(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 686 117 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
19.06.2019 Bulletin 2019/25

(21) Application number: **12715725.3**

(22) Date of filing: **14.03.2012**

(51) Int Cl.:
A61B 8/00 *(2006.01)* ***G10K 11/00*** *(2006.01)*
B06B 1/06 *(2006.01)*

(86) International application number:
PCT/IB2012/051208

(87) International publication number:
WO 2012/123908 (20.09.2012 Gazette 2012/38)

(54) HIGH POROSITY ACOUSTIC BACKING WITH HIGH THERMAL CONDUCTIVITY FOR ULTRASOUND TRANSDUCER ARRAY

IN HOHEM MASSE PORÖSE AKUSTIK-RÜCKSEITENSCHICHT MIT HOHER WÄRMELEITFÄHIGKEIT FÜR EINE ULTRASCHALLWANDLERGRUPPE

SUPPORT ACOUSTIQUE À POROSITÉ ÉLEVÉE PRÉSENTANT UNE CONDUCTIVITÉ THERMIQUE ÉLEVÉE POUR GROUPEMENT DE TRANSDUCTEURS D'ULTRASONS

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **17.03.2011 US 201161453690 P**

(43) Date of publication of application:
22.01.2014 Bulletin 2014/04

(73) Proprietor: **Koninklijke Philips N.V.**
5656 AE Eindhoven (NL)

(72) Inventors:
- **SUDOL, Wojtek**
  NL-5656 AE Eindhoven (NL)
- **WICKLINE, Kevin Grayson**
  NL-5656 AE Eindhoven (NL)
- **YU, Yongjian**
  NL-5656 AE Eindhoven (NL)
- **KNOWLES, Heather Beck**
  NL-5656 AE Eindhoven (NL)
- **PAOLINO, James**
  NL-5656 AE Eindhvoen (NL)
- **DAVIDSEN, Richard Edward**
  NL-5656 AE Eindhoven (NL)

(74) Representative: **Steffen, Thomas**
Philips Intellectual Property & Standards
High Tech Campus 5
5656 AE Eindhoven (NL)

(56) References cited:
WO-A2-2008/121238
JP-A- 2000 165 995
US-A- 5 648 941
US-A1- 2008 098 816
US-A1- 2008 315 724
US-A1- 2009 062 656
US-B1- 6 673 328

Printed by Jouve, 75001 PARIS (FR)

Description

[0001] This invention relates to medical diagnostic ultrasound systems and, in particular, to backing materials for an ultrasonic transducer array.

[0002] Two dimensional array transducers are used in ultrasonic imaging to scan in three dimensions. Two dimensional arrays have numerous rows and columns of transducer elements in both the azimuth and elevation directions, which would require a large number of cable conductors to couple signals between the probe and the mainframe ultrasound system. A preferred technique for minimizing the number of signal conductors in the probe cable is to perform at least some of the beamforming in the probe in a microbeamformer ASIC (application specific integrated circuit.) This technique requires only a relatively few number of partially beamformed signals to be coupled to the mainframe ultrasound system, thereby reducing the required number of signal conductors in the cable. However a large number of signal connections must be made between the two dimensional array and the microbeamformer ASIC. An efficient way to make these connections is to design the transducer array and the ASIC to have flip-chip interconnections, whereby conductive pads of the transducer array are bump bonded directly to corresponding conductive pads of the ASIC.

[0003] The high density electronic circuitry of the microbeamformer ASIC can, however, produce a significant amount of heat in its small IC package, which must be dissipated. There are two main directions in which this heat can flow. One direction is forward through the acoustic stack toward the lens at the patient-contacting end of the probe. Thermal conductivity is aided in this direction by electrically conductive elements in the transducer stack. This forward path exhibits relatively low resistance to thermal flow. Build-up of heat in the lens must then be prevented by reducing transmission voltage and/or the pulse repetition frequency, which adversely affects probe performance.

[0004] The preferred thermal conduction direction is to the rear, away from the lens and toward a heat spreader (typically aluminum) at the rear of the probe. But generally located behind the transducer stack, the array elements and the microbeamformer ASIC, is an acoustic backing block. The purpose of the acoustic backing block is to attenuate ultrasonic energy emanating from the rear of the acoustic stack and prevent this energy from causing reverberations that are reflected toward the acoustic stack. An acoustic backing block is generally made of a material with good acoustic attenuation properties such as an epoxy loaded with micro-balloons or other sound-deadening particles. Although many epoxy-filler composite backings have been developed to isolate the ASICs from the supporting structure (usually aluminum) of the probe assembly, they have two disadvantages. If formulated to have high attenuation then they have unacceptable thermal conductance. If formulated to have high thermal conductance they have unacceptable attenuation. Hence it is desirable to provide an acoustic backing block for an ultrasound probe which exhibits good acoustic attenuation of acoustic energy entering the block, good thermal conductivity toward the rear of the probe and away from the lens, good structural stability which can support the acoustic stack as needed, and appropriate electrical isolation of the microbeamformer ASIC from other conductive components of the probe.

