the like used for acoustic matching between an ultrasonic device and an object to be tested.

[0002] Ultrasonic imaging apparatuses such as an ultrasonic diagnosis apparatus are generally known. An ultrasonic device is incorporated in an ultrasonic prove of such an ultrasonic diagnosis apparatus. In ultrasonic diagnosis, the ultrasonic device is pressed against an object to be tested such as a human body. In pressing of the ultrasonic device, an ultrasonic gel sheet, for example, is interposed between the ultrasonic device and the object. The ultrasonic gel sheet is meant to achieve acoustic matching between the ultrasonic device and the object.

[0003] According to JP-A-2012-176197, an ultrasonic gel sheet has a primary echo gel film and a secondary echo gel film. The secondary echo gel film is directly placed on the primary echo gel film, and the secondary echo gel film is exposed to outside air. As the secondary echo gel film becomes dry, a dispersion medium, i.e., water moves from the primary echo gel film to the secondary echo gel film. Drying therefore proceeds, not only in the secondary echo gel film but also in the primary echo gel film.

[0004] In view of the above, an ultrasonic gel sheet assembly capable of preventing the loss of a dispersion medium as much as possible has been desired.

SUMMARY

[0005] (1) According to an aspect of the invention, an ultrasonic gel sheet assembly used for acoustic matching between an ultrasonic device and an object to be tested, includes: a plurality of gel layers placed on top of each other; and a partition sheet placed between the plurality of gel layers to partition a dispersion medium contained in the gel layers between the gel layers.

[0006] Movement of water or any other dispersion medium is blocked by the partition sheet between the adjacent gel sheets placed on top of each other. Even if the dispersion medium is lost in one gel layer, the other gel layer is prevented from becoming dry. In this gel layer, the dispersion medium is sufficiently held. Therefore, even if the one gel layer loses the function of acoustic matching as it becomes dry, the other gel layer can sufficiently achieve the acoustic matching function. The gel layer moistened with the dispersion medium can be interposed between the ultrasonic device and the object to be tested. If the gel layers are directly placed on top of each other without the intervention of the partition sheet, as one gel layer becomes dry, the dispersion medium will move from the other gel layer to the one gel layer, resulting in that drying of the other gel layer will also proceed along with the drying of the one gel layer.

[0007] (2) The ultrasonic gel sheet assembly can further include coating sheets that cover outer surfaces of uppermost and lowermost gel layers out of the plurality of gel layers. The coating sheets protect the uppermost and lowermost gel layers from outside air. As long as being covered with the coating sheets, the uppermost and lowermost gel layers are prevented from loss of the dispersion medium. The gel layers can therefore be stored in a good state containing the dispersion medium after manufacture and also at a sale destination.

[0008] (3) The coating sheets may be formed of the same material as the partition sheet. With the partition sheet and the coating sheets being formed of the same material, the manufacture of the ultrasonic gel sheet assembly can be simplified. For example, when the uppermost and lowermost gel layers are peeled off, the partition sheet can function as the coating sheet as it is.

[0009] (4) Peripheries of the coating sheets may be sealed to enclose the plurality of gel layers therein. The coating sheets seal the multilayer body of the gel layers to prevent loss of the dispersion medium. The gel layers can therefore be stored in a good state containing the dispersion medium after manufacture and also at a sale destination. Since the coating sheets also serve as a packaging material, saving of the packaging material can be achieved.

[0010] (5) The coating sheets may be formed of a material different from that of the partition sheet. Because the coating sheets are peeled off at the use of the ultrasonic gel sheet assembly, it is unnecessary to consider reflection of ultrasound at the interfaces between the gel layers and the coating sheets. Therefore, a material suitable for the covering function of the coating sheets can be used without the necessity of considering the acoustic impedance of the coating sheets.

[0011] (6) The dispersion medium may be water, and the partition sheet may be formed of any of silicone rubber, natural rubber, polyethylene, polypropylene, polyethylene terephthalate, polycarbonate, paper, and cloth. Having such a combination of the dispersion medium and the partition sheet, reflection of ultrasound is prevented or reduced at the interfaces between the gel layers and the partition sheet. Therefore, ultrasound can be well transmitted from the ultrasonic device to the object to be tested.

