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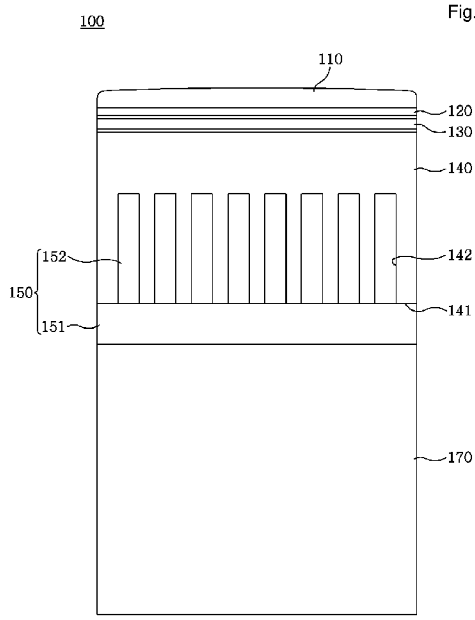
(54) Title: ULTRASONIC PROBE HAVING HEAT SINK

Fig. 2



(57) Abstract: The present invention provides an ultrasonic probe which includes a heat sink (150) provided in a rear layer (140) to dissipate heat. The heat sink is coupled to a rear surface (141) of the rear layer such that contact area there between are increased. The heat sink includes a plurality of heat conductive protrusions (151) on one surface thereof. The heat conductive protrusions are inserted into respective heat conductive depressions (142) formed in the rear layer. Each heat conductive depression has a shape corresponding to the respective heat conductive protrusion. Preferably, each heat conductive protrusion has a bar shape.

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Description

Title of Invention: ULTRASONIC PROBE HAVING HEAT SINK

Technical Field

[1] The present invention relates, in general, to ultrasonic probes and, more particularly, to an ultrasonic probe having a heat sink which prevents deterioration of the characteristics of a piezoelectric device, thus preventing deterioration in performance and durability of the ultrasonic probe, and also prevents an acoustic lens from becoming excessively heated, thereby reducing the temperature of the surface of the ultrasonic probe in contact with a patient.

[2]

Background Art

[3] Generally, ultrasonic imaging apparatuses mainly include an ultrasonic probe which performs conversion between electric and ultrasonic signals, a signal processing unit which processes transmitted or received signals, and a display which expresses images by using signals received from the ultrasonic probe and signals processing unit.

[4] The ultrasonic probe performing signal conversions is a very important part determining the quality of ultrasonic images. In detail, the ultrasonic probe performs conversion between electrical energy and acoustic energy. The ultrasonic probe must satisfy basic conditions: which are good electric-acoustic conversion efficiency (electromechanical coupling coefficient), ultrasonic pulse characteristics, and focusability of ultrasonic beams.

[5] A representative example of conventional medical ultrasonic probes will be explained with reference to the attached drawings.

[6] FIG. 1 is a cross sectional view illustrating a conventional medical ultrasonic probe. As shown in the drawing, the medical ultrasonic probe 10 includes an acoustic lens 11, a matching layer 12, a piezoelectric device 13 and a rear layer 14, which are arranged in sequence from a front front end contacting with a patient.

[7] The acoustic lens 11 covers the front surface of the matching layer 12 and functions to focus ultrasonic waves.

[8] The matching layer 12 is provided on an electrode of an ultrasonic wave sending/receiving surface of the piezoelectric device 13 and functions to enhance the reflectivity and efficiency of ultrasonic waves.

[9] The piezoelectric device 13 is attached to the front surface of the rear layer 14 and is connected to a main PCB (printed circuit board) through a FPCB (flexible printed circuit board; 15). The piezoelectric device 130 converts electrical signals into ultrasonic waves which are acoustic signals and emits the ultrasonic waves into air. As

well, the piezoelectric device 130 converts ultrasonic reflection signals, which are returned from air by reflection, into electrical signals and transmits the electrical signals to a main apparatus.

[10] The rear layer 14 is fastened to a casing 16 in such a way as to apply silicon to the rear layer 14 and the casing 16 after they are closed together. The rear layer 14 functions to absorb ultrasonic waves which are undesirably emitted backwards.

[11] According to the intended purpose, the conventional medical ultrasonic probes 10 having the above-mentioned construction are classified into two kinds of probes, i.e., an image sensing probe of image diagnostic apparatuses and, a medical treatment probe used in HIFU (high intensity focused ultrasound) treatment systems for cancer treatment or fat burning.

[12] With regard to the ultrasonic probes used for imaging, recently, the number of devices mounted to a small area of the ultrasonic probes has gradually increased to enhance the resolution. Here, small devices increase the difference in electrical impedance between the image diagnostic apparatuses and the probes, so that electrical energy which is not converted into ultrasonic waves is converted into thermal energy and is lost.

[13] The ultrasonic probe used for medical treatment requires relatively high output, unlike the ultrasonic probe for imaging. Thus, the amount of heat generated from devices used in the probe is higher.

[14] Heat generation in such a mediCal ultrasonic probe must be restrained due to the two following reasons.

[15] First, the piezoelectric device used in the ultrasonic probe has the characteristic that it cannot stand much heat. Therefore, if the ultrasonic probe is continuously maintained at a high temperature, the characteristics of the piezoelectric device deteriorate, resulting in deterioration of performance and durability of the probe.

[16] Second, the ultrasonic probe is typically brought into contact with a patient when it is in operation, so that the temperature of the contact surface of the ultrasonic probe with the patient must be limited. In the case of ultrasonic probes which generate a lot of heat, a comparatively low voltage is applied to the ultrasonic probe when it is operated, because the temperature of the contact surface of the ultrasonic probe with the patient must not exceed the limiting temperature owing to heat generation of the ultrasonic probe itself. However, this decreases the output of the ultrasonic probe, thus deteriorating the performance thereof.

[17]

Disclosure of Invention

Technical Problem

[18] In an effort to overcome the above-mentioned problems experienced with the conventional medical ultrasonic probes, as methods of restraining heat generation to prevent deterioration of the performance and durability of the ultrasonic probes, a piezoelectric device having a high dielectric constant may be used, and heat dissipation efficiency of the ultrasonic probe may be increased.

[19] In the case where the piezoelectric device having a high dielectric constant is used, because a difference in electrical impedance between the piezoelectric device and the system is reduced, heat generation of the ultrasonic probe can be restrained. Though, a stack type piezoelectric device or a piezoelectric device having a high dielectric constant may be used to achieve the above purposes, there is a limitation owing to limited availability of such piezoelectric device or difficulty in manufacturing the stack type piezoelectric device.

[20] Furthermore, even if a rear layer is made of material having high heat conductivity to increase heat diffusion, there is a limitation in the use of material having high heat conductivity in that the rear layer must satisfy a damping characteristic of an ultrasonic wave. In particular, in the case of the structure for increasing the heat dissipation efficiency of the ultrasonic probe, there is a restriction in that heat generation in a contact surface of the probe with a patient must be minimized and such heat dissipation structure must not affect the performance of the ultrasonic probe.