[0005] Document US 2008/098816 A1 describes an ultrasound transducer array, provided with a porous backing block to attenuate ultrasound back emission and to conduct heat.

[0006] Document US 2008/315724 A1 describes an ultrasound transducer array, wherein a driving circuit is located on the back of the transducer elements and an acoustic backing layer is provided further behind the transducer elements and the circuit.

[0007] Document WO2008/121238 A2 describes an acoustic attenuation material wherein a porous material forming the material is sealed by epoxy material.

[0008] Document US 6,673,328 B1 describes a process to produce a graphite foam material.

[0009] In the present invention, a backing block for an ultrasonic transducer array stack is formed of a porous graphite foam material which has high acoustic attenuation and high thermal conductivity. The foam backing block is constructed as a composite with the foam structure filled with an epoxy resin. An electrically isolating layer can be located on the top of the backing block at the bond between the backing block and the ASIC of the acoustic stack assembly.

[0010] In the drawings:

FIGURE 1 illustrates an acoustic stack with a thermally conductive backing.

FIGURE 2 illustrates the acoustic stack of FIGURE 1 when assembled in a transducer probe with a lens cover.

FIGURE 3 is a perspective view of a thermally conductive backing.

FIGURE 4 is a top plan view of a thermally conductive backing block.

FIGURE 5 is a side cross-sectional view of a thermally conductive backing block.

FIGURE 6 illustrates a composite foam backing block constructed in accordance with the principles of the present invention.

FIGURE 7 illustrates an acoustic stack assembly of the present invention with a film insulating layer between the ASIC and a composite foam backing block.

FIGURE 8 illustrates an acoustic stack assembly of the present invention with a parylene-coated composite foam backing block.

[0011] Referring first to FIGURE 1, an acoustic stack 100 with a thermally conductive backing block which is constructed in accordance with the principles of the present invention is shown schematically. A piezoelectric layer 110 such as PZT and two matching layers bonded to the piezoelectric layer are diced by dicing cuts 75 to form an array 170 of individual transducer elements 175, four of which are seen in FIGURE 1. The array 170 may comprise a single row of transducer elements (a 1-D array) or be diced in two orthogonal directions to form a two-dimensional (2D) matrix array of transducer elements. The matching layers match the acoustic impedance of the piezoelectric material to that of the body being diagnosed, generally in steps of progressive matching layers. In an example, not forming part of the present invention, the first matching layer 120 is formed as an electrically conductive graphite composite and the second matching layer 130 is formed of a polymer loaded with electrically conductive particles. A ground plane 180 is bonded to the top of the second matching layer, and is formed as a conductive layer on a film 150 of low density polyethylene (LDPE) 140. The ground plane is electrically coupled to the transducer elements through the electrically conductive matching layers and is connected to a ground conductor of flex circuit 185. The LDPE film 150 forms the third and final matching layer 140 of the stack.

[0012] Below the transducer elements is an integrated circuit 160, an ASIC, which provides transmit signals for the transducer elements 175 and receives and processes signals from the elements. Conductive pads on the upper surface of the integrated circuit 160 are electrically coupled to conductive pads on the bottoms of the transducer elements by stud bumps 190, which may be formed of solder or conductive epoxy. Signals are provided to and from the integrated circuit 160 by connections to the flex circuit 185. Below the integrated circuit 160 is a backing block 165 which attenuates acoustic energy emanating from the bottom of the transducer stack. In this example, the backing block also conducts heat generated by the integrated circuit away from the integrated circuit and the transducer stack and away from the patient-contacting end of the transducer probe.

[0013] FIGURE 2 illustrates the transducer stack assembly of FIGURE 1 when assembled inside a transducer probe. In the probe of FIGURE 2 the third matching layer 140 is bonded to the acoustic lens 230. Ultrasound waves are transmitted through the lens 230 and into the patient's body during imaging, and echoes received in response to these waves are received by the transducer stack through the lens 230. The LDPE film 150 serves to enclose the transducer stack in this embodiment as it is wrapped around the stack and bonded by an epoxy bond 210 to the probe housing 220. Further details of this construction are found in US patent publication no. US 2010/0168581 (Knowles et al.)