[0012] (7) The partition sheet may have a contact angle with water of 70° to 140°. Having such a contact angle, the partition sheet is given a water repelling function, securing a nature of resisting the passage of water therethrough.

[0013] (8) The partition sheet may have a shape of projections and depressions formed by embossing. Having such a surface, the partition sheet can be easily peeled off from the gel layer.

[0014] (9) The partition sheet may have a tab extending outward from the outline of the gel layers. At the time of peeling off the partition sheet from the gel layer, the user can grip the tab. In this way, the partition sheet can be easily torn off from the gel layer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The invention will be described with reference to the accompanying drawings, wherein like numbers reference like elements.

[0016] FIG. **1** is a partial perspective view schematically showing a structure of an ultrasonic gel sheet assembly according to the first embodiment of the invention.

[0017] FIG. **2** is a schematic view of one specific example of an electronic apparatus, i.e., an ultrasonic diagnosis apparatus according to an embodiment.

[0018] FIG. **3** is an enlarged front view of an ultrasonic probe.

[0019] FIG. **4** is a concept view schematically showing how to use an ultrasonic gel sheet assembly according to a specific example.

[0020] FIG. **5** is a concept view schematically showing how to use the ultrasonic gel sheet assembly in succession to FIG. **4**.

[0021] FIG. **6** is an enlarged partial cross-sectional view of an ultrasonic gel sheet assembly schematically showing walls surrounding gel layers.

[0022] FIG. **7** is a concept view schematically showing how to use an ultrasonic gel sheet assembly according to another specific example.

[0023] FIG. **8** is a concept view schematically showing how to use the ultrasonic gel sheet assembly in succession to FIG. **7**.

[0024] FIG. **9** is a partial perspective view schematically showing a structure of an ultrasonic gel sheet assembly according to the second embodiment of the invention.

[0025] FIG. **10** is a partial perspective view schematically showing a structure of an ultrasonic gel sheet assembly according to a variation of the second embodiment.

[0026] FIG. **11** is a partial perspective view schematically showing a structure of an ultrasonic gel sheet assembly according to the third embodiment of the invention.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0027] The following describe embodiments of the present invention with reference to the accompanying drawings. It is to be noted that the embodiments to be described hereinafter will not unduly limit the content of the invention defined in the appended claims and that all of configurations to be described in the embodiments are not necessarily essential for achievement of the invention.

[0028] (1) Configuration of Ultrasonic Gel Sheet Assembly of First Embodiment

[0029] FIG. **1** schematically shows an ultrasonic gel sheet assembly **11** according to the first embodiment of the invention. The ultrasonic gel sheet assembly **11** has a multilayer body **12**. The multilayer body **12** is in the shape of a sheet having a rectangular outline, for example, and has a plurality of gel layers **13** placed on top of each other. About 2 to 50 gel layers **13** are placed on top of each other in the multilayer body **12**. A partition sheet **14** is placed between any adjacent gel layers **13**. Coating sheets **15***a* and **15***b* are respectively placed on the outer surfaces of uppermost and lowermost gel layers **13***a* and **13***b* out of the gel layers **13**. The coating sheets **15***a* and **15***b* cover the outer surfaces of the uppermost and lowermost gel layers **13***a* and **13***b*.

[0030] The gel layers **13** are formed of a gel material. The gel is formed by adding a thickening stabilizer (dispersoid) such as xanthan gum to water (dispersion medium). The gel maintains a fixed shape, for example, while having fluidity. The gel layers **13** are formed to have equal thicknesses: they have a thickness of about 0.05 mm to 5.0 mm, for example. The gel layers **13** may otherwise have thicknesses different from each other. Also, the thickness may vary in one gel layer **13**.

[0031] The partition sheets **14** separate the dispersion medium contained in the gel layers **13** between the adjacent gel layers **13**. The partition sheets **14** are formed of any of silicone rubber, natural rubber, polyethylene, polypropylene, polyethylene terephthalate, polycarbonate, paper, and cloth. The acoustic impedance of the partition sheets **14** is determined according to the acoustic impedance of the gel layers **13**. Depending on the setting of the acoustic impedances, reflection of ultrasound is prevented or reduced as much as possible at the boundaries of the partition sheets **14** and the gel layers **13**. In view of prevention of reflection of ultrasound, the acoustic impedance ratio of the partition sheets **14** to the gel layers **13** may be set in the range of 0.8 to 1.5.