[21] Accordingly, the present invention has been made keeping in mind the above problems occurring in the prior art, and an object of the present invention is to provide an ultrasonic probe which is constructed such that heat is dissipated through a rear layer to prevent heat from being emitted through a contact surface contacting with a patient and such heat dissipation structure does not deteriorate the performance of the ultrasonic probe.

[22]

Solution to Problem

[23] In order to accomplish the above object, the present invention provides an ultrasonic probe which includes a heat sink provided in a rear layer to dissipate heat.

[24]

Advantageous Effects of Invention

[25] In the present invention, heat generated from a piezoelectric device is rapidly conducted to a heat sink via a rear layer and dissipated. Therefore, deterioration in characteristics of the piezoelectric device can be prevented, so that deterioration in performance and durability of the ultrasonic probe can be prevented. As well, a temperature of the contact surface of the ultrasonic probe with the patient can be reduced by preventing heat generation in an acoustic lens. Furthermore, ultrasonic waves

absorbed into the rear layer are prevented from being re-reflected towards the front surface of the rear layer, so that the performance of the ultrasonic probe can be maintained.

[26]

Brief Description of Drawings

[27] FIG. 1 is a cross sectional view illustrating a conventional medical ultrasonic probe;

[28] FIG. 2 is a perspective view illustrating an ultrasonic probe having a heat sink in accordance with a first embodiment of the present invention;

[29] FIG. 3 is a cross sectional view of the ultrasonic probe having the heat sink in accordance with the first embodiment of the present invention;

[30] FIG. 4 is a perspective view showing the heat sink of the ultrasonic probe in accordance with the first embodiment of the present invention;

[31] FIG. 5 is a perspective view illustrating an ultrasonic probe having a heat sink, in accordance with a second embodiment of the present invention;

[32] FIG. 6 is a cross sectional view of the ultrasonic probe having the heat sink in accordance with the second embodiment of the present invention;

[33] FIG. 7 is a perspective view showing the heat sink of the ultrasonic probe in accordance with the second embodiment of the present invention;

[34] FIG. 8 is a cross sectional view of an ultrasonic probe having a heat sink in accordance with a third embodiment of the present invention;

[35] FIG. 9 is a perspective view showing the heat sink of the ultrasonic probe in accordance with the third embodiment of the present invention;

[36] FIG. 10 is a cross sectional view of an ultrasonic probe having a heat sink in accordance with a fourth embodiment of the present invention;

[37] FIG. 11 is a perspective view showing the heat sink of the ultrasonic probe in accordance with the fourth embodiment of the present invention;

[38] FIG. 12 is a cross sectional view of an ultrasonic probe having a heat sink in accordance with a fifth embodiment of the present invention; and

[39] FIG. 13 is a perspective view showing the heat sink of the ultrasonic probe in accordance with the fifth embodiment of the present invention.

[40]

Mode for the Invention

[41] Hereinafter, preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings. In the description of the present invention, detailed explanation of well-known functions and constructions will be omitted so that the present invention can be described more clearly.

[42] FIG. 2 is a perspective view illustrating an ultrasonic probe 100 having a heat sink

150, in accordance with a first embodiment of the present invention. FIG. 3 is a cross sectional view of the ultrasonic probe 100 having the heat sink 150 in accordance with the first embodiment of the present invention. FIG. 4 is a perspective view showing the heat sink 150 of the ultrasonic probe 100 in accordance with the first embodiment of the present invention. As shown in the drawings, the ultrasonic probe 100 having the heat sink 150 in accordance with the first embodiment of the present invention includes, from the front end to be contacted with a patient sequentially, an acoustic lens 110, a matching layer 120, a piezoelectric device 130 and a rear layer 140. The heat sink 150 is provided in the rear layer 140.

[43] The acoustic lens 110 is attached to the matching layer 120 in a shape which covers the front surface of the matching layer 120. The acoustic lens 110 serves to focus ultrasonic waves.

[44] The matching layer 120 is provided on an electrode of an ultrasonic wave receive/ send surface of the piezoelectric device 130 to increase ultrasonic wave transmitting efficiency and reflectivity of ultrasonic waves.

[45] The piezoelectric device 130 is adhered to the front surface of the rear layer 140. First and second electrodes which are connected to a PCB (not shown) through an FPCB 160 (flexible printed circuit board) are provided on the respective opposite surfaces of the piezoelectric device 130. The piezoelectric device 130 converts electrical signals into ultrasonic waves, which are acoustic signals, and emits the ultrasonic waves into air. The piezoelectric device 130 converts ultrasonic reflection signals, which are returned from the air by reflection, into electrical signals and transmits the electrical signals to a main apparatus.

[46] The rear layer 140 is coupled to the heat sink 150 and absorbs unnecessary ultrasonic waves that are emitted backwards. For the coupling with the heat sink 150, the rear layer 140 may be integrally molded with the heat sink 150.

[47] The heat sink 150 is made of high heat conductivity, e.g., metal such as aluminum (Al) and copper (Cu). The heat sink 150 is fastened to a rear surface 141 of the rear layer 140, that is, to a surface of the rear layer 140 which is opposite the surface to which the piezoelectric device 130 is adhered. The heat sink 150 is fastened to a casing 170 by applying silicon to the heat sink 150 and the casing 170 after they are closed together.

[48] It is preferable that the heat sink 150 is coupled to the rear surface 141 of the rear layer 140 such that the contact area therebetween can be large enough to increase heat transfer therebetween. To achieve the above purpose, a plurality of heat transfer protrusions 152 for increasing heat transfer efficiency with the rear layer 140 is provided on one surface of a base body 151 of the heat sink 150. Furthermore, a plurality of heat conductive depressions 142 which have shapes corresponding to the heat conductive

protrusions 152 is formed in the rear layer 140, so that the heat conductive protrusions 152 are inserted into the respective heat conductive depressions 142. As such, because the rear layer 140 has the heat conductive depressions 142 having shapes corresponding to the heat conductive protrusions 152, a closer contact between the heat conductive depressions 142 and the heat conductive protrusions 152 is provided, thus enhancing heat transfer between the rear layer 140 and the heat sink 150.

[49] As shown in FIG. 4, each heat conductive protrusion 152 preferably has a bar shape, thus maximizing the contact area with the rear layer 140 which is connected to the heat conductive protrusions 152 through the heat conductive depressions 142.

[50] In the ultrasonic probe 100 having the heat sink 150 in accordance with the first embodiment of the present invention having the above-mentioned construction, heat generated from the piezoelectric device 130 is conducted to the heat sink 150 via the rear layer 140 and dissipated, thus increasing a heat transfer rate to the rear layer 140. In particular, because the ultrasonic probe 100 is constructed such that the heat conductive protrusions 152 of the heat sink 150 are inserted into the respective heat conductive depressions 142 of the rear layer 140, the contact surface between the rear layer 140 and the heat sink 150 is increased, so that the heat transfer from the rear layer 140 to the heat sink 150 can be markedly enhanced.