[0014] An example for the backing block 165 is illustrated in the drawings 3 - 5. An example of a backing block 165 starts with a block of graphite 20. Other alternatives include graphite loaded with metals such as nickel or copper which provide good machinability and favorable thermal properties. The graphite block 20 is used to form a composite backing structure which satisfies a number of performance objectives. First, the backing structure must have good Z-axis thermal conductivity. Graphite has good thermal conductivity, a Tc of 80 to 240 W/m°K at 0°C-100°C. For conduction parallel to the crystal layers, Tc will approach 1950 W/m°K at 300°K. The Z-axis direction is the direction back and away from the transducer stack 100 and the integrated circuit 160. Thus, it is desirable to align the crystal layers of the graphite block 20 for heat flow in the Z-axis direction. In other examples it may be desirable to preferentially conduct heat laterally or both laterally and in the Z-axis direction, in which case a different direction of crystal alignment may be desired or the alignment direction may be immaterial to the design. When aluminum is used to dissipate some of the heat, which may be by use of an aluminum heat spreader or an aluminum frame inside the probe housing, it is desirable for the thermal conductivity of the backing block be comparable to or better than that of aluminum, so that heat will preferentially flow to the aluminum. Aluminum has a comparable Tc of 237 W/m°K at room temperature, so this performance objective is well met by a graphite block 20.

[0015] A second objective is that the backing block provide structural support for the acoustic stack 100 and integrated circuit 160. A graphite block is structurally sound, satisfying this objective.

[0016] A third objective is to provide electrical isolation of the integrated circuit 160 from the aluminum member or frame of the probe. Graphite, being electrically conductive, can satisfy this objective by coating the backing block with a nonconductive insulative coating. In some implementations it may be desirable to coat only the side of the block which is in contact with the transducer stack. In other implementations it may be desirable to coat multiple sides of the backing block. It may be desirable, for instance, to coat the lateral sides of the block with an insulative acoustic damping material which would provide the additional benefit of suppressing lateral acoustic reverberation.

[0017] The fourth objective is that the backing block must dampen acoustic energy entering the block. Graphite is a good conductor of acoustic energy and provides very little inherent acoustic damping. This objective is satisfied by employing the graphite block as the framework for a composite structure of internal acoustic dampening members as shown in FIGURES 3, 4, and 5. In these drawings the graphite is rendered translucent for clarity of illustration of the internal composite structure of the block. The dampening members are formed as a plurality of angled cylinders 30 of backing material in the backing block. The cylinders 30 are cut or drilled into the graphite block 20, then filled with acoustic dampening material such as epoxy filled with micro balloons or other acoustic damping particles. As the top plan view of the backing block of FIGURE 4 illustrates, the tops of the cylinders 30 present a large area of acoustic dampening material to the back of the integrated circuit. A considerable amount of the undesired acoustic energy emanating from the back of the integrated circuit and acoustic stack will thus pass immediately into the dampening material. The angling of the cylinders as seen in FIGURE 3 and best seen in the cross-section view of FIGURE 5 assures that acoustic energy traveling in the Z-axis direction will have to intersect dampening material at some point in the path of travel. Preferably, there is no path in the Z-axis direction formed entirely of graphite, and the angling of the cylinders does not promote reflection of energy back to the integrated circuit but provides scattering angles downward and away from the integrated circuit. In practice it may be sufficient to block most of the Z-axis pathways such as by blocking 95% of the pathways. Thus, the angling of the cylinders assures damping of all or substantially all of the Z-axis directed energy.

[0018] Heat, however, will find continuous pathways through the graphite between the cylinders 30. Since the flow of heat is from higher temperature regions to lower (greater thermal density to lesser), heat will flow away from the integrated circuit 160 and acoustic stack 100 to structures below the backing block 165 where it may be safely dissipated.

[0019] Other materials may be used for the thermally conductive material of the backing block, such as aluminum, graphite foam, or aluminum nitride.

[0020] In the embodiment of the present invention, one composite structure which has been found to be advantageous for many applications is a conductive graphite foam filled with epoxy resin. The macroscopic nature of the machined and filled graphite block described above can provide an uneven bonding surface to the ASIC, which is vulnerable to expansion mismatches. the machining and filling of the holes with epoxy is also a labor intensive process. FIGURE 6 illustrates an implementation of the present invention in which The backing material of the backing block of FIGURE 6 uses a thermally conductive graphite foam (POCO HTC) filled with a soft unfilled attenuating epoxy resin. The unfilled HTC foam has significant porosity (60%), of which 95% of the total porosity is open. When this open porosity is filled with soft resin, this composite backing exhibits a high acoustic attenuation of approximately 50 dB/mm at 5 Mhz. This high attenuation is mainly due to two mechanisms: 1) the absorption of acoustic energy by the soft resin and 2) acoustic energy scattering due to the impedance mismatch between epoxy, graphite, and air in the porous structure. As a result of this high acoustic attenuation, the backing thickness can be reduced to facilitate transducer heat dissipation. Another property of this epoxy filled graphite foam is its high thermal conductivity (-50 W/mK), which is one order of magnitude higher than typical epoxy-filler backing formulations.