[0032] The contact angle between the partition sheets **14**/coating sheets **15***a* and **15***b* and water is 70° to 140° . Depending on this contact angle, the partition sheets **14** and the coating sheets **15***a* and **15***b* are given a water repelling function, securing a nature of resisting the passage of water therethrough. Moreover, the partition sheets **14** and the coating sheets **15***a* and **15***b* easily come off from the gel layers **13** compared with the skin of which the contact angle with water is 50° to 70°. In the illustrated example, the partition sheets **14** and the coating sheets **15***a* and **15***b* have surfaces in a shape of projections and depressions formed by embossing. The projections and depressions are formed in a mesh pattern **16**. Such embossing can facilitate coming off of the partition sheets **14** and the coating sheets **15***a* and **15***b* from the gel layers **13**.

[0033] In the illustrated example, the coating sheets **15***a* and **15***b* are formed of the same material as the partition sheets **14**. The coating sheets **15***a* and **15***b* therefore isolate the dispersion medium contained in the uppermost and lowermost gel layers **13***a* and **13***b* from outside air. Evaporation of the dispersion medium from the outer surfaces of the uppermost and lowermost gel layers **13***a* and **13***b* is prevented. The coating sheets **15***a* and **15***b* cover the entire outer surfaces of the uppermost and lowermost gel layers **13***a* and **13***b*. The coating sheets **15***a* and **15***b* may otherwise be formed of a material different from that of the partition sheets **14**.

[0034] As shown in FIG. **1**, the partition sheets **14** and the coating sheets **15***a* and **15***b* each have a tab **17** extending outward from the outline of the gel layer **13**. The tab **17** is formed to have a size large enough to allow the user to pinch it easily with his or her two fingers. The tab **17** is placed next to one corner of the rectangular outline, for example. With this placement, the force of tearing off with the tab **17** at one position can act on the entire sheet sufficiently. The tabs **17** may be formed so that the edges (tips) thereof be located farther from the outline of the gel layers **13** as the tabs **17** are closer to the uppermost one. Such tabs **17** can be pinched one by one in descending order from the uppermost one.

[0035] (2) Operation of Ultrasonic Gel Sheet Assembly (Part 1)

[0036] In formation of an ultrasonic image, an ultrasonic probe of an ultrasonic imaging apparatus such as an ultrasonic diagnosis apparatus is pressed against an object to be tested such as a human body, for example. In pressing of the ultrasonic probe, the ultrasonic gel sheet assembly **11** is interposed between the ultrasonic probe and the object. As shown in FIG. **2**, an specific example of an ultrasonic diagnosis apparatus **21** includes a terminal **22** and an ultrasonic probe **23**, for example. The terminal **22** and the ultrasonic probe **23** are connected to each other via a cable **24**, and exchange electronic signals with each other via the cable **24**. A display panel **25** is incorporated in the terminal **22**. The screen of the display panel **25** is exposed at the surface of the terminal **22**. In the terminal **22**, an image is generated based on the ultrasound detected by the ultrasonic probe **23**, and the imaged detected result is displayed on the screen of the display panel **25**.

[0037] As shown in FIG. **3**, the ultrasonic probe **23** has a housing **26**. An ultrasonic device **27** is housed in the housing **26**. The surface of the ultrasonic device **27** can be exposed at

the surface of the housing **26**. The ultrasonic device **27** outputs ultrasound from its surface and also receives a reflected wave of the ultrasound.