[51] As such, in the present invention, heat generated from the piezoelectric device 130 can be rapidly dissipated by using the heat sink 150. Therefore, the piezoelectric device 130 can be protected from heat, thus preventing deterioration in characteristics of the piezoelectric device 130. In addition, the rear layer 140 can maintain its ultrasonic attenuation characteristic. Accordingly, deterioration in performance and durability of the ultrasonic probe 100 can be prevented. Further, since heat conduction to the acoustic lens 110 is reduced, the temperature of the contact surface of the ultrasonic probe 100 to be contacted with the patient can be reduced.

[52] FIG. 5 is a perspective view illustrating an ultrasonic probe 200 having a heat sink 250 in accordance with a second embodiment of the present invention. FIG. 6 is a cross sectional view of the ultrasonic probe 200 having the heat sink 250 in accordance with the second embodiment of the present invention. As shown in the drawings, the ultrasonic probe 200 having the heat sink 250 in accordance with the second embodiment of the present invention includes, sequentially from the front end to be brought into contact with a patient, an acoustic lens 210, a matching layer 220, a piezoelectric device 230 and a rear layer 240. The heat sink 250 is provided in the rear layer 240. The general construction of the ultrasonic probe 200 in accordance with the second embodiment, except for the heat sink 250, remains the same as that of the ultrasonic probe 100 in accordance with the first embodiment, and therefore further explanation is deemed unnecessary.

[53] To couple the heat sink 250 to the rear layer 240 such that the contact area therebetween are increased, heat conductive protrusions 252 are perpendicularly provided on one surface of a base body 251 of the heat sink 250 and are inserted into respective heat conductive depressions 242 which are formed in the rear layer 240. As shown in FIG. 7, each heat conductive protrusion 252 has a bar shape which has an inclined surface 252a on an end thereof to form an acute end.

[54] Each of the heat conductive depressions 242 of the rear layer 240 has a shape corresponding to that of the corresponding heat conductive protrusion 252, so that the entire surfaces of heat conductive protrusions 252 can be in close contact with the rear layer 240.

[55] In the ultrasonic probe 200 having the heat sink 250 in accordance with the second embodiment of the present invention having the above-mentioned construction, heat generated from the piezoelectric device 230 is rapidly conducted to the heat sink 250 via the rear layer 240 and is dissipated, thus preventing deterioration of characteristics of the piezoelectric device 230. Accordingly, deterioration in performance and durability of the ultrasonic probe 200 can be prevented. As well, the temperature of the contact surface of the ultrasonic probe 200 to be contacted with the patient can be reduced by virtue of a reduction in temperature of the acoustic lens 210.

[56] Furthermore, as shown in FIG. 6, ultrasonic waves absorbed into the rear layer 240 are reflected in transverse directions by the inclined surfaces 252a that are formed on the heat conductive protrusions 252 of the heat sink 250. Thus, ultrasonic waves absorbed into the rear layer 240 are prevented from being re-reflected towards the front surface of the ultrasonic probe 200, so that the ultrasonic waves can be reabsorbed in the rear layer 240 and thus extinguished. Therefore, the intended purpose of the rear layer 240, that is, the purpose of absorbing back reflection waves, can be achieved, thus preventing deterioration in performance of the ultrasonic probe 200.

[57] FIG. 8 is a cross sectional view of an ultrasonic probe 300 having a heat sink 350 in accordance with a third embodiment of the present invention. FIG. 9 is a perspective view showing the heat sink 350 of the ultrasonic probe 300 in accordance with the third embodiment of the present invention. As shown in the drawings, the ultrasonic probe 300 having the heat sink 350 in accordance with the third embodiment of the present invention includes, sequentially from the front end which is to be brought into contact with a patient, an acoustic lens 310, a matching layer 320, a piezoelectric device 330 and a rear layer 340. The heat sink 350 is provided in the rear layer 340. The general construction of the ultrasonic probe 300 in accordance with the third embodiment, except for the heat sink 350, remains the same as that of the ultrasonic probe 100 in accordance with the first embodiment, therefore further explanation is deemed unnecessary.

[58] To couple the heat sink 350 to the rear layer 340 such that the contact area therebetween is increased, heat conductive protrusions 352 are perpendicularly provided on one surface of a base body 351 of the heat sink 350 and are inserted into respective heat conductive depressions 342 which are formed in the rear layer 340. Each heat conductive protrusion 352 is formed in a bar shape and has therein an insert hole 352a which penetrated from the distal end of the heat conductive protrusion 352 towards the proximal end thereof.

[59] The insert hole 352a has a conical shape to prevent ultrasonic waves absorbed into the rear layer 340 from being re-reflected towards the front surface of the ultrasonic probe 300 by the heat sink 350.

[60] Each of the heat conductive depressions 342 of the rear layer 340 has a shape corresponding to that of the corresponding heat conductive protrusion 352, so that the entire surface of heat conductive protrusions 352 can be in close contact with the rear layer 340. In other words, each heat conductive depression 342 has a shape capable of receiving the corresponding heat conductive protrusion 352, and an insert protrusion 342a is provided in each heat conductive depression 342 and inserted into the insert hole 352a of the corresponding heat conductive protrusion 352.

[61] In the ultrasonic probe 300 having the heat sink 350 in accordance with the third embodiment of the present invention having the above-mentioned construction, heat generated from the piezoelectric device 330 is rapidly conducted to the heat sink 350 via the rear layer 340 and is dissipated, thus preventing deterioration of characteristics of the piezoelectric device 330. Accordingly, deterioration in performance and durability of the ultrasonic probe 300 can be prevented. As well, the temperature of the contact surface of the ultrasonic probe 300 to be contacted with the patient can be reduced by virtue of a reduction in temperature of the acoustic lens 310.

[62] Furthermore, ultrasonic waves absorbed into the rear layer 340 are repeatedly reflected by the inner surfaces of the insert holes 352a of the heat sink 350 and are eventually cancelled out, thus reducing reflection of the ultrasonic waves towards the front surface of the rear layer 340, thereby preventing deterioration in performance of the ultrasonic probe 300.

[63] FIG. 10 is a cross sectional view of an ultrasonic probe 400 having a heat sink 450 in accordance with a fourth embodiment of the present invention. FIG. 11 is a perspective view showing the heat sink 450 of the ultrasonic probe 400 in accordance with the fourth embodiment of the present invention. As shown in the drawings, the ultrasonic probe 400 having the heat sink 450 in accordance with the fourth embodiment of the present invention includes, sequentially from the front end which is to be brought into contact with a patient, an acoustic lens 410, a matching layer 420, a piezoelectric device 430 and a rear layer 440. The heat sink 450 is provided in the rear layer 440.