[0021] The composite graphite foam backing block 32 of FIGURE 6 illustrates the high porosity of the foam. In this example the surface of the foam block 32 is coated with an epoxy resin 34 which soaks into the block by a depth 36 which is a function of the porosity of the foam block and the viscosity of the resin, as indicated by the shaded areas in the drawing. The cured epoxy gives the block good structural stability. The composite backing block can then be directly bonded to the ASIC 160 with a thin epoxy bondline. In order to provide adequate electrical isolation from the ASIC, an insulating layer can be used between the backing block and the ASIC as illustrated in FIGURES 7 and 8, which show exploded views of two implementations in an acoustic stack. At the top of each drawing is the transducer layer 170 with its matching layers. Below the transducer layer is the ASIC 160. In FIGURE 7 a thin (12 to 25 microns) polyimide film 38 is attached to the ASIC before bonding the backing block to the assembly. The composite foam backing block 32 is then bonded to the insulating film 38. In FIGURE 8 a parylene coating 58 of 10 to 15 microns is applied to the HTC backing block. The parylene coated backing block is then bonded to the ASIC 160.

Claims

1. An ultrasonic transducer array assembly comprising:

   an array (170) of transducer elements having a forward desired direction for the transmission of ultrasonic waves and a rearward undesired ultrasonic emission direction;
   an integrated circuit (160) structurally coupled to the array of transducer elements;
   a composite foam backing block (165), located rearward of the array of transducer elements and integrated circuit, the composite foam backing block being formed of a foam material having a porous structure;
   characterized in that:

      an epoxy resin (34) is adapted to fill at least some of the porous structure of the foam backing block; and
      the foam material further comprises a graphite foam; and

   wherein ultrasonic emissions in the rearward direction are scattered or attenuated by the porous foam structure and epoxy, and heat is conducted away from the array of transducer elements and integrated circuit by the graphite foam in the backing block material.

2. The ultrasonic transducer array assembly of Claim 1, wherein the composite foam backing block further comprises an exterior surface, and wherein the epoxy resin fills the porous structure of the foam backing block adjacent to the exterior surface.

3. The ultrasonic transducer array assembly of Claim

1, wherein the integrated circuit further comprises a beamformer ASIC coupled to the rearward side of the array of transducer elements,
wherein the composite foam backing block is thermally coupled to the beamformer ASIC.

4. The ultrasonic transducer array assembly of Claim 3, wherein the composite foam backing block is bonded to the beamformer ASIC by an epoxy bond.

5. The ultrasonic transducer array assembly of Claim 3, further comprising an electrically insulating layer between the beamformer ASIC and the composite foam backing block.

6. The ultrasonic transducer array assembly of Claim 5, wherein the electrically insulating layer further comprises a polyimide film (38).

7. The ultrasonic transducer array assembly of Claim 6, wherein the polyimide film is no thicker than 25 microns.

8. The ultrasonic transducer array assembly of Claim 5, wherein the electrically insulating layer further comprises a parylene coating.

9. The ultrasonic transducer array assembly of Claim 8, wherein the parylene coating is no thicker than 15 microns.

10. The ultrasonic transducer array assembly of Claim 1, wherein the porous structure exhibits a porosity of at least 60%.

11. The ultrasonic transducer array assembly of Claim 10, wherein at least 95% of the total porosity of the porous structure is open.

12. The ultrasonic transducer array assembly of Claim 1, wherein the rearward ultrasonic emission scattering is due to the impedance mismatch between epoxy, the graphite foam material, and air in the graphite foam structure.

13. The ultrasonic transducer array assembly of Claim 1, wherein attenuation of rearward ultrasonic emissions is due to absorption by the epoxy resin.