[0038] As shown in FIG. **4**, at the use of the ultrasonic gel sheet assembly **11**, the two coating sheets **15***a* and **15***b* are peeled off, whereby the outer surfaces of the uppermost and lowermost gel layers **13***a* and **13***b* are exposed. For peeling off, the tabs **17** of the coating sheets **15***a* and **15***b* may be pinched. As shown in FIG. **5**, the outer surface of the lowermost gel layer **13***b* is stuck to an object H to be tested. Since the gel layer **13***b* is sufficiently moistened with the dispersion medium, the outer surface of the gel layer **13***b* comes into close contact with the object H. For example, pores of the skin are closed. Air is expelled from the interface. The ultrasonic device **27** is pressed against the outer surface of the uppermost gel layer **13***a*. Since the gel layer **13***a* is also sufficiently moistened with the dispersion medium, the ultrasonic device **27** can be brought into close contact with the outer surface of the gel layer **13***a*. Air is expelled from the interface. The ultrasonic device **27** can slide on the outer surface of the gel layer **13***a*. In this way, the ultrasonic device **27** and the object H are well coupled to each other acoustically. A good ultrasonic image can thus be formed.

[0039] When the object H is changed to another one, the partition sheet **14** adjacent to the lowermost gel layer **13***b* is peeled off from its adjacent gel layer **13**. For peeling off, the tab **17** of the partition sheet **14** may be pinched. The lowermost gel layer **13***b* is removed together with the partition sheet **14**. The gel layer **13** moistened with the dispersion medium is then newly exposed. The outer surface of the newly-exposed gel layer **13** is then stuck to an object H to be tested. Since the gel layer **13** is sufficiently moistened with the dispersion medium, the outer surface of the gel layer **13** comes into close contact with the object H. Similarly, every time the object H is changed to another one, the partition sheet **14** adjacent to the uppermost gel layer **13***a* may be peeled off from its adjacent gel layer **13**. In this way, the uppermost gel layer **13***a* can be removed together with the partition sheet **14**.

[0040] Otherwise, the partition sheet **14** adjacent to the uppermost gel layer **13***a* may be maintained over a plurality of objects H to be tested. In this case, the uppermost gel layer **13***a* is kept exposed to outside air. Therefore, the dispersion medium is gradually lost from the gel layer **13***a*. Once it is recognized that the uppermost gel layer **13***a* has become dry, the partition sheet **14** adjacent to the uppermost gel layer **13***a* may be peeled off from its adjacent gel layer **13**. In this way, the uppermost gel layer **13***a* can be removed together with the partition sheet **14**. The gel layer **13** moistened with the dispersion medium is then newly exposed.

[0041] Movement of water or any other dispersion medium is blocked between the gel layers **13** placed on top of each other. Even if the dispersion medium is lost from the gel layers **13***a* and **13***b* facing outside air, their adjacent gel layers **13** are prevented from drying: the dispersion medium is sufficiently held in the gel layers **13**. Therefore, even if the function of acoustic matching is lost from the uppermost and lowermost gel layers **13***a* and **13***b* as they become dry, the other gel layers **13** can adequately achieve the function of acoustic matching. The gel layers **13** moistened with the dispersion medium can be interposed between the ultrasonic device **27** and the object H. If the gel layers **13** are directly placed on top of each other without the intervention of the partition sheet **14**, as one gel layer **13** becomes dry, the dispersion medium will move from the other gel layer **13** to the one gel layer **13**, resulting in that drying of the other gel layer **13** will also proceed along with the drying of the one gel layer **13**.

[0042] The coating sheets **15***a* and **15***b* protect the uppermost and lowermost gel layers **13***a* and **13***b* from outside air. As long as being covered with the coating sheets **15***a* and **15***b*, the uppermost and lowermost gel layers **13***a* and **13***b* are prevented from losing the dispersion medium. The moist gel layers **13***a* and **13***b* can be well stored after manufacture and also at a sale destination. Moreover, since the partition sheets **14** and the coating sheets **15***a* and **15***b* are formed of the same material in the illustrated example, the manufacture of the ultrasonic gel sheet assembly **11** can be simplified. For example, when the uppermost and lowermost gel layers **13***a* and **13***b* are peeled off, the partition sheets **14** can function as the coating sheets **15***a* and **15***b* as they are. Otherwise, the coating sheets **15***a* and **15***b* may be formed of a material different from that of the partition sheets **14**. Because the coating sheets **15***a* and **15***b* are peeled off at the use of the ultrasonic gel sheet assembly **11**, it is unnecessary to consider reflection of ultrasound at the interfaces between the gel layers **13** and the coating sheets **15***a* and **15***b*. Therefore, no consideration on the acoustic impedance of the coating sheets **15***a* and **15***b* is necessary. A material suitable for the function of the coating sheets **15***a* and **15***b* can be used.