The general construction of the ultrasonic probe 400 in accordance with the fourth embodiment remains the same as that of the ultrasonic probe 100 in accordance with the first embodiment except for the heat sink 450, and therefore further explanation is deemed unnecessary.

[64] To couple the heat sink 450 to the rear layer 440 such that the contact area therebetween is increased, heat conductive protrusions 452 are perpendicularly provided on one surface of a base body 451 of the heat sink 450 and are inserted into respective heat conductive depressions 442 which are formed in the rear layer 440. Each heat conductive depression 442 has a shape corresponding to that of the corresponding heat conductive protrusion 452. Each heat conductive protrusion 452 has a conical shape to prevent ultrasonic waves absorbed into the rear layer 440 from being re-reflected towards the front surface of the rear layer 440.

[65] Furthermore, each of the heat conductive depressions 442 of the rear layer 440 has a shape, i.e., a conical shape, corresponding to the corresponding heat conductive protrusion 452, so that the entire surface of the heat conductive protrusions 452 can be in close contact with the rear layer 440.

[66] In the same manner as the prior embodiments, in the ultrasonic probe 400 having the heat sink 450 in accordance with the fourth embodiment of the present invention having the above-mentioned construction, heat generated from the piezoelectric device 430 is rapidly conducted to the heat sink 450 via the rear layer 440 and is dissipated, thus preventing deterioration of characteristics of the piezoelectric device 430. Accordingly, deterioration in performance and durability of the ultrasonic probe 400 can be prevented. As well, the temperature of the surface of the ultrasonic probe 400 coming into contact with the patient can be reduced by virtue of a reduction in temperature of the acoustic lens 410.

[67] Furthermore, since ultrasonic waves absorbed into the rear layer 440 are reflected in transverse directions by the conical heat conductive protrusions 452 of the heat sink 450, the ultrasonic waves are prevented from being re-reflected towards the front surface of the rear layer 440 and are reabsorbed into portions of the rear layer 440 which are disposed around the heat conductive protrusions 452. The reabsorbed ultrasonic waves are eventually cancelled out. Therefore, deterioration in performance of the ultrasonic probe 400 can be prevented.

[68] FIG. 12 is a cross sectional view of an ultrasonic probe 500 having a heat sink 550 in accordance with a fifth embodiment of the present invention. FIG. 13 is a perspective view showing the heat sink 550 of the ultrasonic probe 500 in accordance with the fifth embodiment of the present invention. As shown in the drawings, the ultrasonic probe 500 having the heat sink 550 in accordance with the fifth embodiment of the present invention includes, sequencially from the front end which is to be brought into contact

with a patient, an acoustic lens 510, a matching layer 520, a piezoelectric device 530 and a rear layer 540. The heat sink 550 is provided in the rear layer 540. The general construction of the ultrasonic probe 500 in accordance with the fifth embodiment, except for the rear layer 540 and the heat sink 550, remains the same as that of the ultrasonic probe 100 in accordance with the first embodiment, and therefore further explanation is deemed unnecessary.

[69] With regard to the coupling of the heat sink 550 to the rear layer 540, an insert part 552 is provided on one surface of a base body 551 of the heat sink 550 and is embedded in the rear surface 541 of the rear layer 540.

[70] It is preferable that the insert part 552 be made of a wire 552a having a coil shape to increase heat conductivity between the rear layer 540 and the heat sink 550.

[71] The insert part 552 includes a plurality of coil-shaped wires 552a which are, for example, arranged in parallel with each other on a base body 551 of the heat sink 550. Each coil-shaped wire 552a may be provided in such a way that the opposite ends thereof are integrated with the base body 551 when the base body 551 is formed or, alternatively, in such a way that the opposite ends thereof force-fitted into the base body 551. Furthermore, the coil-shaped wires 552a is embedded in the rear layer 540 when the rear layer 540 is formed on the base body 551 of the heat sink 550 by molding. Accordingly, the base body 551 of the heat sink 550 is coupled to the rear layer 540. Furthermore, interference with ultrasonic waves absorbed into the rear layer 540 is minimized, thus preventing the ultrasonic waves from being re-reflected towards the front surface of the rear layer 540.

[72] In the same manner as the prior embodiments, in the ultrasonic probe 500 having the heat sink 550 in accordance with the fifth embodiment of the present invention having the above-mentioned construction, heat generated from the piezoelectric device 530 is rapidly conducted to the heat sink 550 via the rear layer 540 and is dissipated, thus preventing deterioration of characteristics of the piezoelectric device 430. Accordingly, deterioration in performance and durability of the ultrasonic probe 400 can be prevented. Further, the temperature of the acoustic lens 410 can be reduced. In particular, the coil-shaped wires 552a which are embedded in the rear layer 540 serve to increase the area of a heat conduction passage between the rear layer 540 and the heat sink 550, thus further enhancing the heat transfer efficiency of the heat sink 550.

[73] As well, in the fifth embodiment, since ultrasonic waves absorbed into the rear layer 540 pass between the coil-shaped wires 552a, the ultrasonic waves are prevented from being re-reflected towards the front surface of the rear layer 540, thus preventing deterioration in performance of the ultrasonic probe 500.

[74] As described above, in accordance with the preferred embodiments of the present invention, heat generated from a piezoelectric device is rapidly conducted to a heat

sink via a rear layer and dissipated. Therefore, deterioration in characteristics of the piezoelectric device can be prevented, so that deterioration in performance and durability of the ultrasonic probe can be prevented. Further, the temperature of the surface of the ultrasonic probe which comes into contact with the patient can be reduced by virtue of a reduction in temperature of the acoustic lens.

[75] Furthermore, ultrasonic waves absorbed into the rear layer are prevented from being re-reflected towards the front surface of the rear layer, so that the performance of the ultrasonic probe can be maintained. In addition, heat conductive protrusions of the heat sink have shapes to prevent absorbed ultrasonic waves from being re-reflected towards the front surface of the rear layer. Hence, the present invention can overcome a disadvantage in which the heat sink cannot be disposed adjacent to the piezoelectric device due to the possibility of re-reflection of ultrasonic waves to the front surface of the rear layer. Accordingly, the efficiency of heat transfer to the rear layer can be markedly enhanced.

[76] Although the preferred embodiments of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

[77]

Claims

[Claim 1] An ultrasonic probe, comprising:
a rea layer; and
a heat sink provided in the rear layer to dissipate heat.

[Claim 2] The ultrasonic probe according to claim 1, wherein the heat sink is coupled to a rear surface of the rear layer such that contact area therebetween are increased.

[Claim 3] The ultrasonic probe according to claim 2, wherein the heat sink includes a plurality of heat conductive protrusions on one surface thereof, the heat conductive protrusions being inserted into respective heat conductive depressions formed in the rear layer, each of the heat conductive depressions having a shape corresponding to the respective heat conductive protrusion.