Patentansprüche

1. Ultraschallwandler-Arrayanordnung, umfassend:

ein Array (170) von Wandlerelementen mit einer gewünschten Vorwärtsrichtung für die Transmission von Ultraschallwellen und einer unerwünschten Ultraschallemissions-Rückwärtsrichtung;
einen integrierten Schaltkreis (160), der strukturell an das Array von Wandlerelementen gekoppelt ist;
einen Verbundschaumstoffträgerblock (165), der sich hinter dem Array von Wandlerelementen und dem integrierten Schaltkreis befindet, wobei der Verbundschaumstoffträgerblock aus einem Schaumstoffmaterial mit einer porösen Struktur gebildet ist;
dadurch gekennzeichnet, dass:

ein Epoxidharz (34) so angepasst ist, dass es zumindest einen Teil der porösen Struktur des Schaumstoffträgerblocks füllt; und das Schaumstoffmaterial ferner einen Graphitschaum umfasst; und

wobei Ultraschallemissionen in der Rückwärtsrichtung von der porösen Schaumstoffstruktur und Epoxid gestreut oder abgeschwächt werden und Wärme von dem Array von Wandlerelementen und dem integrierten Schaltkreis durch den Graphitschaum in dem Trägerblockmaterial weggeleitet wird.

2. Ultraschallwandler-Arrayanordnung nach Anspruch 1, wobei der Verbundschaumstoffträgerblock ferner eine Außenfläche umfasst und wobei das Epoxidharz die poröse Struktur des Schaumstoffträgerblocks neben der Außenfläche füllt.

3. Ultraschallwandler-Arrayanordnung nach Anspruch 1, wobei der integrierte Schaltkreis ferner einen Strahlformer-ASIC umfasst, der an die Rückseite des Arrays von Wandlerelementen gekoppelt ist,
wobei der Verbundschaumstoffträgerblock thermisch an den Strahlformer-ASIC gekoppelt ist.

4. Ultraschallwandler-Arrayanordnung nach Anspruch 3, wobei der Verbundschaumstoffträgerblock an den Strahlformer-ASIC mit einer Epoxidbindung gebunden ist.

5. Ultraschallwandler-Arrayanordnung nach Anspruch 3, ferner umfassend eine elektrisch isolierende Schicht zwischen dem Strahlformer-ASIC und dem Verbundschaumstoffträgerblock.

6. Ultraschallwandler-Arrayanordnung nach Anspruch 5, wobei die elektrisch isolierende Schicht ferner einen Polyimidfilm (38) umfasst.

7. Ultraschallwandler-Arrayanordnung nach Anspruch 6, wobei der Polyimidfilm nicht dicker als 25 Mikrometer ist.

8. Ultraschallwandler-Arrayanordnung nach Anspruch

5, wobei die elektrisch isolierende Schicht ferner eine Parylenebeschichtung umfasst.

9. Ultraschallwandler-Arrayanordnung nach Anspruch 8, wobei die Parylenebeschichtung nicht dicker als 15 Mikrometer ist.

10. Ultraschallwandler-Arrayanordnung nach Anspruch 1, wobei die poröse Struktur eine Porosität von zumindest 60 % aufweist.

11. Ultraschallwandler-Arrayanordnung nach Anspruch 10, wobei zumindest 95 % der gesamten Porosität der porösen Struktur offen sind.

12. Ultraschallwandler-Arrayanordnung nach Anspruch 1, wobei die Ultraschallemissionsrückstreuung auf die Impedanzfehlanpassung zwischen Epoxid, dem Graphitschaummaterial und Luft in der Graphitschaumstruktur zurückzuführen ist.

13. Ultraschallwandler-Arrayanordnung nach Anspruch 1, wobei die Abschwächung der Ultraschallrückemissionen auf die Absorption durch das Epoxidharz zurückzuführen ist.

Revendications

1. Ensemble de groupement de transducteurs ultrasonores comprenant :

un groupement (170) d'éléments transducteurs ayant une direction souhaitée vers l'avant pour la transmission d'ondes ultrasonores et une direction d'émission ultrasonore non souhaitée vers l'arrière ;
un circuit intégré (160) structuralement couplé au groupement d'éléments transducteurs ;
un bloc de support en mousse composite (165), situé à l'arrière du groupement d'éléments transducteurs et du circuit intégré, le bloc de support en mousse composite étant composé d'un matériau en mousse ayant une structure poreuse ;
caractérisé en ce que :

une résine époxy (34) est adaptée pour remplir au moins une partie de la structure poreuse du bloc de support en mousse ; et
le matériau en mousse comprend en outre une mousse graphite ; et

dans lequel des émissions ultrasonores dans la direction vers l'arrière sont dispersées ou atténuées par a structure en mousse poreuse et l'époxy, et de la chaleur est conduite loin du groupement d'éléments transducteurs et du circuit intégré par la mousse graphite dans le matériau de bloc de support.