[0043] Water is used as the dispersion medium in the ultrasonic gel sheet assembly **11** according to this embodiment. In this case, the partition sheets **14** and the coating sheets **15***a* and **15***b* are formed of any of silicone rubber, natural rubber, polyethylene, polypropylene, polyethylene terephthalate, polycarbonate, paper, and cloth. Having such a combination of the dispersion medium and the partition sheets **14**/coating sheets **15***a* and **15***b*, reflection of ultrasound is prevented or reduced at the interfaces between the gel layers **13** and the partition sheets **14**/coating sheets **15***a* and **15***b*. Therefore, ultrasound can be well transmitted from the ultrasonic device **27** to the object H.

[0044] As described earlier, the contact angle between the surfaces of the the partition sheets **14**/coating sheets **15***a* and **15***b* and water is 70° to 140°. With such a contact angle, the partition sheets **14** and the coating sheets **15***a* and **15***b* are given a water repelling function, securing a nature of resisting the passage of water therethrough. Moreover, the partition sheets **14** and the coating sheets **15***a* and **15***b* easily come off from the gel layers **13** compared with the skin of which the contact angle with water is 50° to 70°. In particular, since the mesh pattern **16** is formed on the surfaces of the partition sheets **14** and the coating sheets **15***a* and **15***b* by embossing, the partition sheets **14** and the coating sheets **15***a* and **15***b* can be easily peeled off from the gel layers **13**. For example, the contact angle between a silicone rubber sheet and water (ultrapure water) was 113.3° to 114.1° (average: 113.7°) by the θ/2 method according to measurements using an automatic dynamic contact angle meter manufactured by Kyowa Interface Science Co., Ltd. Likewise, the contact angle between a polyethylene terephthalate (PET) film and water (ultrapure water) was 70.5° to 73.6° (average: 71.9°) by the θ/2 method according to measurements using the automatic dynamic contact angle meter manufactured by Kyowa Interface Science Co., Ltd.

[0045] In the ultrasonic gel sheet assembly **11**, as shown in FIG. **6**, a solid wall **31** may be placed along the outer rim of each gel layer **13**. The wall **31** surrounds the gel layer **13** between the adjacent partition sheets **14** or between the par-

tition sheet **14** and the coating sheet **15***a* or **15***b* along the surface of the partition sheet **14**. The wall **31** may be formed by hardening the material of the gel layer **13** itself or formed of silicone rubber or any other solid material similar to that of the partition sheets **14**. The wall **31** forms a storage space for the gel layer **13** in cooperation with the paired adjacent partition sheets **14** (one of which may be the coating sheet **15***a* or **15***b*). As a result, the dispersion medium can be prevented from evaporating from the outer rim of the gel layer **13**, achieving further effective prevention of drying of the gel layer **13**.

[0046] With the tab **17** extending outside from the outline of the gel layer **13** formed on each of the partition sheets **14** and the coating sheets **15***a* and **15***b*, the user can grip the tab **17** when peeling off the partition sheet **14** (coating sheet **15***a* or **15***b*) from the gel layer **13**. In this way, the partition sheets **14** and the coating sheets **15***a* and **15***b* can be easily torn off from the gel layers **13**. In particular, with the stacked partition sheets **14** and coating sheets **15***a* and **15***b*, the tabs **17** are avoided from completely overlapping one another but placed at displaced positions. Thus, the partition sheets **14** and the coating sheets **15***a* and **15***b* can be easily peeled off individually.

[0047] (3) Operation of Ultrasonic Gel Sheet Assembly (Part 2)

[0048] The coating sheet **15***b* covering the lowermost gel layer **13***b* is peeled off, whereby the outer surface of the lowermost gel layer **13***b* is exposed in the ultrasonic gel sheet assembly **11**. For peeling off, the tab **17** of the coating sheet **15***b* may be pinched. At this time, the coating sheet **15***a* may maintain the covering of the uppermost gel layer **13***a*. As shown in FIG. **7**, the outer surface of the lowermost gel layer **13***b* is stuck to an object H to be tested. Since the gel layer **13***b* is sufficiently moistened with the dispersion medium, the outer surface of the gel layer **13***b* comes into close contact with the object H. Air is expelled from the interface.