[Claim 4] The ultrasonic probe according to claim 3, wherein each of the heat conductive protrusions has a bar shape.

[Claim 5] The ultrasonic probe according to claim 4, wherein each of the heat conductive protrusions has an inclined surface on an end thereof to form an acute end.

[Claim 6] The ultrasonic probe according to claim 4, wherein each of the heat conductive protrusions includes an insert hole, the insert hole penetrating from a distal end of the heat conductive protrusion to a proximal end thereof.

[Claim 7] The ultrasonic probe according to claim 6, wherein the insert hole has a conical shape.

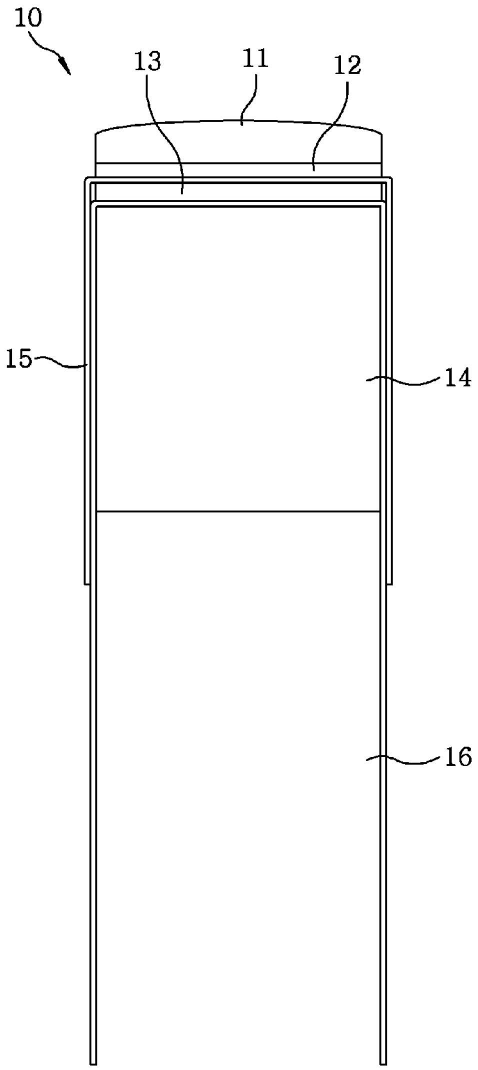
[Claim 8] The ultrasonic probe according to claim 3, wherein each of the heat conductive protrusions has a conical shape.

[Claim 9] The ultrasonic probe according to claim 2, wherein the heat sink includes an insert part to be inserted toward a rear surface of the rear layer.

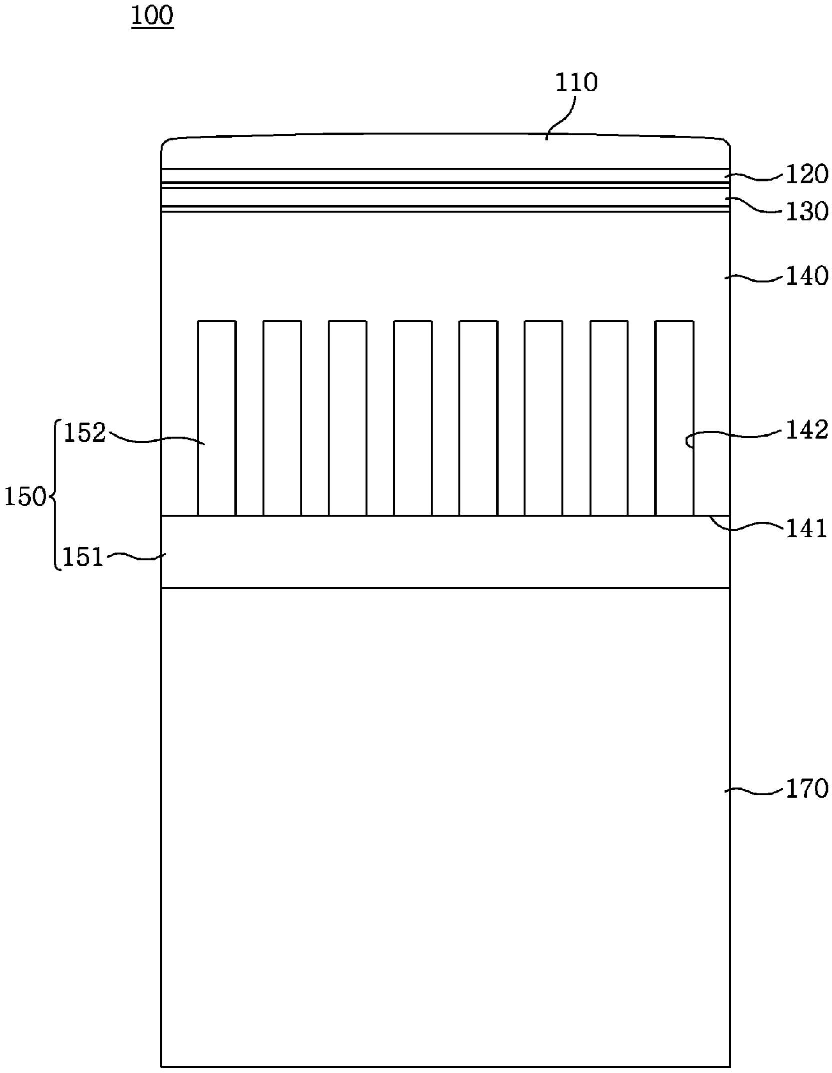
[Claim 10] The ultrasonic probe according to claim 9, wherein the insert part includes a coil-shaped wire.

[Fig. 1]