2. Ensemble de groupement de transducteurs ultrasonores selon la revendication 1, dans lequel le bloc de support en mousse composite comprend en outre une surface extérieure, et dans lequel la résine époxy remplit la structure poreuse du bloc de support en mousse adjacente à la surface extérieure.

3. Ensemble de groupement de transducteurs ultrasonores selon la revendication 1, dans lequel le circuit intégré comprend en outre un ASIC de mise en forme de faisceau couplé au côté arrière du groupement d'éléments transducteurs,
dans lequel le bloc de support en mousse composite est thermiquement couplé à l'ASIC de formation de faisceau.

4. Ensemble de groupement de transducteurs ultrasonores selon la revendication 3, dans lequel le bloc de support en mousse composite est lié à l'ASIC de formation de faisceau par une liaison époxy.

5. Ensemble de groupement de transducteurs ultrasonores selon la revendication 3, comprenant en outre une couche électriquement isolante entre l'ASIC de formation de faisceau et le bloc de support en mousse composite.

6. Ensemble de groupement de transducteurs ultrasonores selon la revendication 5, dans lequel la couche électriquement isolante comprend en outre un film de polyimide (38).

7. Ensemble de groupement de transducteurs ultrasonores selon la revendication 6, dans lequel le film de polyimide ne fait pas plus de 25 micromètres d'épaisseur.

8. Ensemble de groupement de transducteurs ultrasonores selon la revendication 5, dans lequel la couche électriquement isolante comprend en outre un revêtement de parylène.

9. Ensemble de groupement de transducteurs ultrasonores selon la revendication 8, dans lequel le revêtement de parylène ne fait pas plus de 15 micromètres d'épaisseur.

10. Ensemble de groupement de transducteurs ultrasonores selon la revendication 1, dans lequel la structure poreuse présente une porosité d'au moins 60 %.

11. Ensemble de groupement de transducteurs ultrasonores selon la revendication 10, dans lequel au moins 95 % de la porosité totale de la structure poreuse est ouverte.

12. Ensemble de groupement de transducteurs ultrasonores selon la revendication 1, dans lequel la dispersion d'émission ultrasonore vers l'arrière est due à la non-correspondance d'impédance entre l'époxy, le matériau en mousse graphite et l'air dans la structure en mousse graphite.

13. Ensemble de groupement de transducteurs ultrasonores selon la revendication 1, dans lequel une atténuation d'émissions ultrasonores vers l'arrière est due à une absorption par la résine époxy.

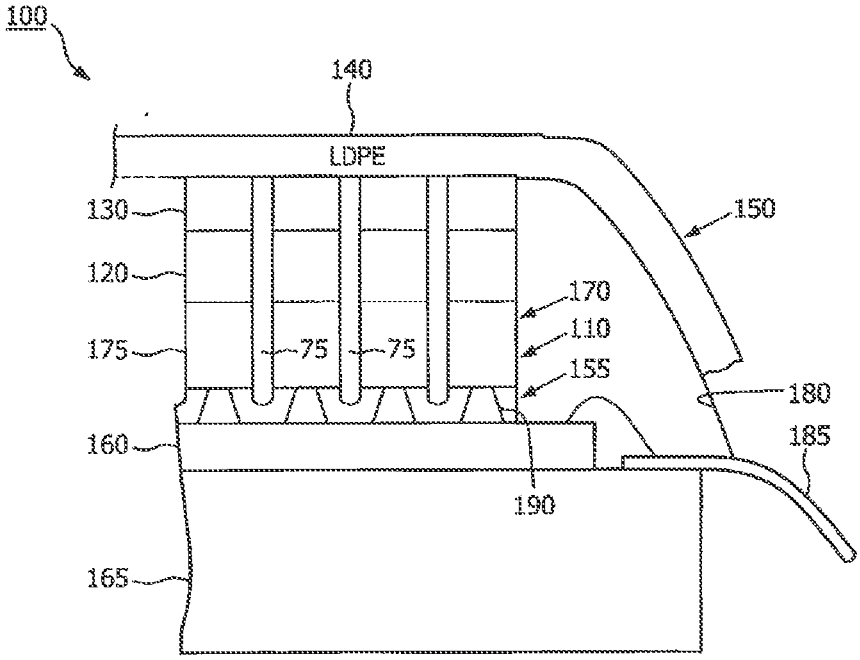
100
140
LDPE
150
130
120
170
110
175
75
75
155
180
185
160
190
165