[0049] Subsequently, as shown in FIG. **8**, the partition sheet **14** adjacent to the lowermost gel layer **13***b* that is in close contact with the object H is peeled off from the gel layer **13***b*. At this time, since the contact angle between the partition sheet **14** and water is larger than the contact angle between the skin and water, the partition sheet **14** comes off from the gel layer **13** more easily than the skin. Therefore, at the tearing off of the partition sheet **14**, the gel layer **13** will not come off from the skin. The tab **17** of the partition sheet **14** may just be pinched at this peeling off. The multilayer body **12** including the layers located above this partition sheet **14** is separated together, and only the lowermost gel layer **13***b* remains on the object H. The ultrasonic device **27** is pressed against the surface of the remaining gel layer **13**. Since the gel layer **13***b* is sufficiently moistened with the dispersion medium, the ultrasonic device **27** can be brought into close contact with the outer surface of the gel layer **13***b*. Air is expelled from the interface. The ultrasonic device **27** can slide on the outer surface of the gel layer **13***b*. In this way, the ultrasonic device **27** and the object H are well coupled to each other acoustically. A good ultrasonic image can thus be formed.

[0050] (4) Configuration of Ultrasonic Gel Sheet Assembly of Second Embodiment

[0051] FIG. **9** schematically shows an ultrasonic gel sheet assembly **11***a* according to the second embodiment of the invention. The ultrasonic gel sheet assembly **11***a* has a multilayer body **12** as in the first embodiment. A frame **32** is secured to the coating sheet **15***b* of the multilayer body **12**. The frame **32** may be formed of a metal material such as stainless steel and aluminum or a resin material such as polypropylene and polyethylene. The frame **32** continuously surrounds an inner space. The top end of the frame **32** supports the outer rim of the coating sheet **15***b*, and the coating sheet **15***b* adjoins the space inside the frame **32**. The ratio of the acoustic impedance of the partition sheets **14** and the coating sheet **15***b* to the acoustic impedance of the gel layers **13** is set in the range of 0.8 to 1.5.

[0052] An acoustic matching film **33** is fixed to the bottom end of the frame **32**. The acoustic matching film **33** is supported by the bottom end of the frame **32** along its outer rim, and adjoins the space inside the frame **32**. Thus, an enclosed space **34** is formed by the acoustic matching film **33**, the frame **32**, and the coating sheet **15***b*. The enclosed space **34** in the frame **32** is filled with an acoustic matching medium such as water. The acoustic matching film **33** has flexibility, and can be deformed in response to the action of an external force. With such a deforming nature, the acoustic matching film **33** can follow the shape of the object H. The acoustic matching film **33** may be formed of a material having an acoustic impedance close to that of the object H. In the illustrated example, the acoustic matching film **33** is formed of natural rubber or silicone rubber.

[0053] A pressure regulation bag **35** is connected to the frame **32**. The pressure regulation bag **35** is formed of a stretchable material. The inner space of the pressure regulation bag **35** is connected to the enclosed space **34** of the frame **32**. When the volume of the enclosed space **34** changes with the deformation of the acoustic matching film **33**, the volume of the pressure regulation bag **35** changes with this change. In this way, the total volume of these spaces is kept fixed. In the illustrated example, the Young's modulus of the multilayer body **12** is larger than that of the material of the pressure regulation bag **35**.

[0054] In formation of an ultrasonic image, the ultrasonic gel sheet assembly **11***a* is pressed against the object H. The acoustic matching film **33** follows projections of the object H. At this time, according to the magnitude of the Young's modulus, while the multilayer body **12** maintains its original shape, the pressure regulation bag **35** expands. Thus, even if projections and depressions are present on the object H, the space between the object H and the ultrasonic gel sheet assembly **11***a* can be filled with an acoustic coupling material without causing deformation of the gel layers **13** and the partition sheets **14**. The ultrasonic device **27** can therefore be coupled to the object H acoustically without fail.