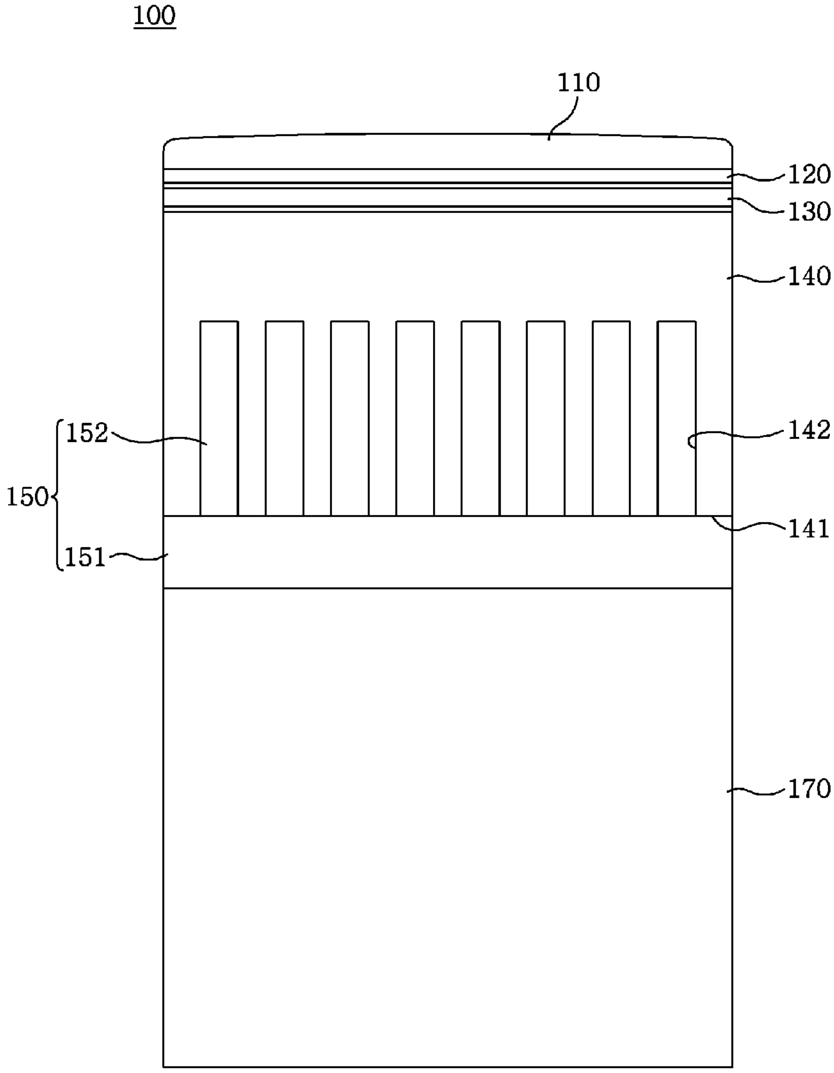
(PRIOR ART)



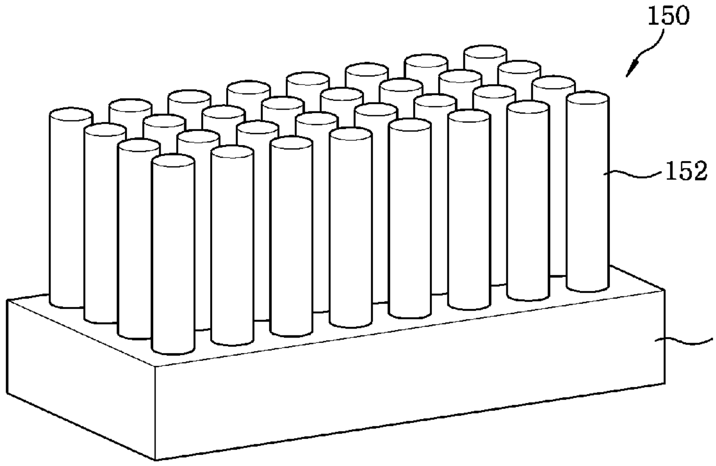
[Fig. 2]



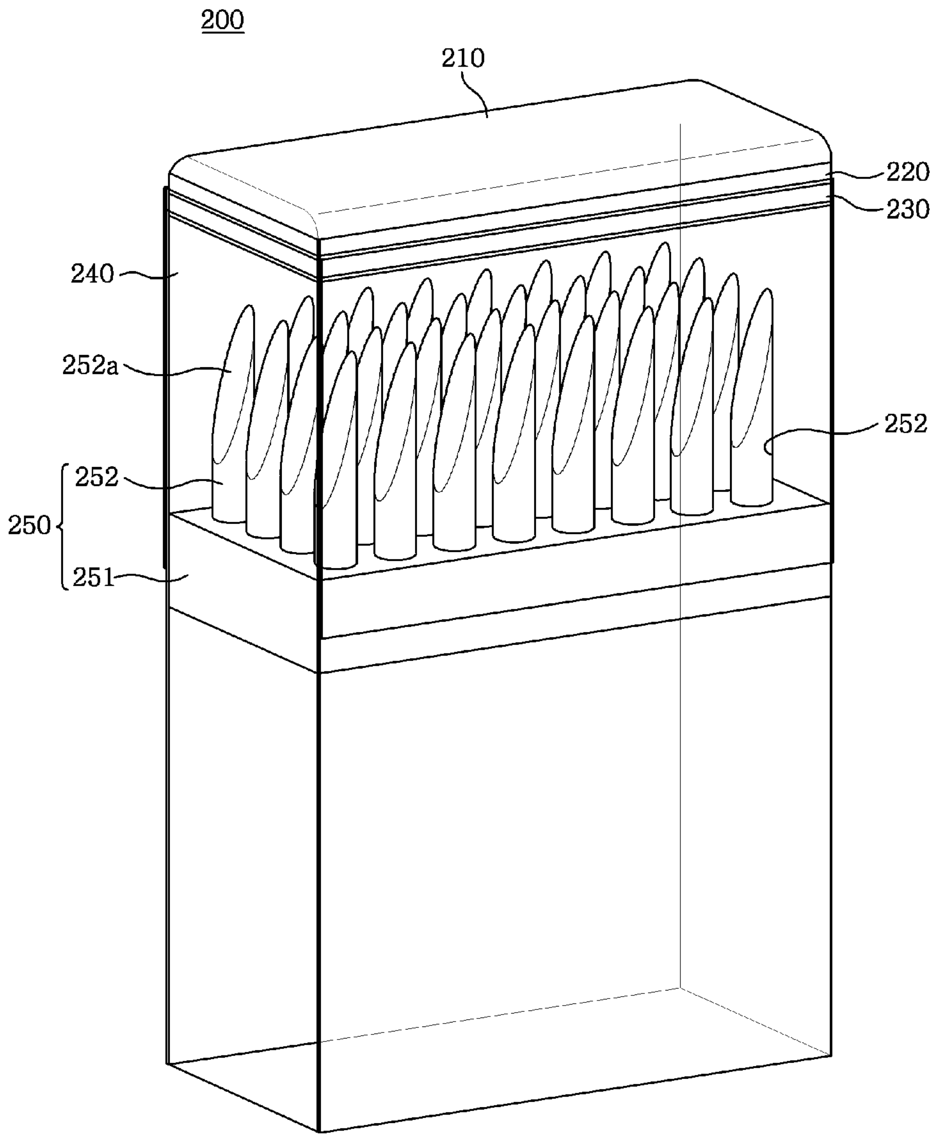
[Fig. 3]