FIG. 1

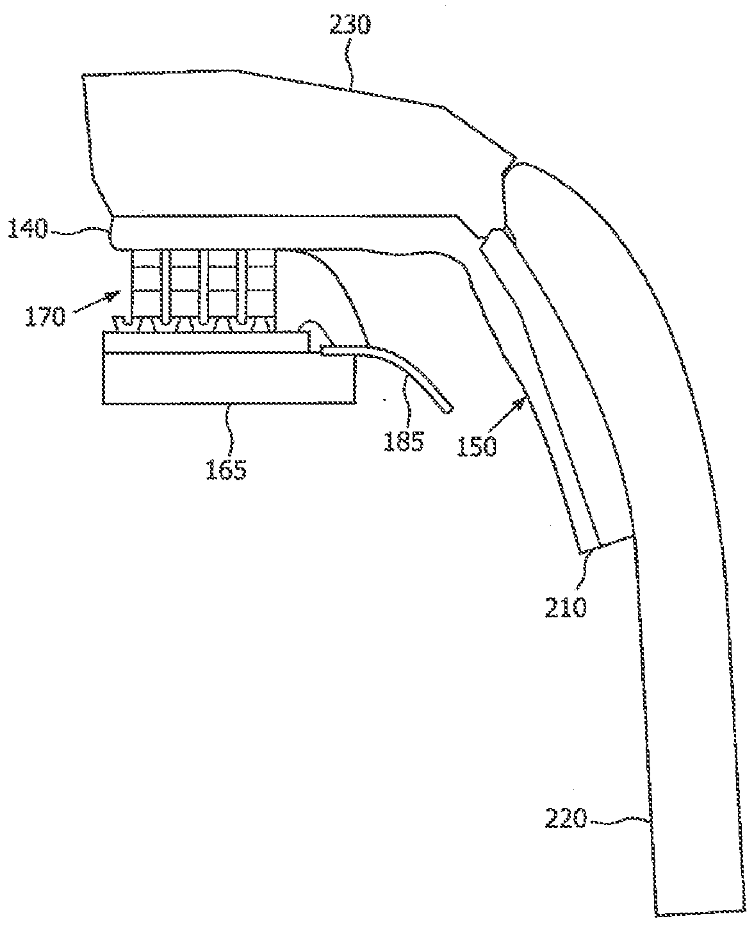

FIG. 2

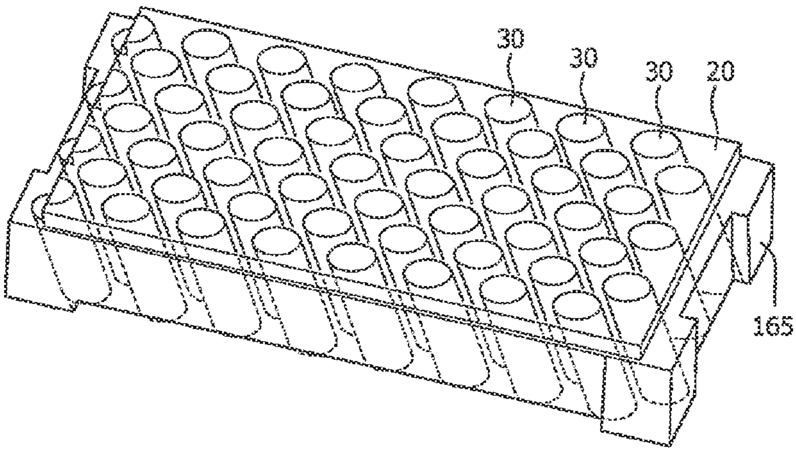

FIG. 3

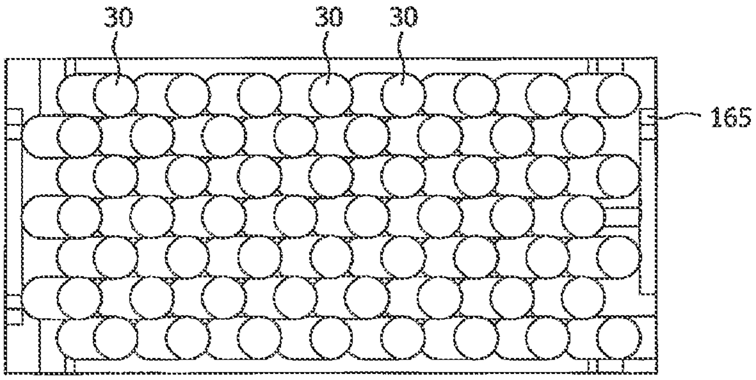

FIG. 4

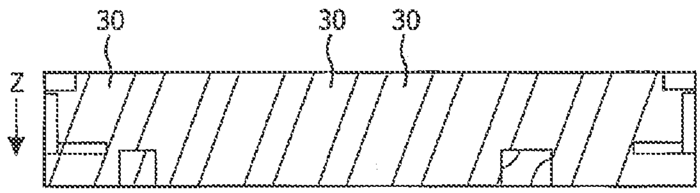

FIG. 5

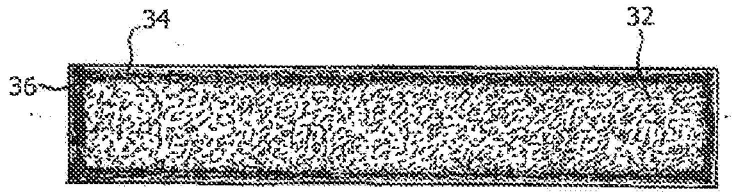

FIG. 6

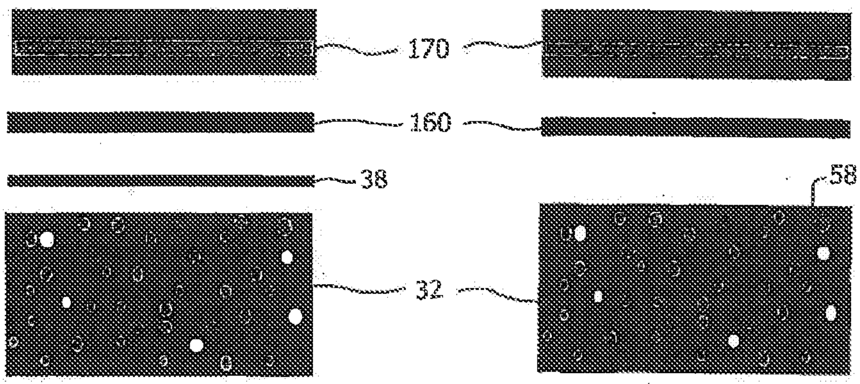

FIG. 7

FIG. 8

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

- US 2008098816 A1 **[0005]**
- US 2008315724 A1 **[0006]**
- WO 2008121238 A2 **[0007]**
- US 6673328 B1 **[0008]**
- US 20100168581 A, Knowles **[0013]**

patsnap

专利名称(译)	用于超声换能器阵列的具有高导热率的高孔隙率声学背衬		
公开(公告)号	EP2686117B1	公开(公告)日	2019-06-19
申请号	EP2012715725	申请日	2012-03-14
[标]申请(专利权)人(译)	皇家飞利浦电子股份有限公司		
申请(专利权)人(译)	皇家飞利浦N.V.		