[0055] FIG. **10** schematically shows an ultrasonic gel sheet assembly **11***b* according to a variation of the second embodiment. In the ultrasonic gel sheet assembly **11***b*, the frame **32** is formed of an elastic material, and can follow the shape of the object H. Bands **36** are attached to the frame **32**. The bands **36** can be formed of a stretchable material, for example. The ultrasonic gel sheet assembly **11***b* can be mounted on the object H, for example, with the bands **36**. The bands **36** can be wound around, for example, an arm or leg of a human body. The other configuration is similar to that of the ultrasonic gel sheet assembly **11***a*.

[0056] (5) Configuration of Ultrasonic Gel Sheet Assembly of Third Embodiment

[0057] FIG. **11** schematically shows an ultrasonic gel sheet assembly **11***c* according to the third embodiment of the invention. The ultrasonic gel sheet assembly **11***c* has a multilayer body **12** as in the above embodiments. The multilayer body **12**

is sealed in a packaging material **37**. The packaging material **37** can be formed of a flexible resin sheet, for example. In the illustrated example, the packaging material **37** also serves as the coating sheets **15***a* and **15***b* of the multilayer body **12**. In other words, the coating sheets **15***a* and **15***b* constitute part of the material the periphery of which is sealed to enclose the gel layers **13** therein. The other configuration is similar to those of the ultrasonic gel sheet assemblies **11**, **11***a*, and **11***b*.

[0058] While the embodiments have been described in detail, it is to be easily understood by those skilled in the art that many modifications can be made without substantially departing from the novel matters and advantages of the invention. It is therefore construed that all of such modifications are included in the scope of the invention. For example, a term having appeared together with a broader or synonymous different term at least once in the description or any of the drawings can be replaced with such a different term at any position in the description or the drawing. It is also to be understood that the configurations and operations of the ultrasonic diagnosis apparatus **21**, the ultrasonic probe **23**, the ultrasonic device **27**, etc. are not limited to those described in the embodiments, but can be modified in various ways.

[0059] The entire disclosure of Japanese Patent Application No. 2013-240698 filed on Nov. 21, 2013 is expressly incorporated by reference herein.

What is claimed is:

1. An ultrasonic gel sheet assembly used for acoustic matching between an ultrasonic device and an object to be tested, comprising:

a plurality of gel layers placed on top of each other; and

a partition sheet placed between the plurality of gel layers to partition a dispersion medium contained in the gel layers between the gel layers.

2. The ultrasonic gel sheet assembly of claim **1**, further comprising coating sheets that cover outer surfaces of uppermost and lowermost gel layers out of the plurality of gel layers.

3. The ultrasonic gel sheet assembly of claim **2**, wherein the coating sheets are formed of the same material as the partition sheet.

4. The ultrasonic gel sheet assembly of claim **2**, wherein peripheries of the coating sheets are sealed to enclose the plurality of gel layers therein.

5. The ultrasonic gel sheet assembly of claim **2**, wherein the coating sheets are formed of a material different from that of the partition sheet.

6. The ultrasonic gel sheet assembly of claim **1**, wherein the dispersion medium is water, and the partition sheet is formed of any of silicone rubber, natural rubber, polyethylene, polypropylene, polyethylene terephthalate, polycarbonate, paper, and cloth.

7. The ultrasonic gel sheet assembly of claim **1**, wherein the partition sheet has a contact angle with water of 70° to 140°.

8. The ultrasonic gel sheet assembly of claim **7**, wherein the partition sheet has a shape of projections and depressions formed by embossing.

9. The ultrasonic gel sheet assembly of claim **1**, wherein the partition sheet has a tab extending outward from an outline of the gel layers.

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摘要(译)

超声凝胶片组件用于超声装置和待测物体之间的声匹配。超声凝胶片组件包括彼此叠置的多个凝胶层。将隔板放置在任何相邻的凝胶层之间。隔板将包含在凝胶层中的分散介质分隔在凝胶层之间。水或任何其他分散介质的移动被相邻凝胶层之间的分隔板 14阻挡。