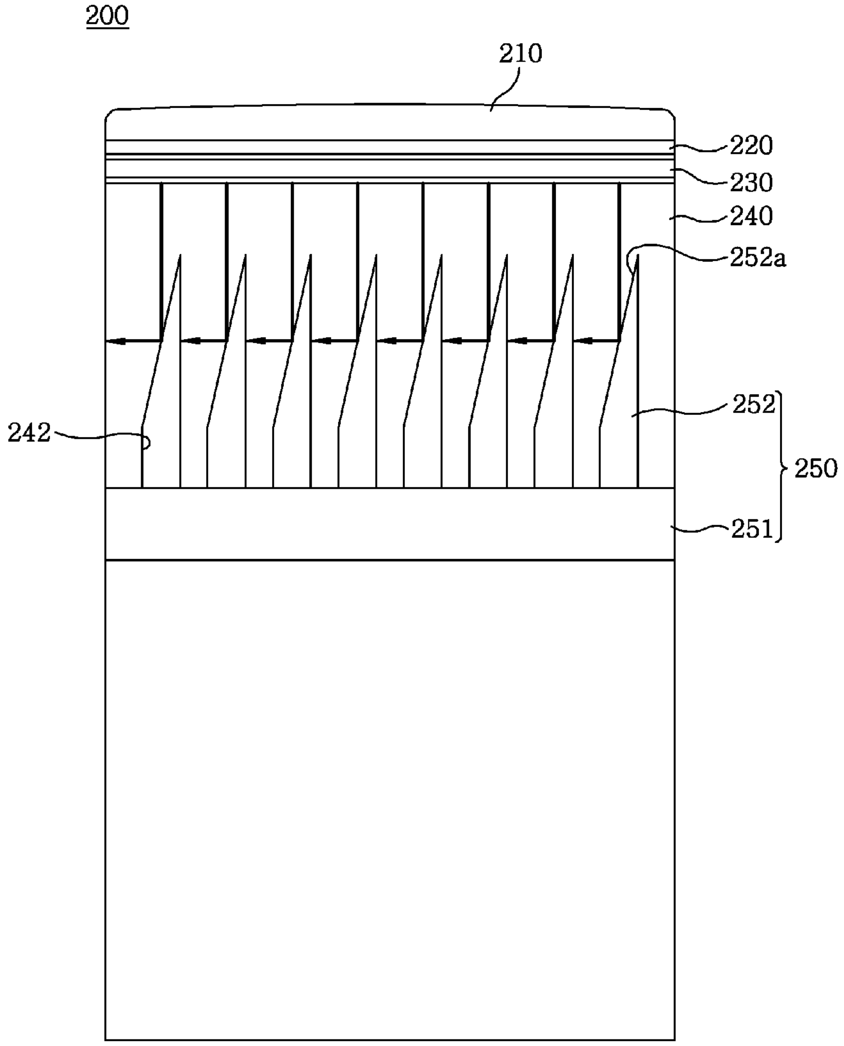
[Fig. 4]



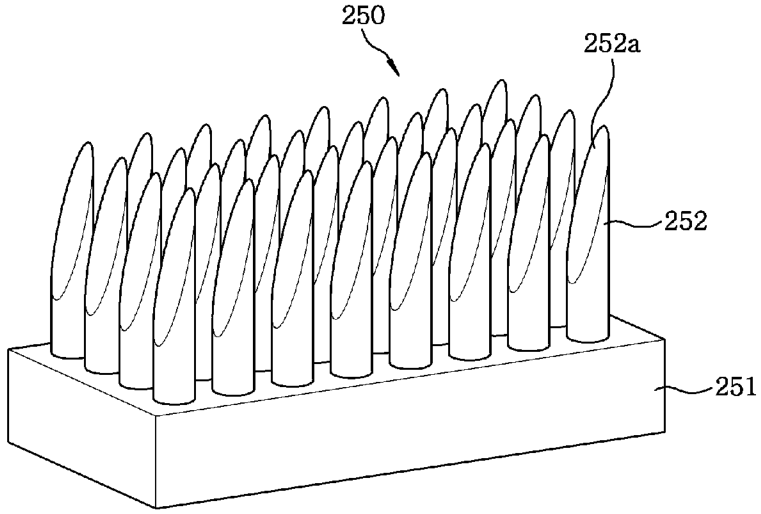
[Fig. 5]



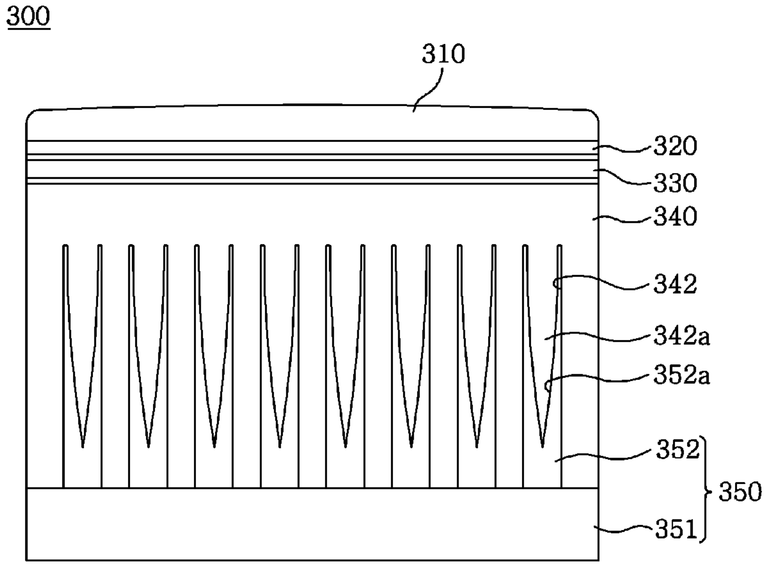
[Fig. 6]



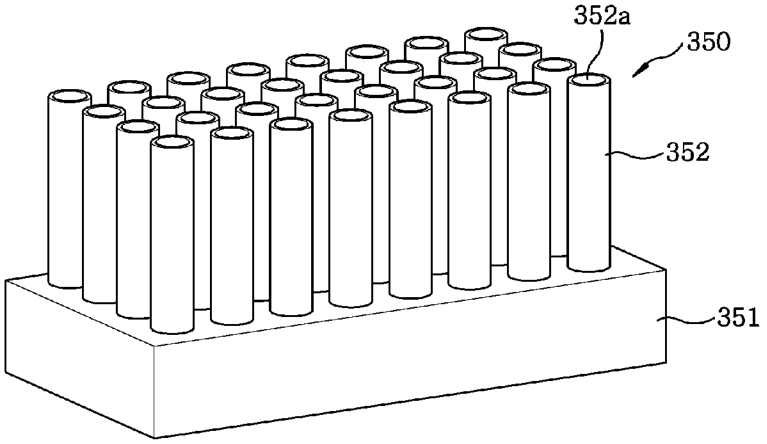
[Fig. 7]