当前申请(专利权)人(译)	皇家飞利浦N.V.		
[标]发明人	SUDOL WOJTEK WICKLINE KEVIN GRAYSON YU YONGJIAN KNOWLES HEATHER BECK PAOLINO JAMES DAVIDSEN RICHARD EDWARD		
发明人	SUDOL, WOJTEK WICKLINE, KEVIN GRAYSON YU, YONGJIAN KNOWLES, HEATHER BECK PAOLINO, JAMES DAVIDSEN, RICHARD EDWARD		
IPC分类号	A61B8/00 G10K11/00 B06B1/06		
CPC分类号	A61B8/4494 A61B8/4483 B06B1/0629 G10K11/002		
代理机构(译)	STEFFEN , THOMAS		
优先权	61/453690 2011-03-17 US		
其他公开文献	EP2686117A2		
外部链接	Espacenet		

摘要(译)

用于超声探头的超声换能器阵列堆叠的背衬块形成为高导热率材料的复合结构，其中嵌入有声阻尼材料的结构。在构造的实施例中，复合结构由导热石墨块形成，其中形成多个圆柱形孔，这些圆柱形孔填充有声学阻尼材料。孔从换能器叠层的后部相对于Z轴方向成角度，使得在该方向上行进的混响能量将遇到声学阻尼材料。孔周围的石墨有效地将热量传导到探头后部并远离换能器叠层及其ASIC。

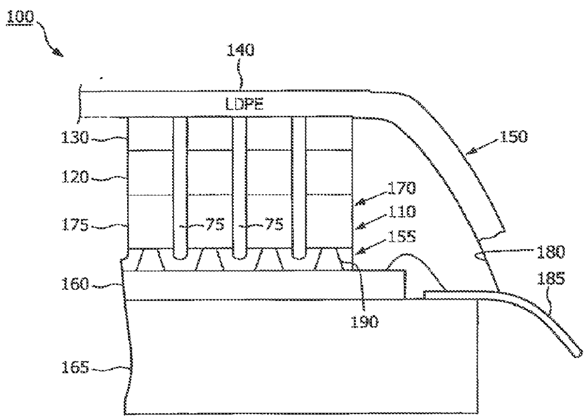

FIG. 1