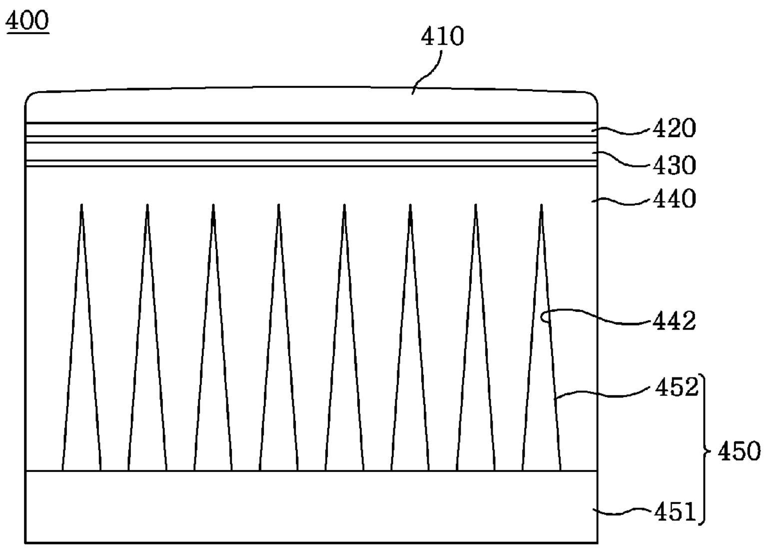
[Fig. 8]



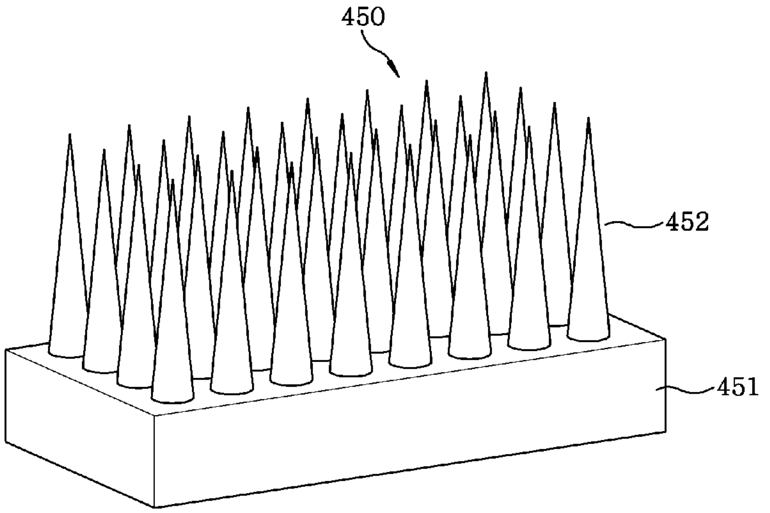
[Fig. 9]



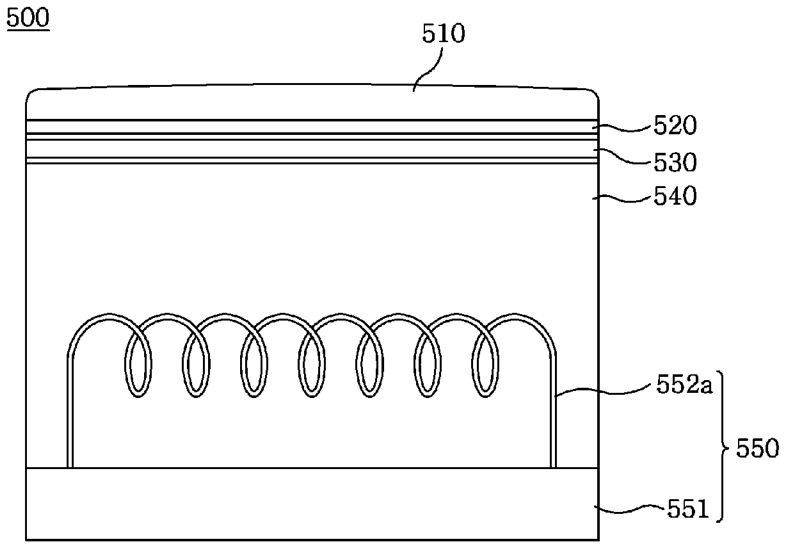
[Fig. 10]



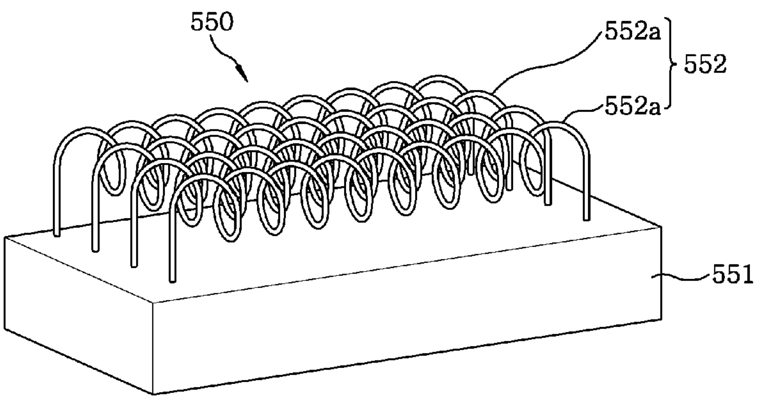
[Fig. 11]



[Fig. 12]



[Fig. 13]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR 2009/003677

A. CLASSIFICATION OF SUBJECT MATTER
IPC[8]: ***A61B 8/00*** (2006.01)
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)
IPC[8]: A61B 8/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPI, EPODOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2006/129965 A (TOSHIBA) 25 May 2006 (25.05.2006) *whole document*	1
A	JP 2007/158468 A (TOSHIBA) 21 June 2007 (21.06.2007) *whole document*	1

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
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"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
"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
"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
"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
"&" document member of the same patent family

Date of the actual completion of the international search
17 September 2009 (17.09.2009)

Date of mailing of the international search report
13 October 2009 (13.10.2009)

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR 2009/003677

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP A 2006129965		JP A 2006129965	2006-05-25
JP A 2007158468		JP A 2007158468	2007-06-21

patsnap

专利名称(译)	具有散热器的超声波探头		
公开(公告)号	EP2309930A1	公开(公告)日	2011-04-20
申请号	EP2009800515	申请日	2009-07-06
申请(专利权)人(译)	HUMANSCAN CO.，LTD.		
当前申请(专利权)人(译)	HUMANSCAN CO.，LTD.		
[标]发明人	RHIM SUNG MIN		
发明人	RHIM, SUNG MIN		
IPC分类号	A61B8/00		
CPC分类号	A61B8/00 A61B8/4483 A61B8/546 G10K11/004		
优先权	1020080071290 2008-07-22 KR		
其他公开文献	EP2309930A4		
外部链接	Espacenet		

摘要(译)

本发明提供一种超声波探头，其包括设置在后层（140）中以散热的散热器（150）。散热器耦合到后层的后表面（141），使得其间的接触区域增加。散热器在其一个表面上包括多个导热突起（151）。导热突起插入形成在后层中的相应导热凹陷（142）中。每个导热凹陷具有与相应的导热突起对应的形状。优选地，每个导热突起具有条形。