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(54) Piezocomposite, ultrasonic probe for ultrasonic diagnostic equipment, ultrasonic diagnostic equipment and method for producing piezocomposite

(57) A composite sheet unit (6) in which a plurality of sintered piezoelectric thin wires (33) are arranged in a uniform direction on a surface of a resin layer (22) is prepared, and a plurality of the same are laminated and integrated so that the sintered piezoelectric thin wires (33) are positioned between the resin layers (22). Here, a curing resin may be impregnated therein so as to form resin-impregnated-cured portions (23). Then, the lamination is cut in a direction crossing a lengthwise direction of the sintered piezoelectric thin wires (33), so that a piezocomposite is obtained. Cut surfaces may be ground. By so doing, it is possible to provide a highly reliable piezocomposite having a fine structure at low cost, and to provide an ultrasonic probe for an ultrasonic diagnostic equipment, as well as an ultrasonic diagnostic equipment.

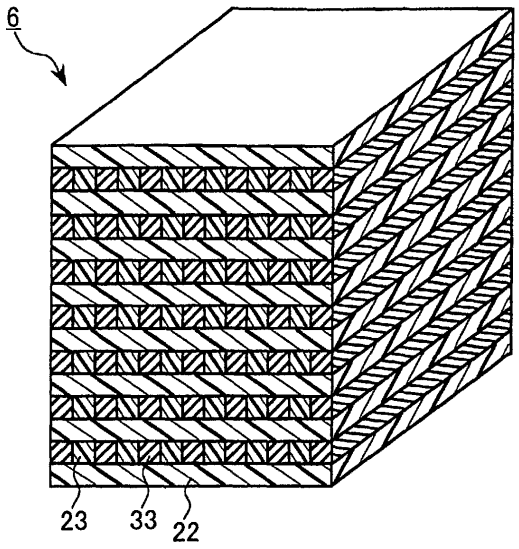

FIG. 14

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EUROPEAN SEARCH REPORT

Application Number
EP 02 00 1590

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	EP 0 137 529 A (PHILIPS NV) 17 April 1985 (1985-04-17) * page 3, paragraph 3 - page 8, paragraph 1; figures 3,4 *	1-8,18, 19	H01L41/18 H01L41/22 B06B1/06
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X	SMITH W A: "Composite piezoelectric materials for medical ultrasonic imaging transducers-a review" ISAF '86. PROCEEDINGS OF THE SIXTH IEEE INTERNATIONAL SYMPOSIUM ON APPLICATIONS OF FERROELECTRICS (CAT. NO.86CH2358-0), BETHLEHEM, PA, USA, 8-11 JUNE 1986, pages 249-256, XP001157081 1986, New York, NY, USA, IEEE, USA * page 249, column 1, paragraph 2 - page 251, column 1, paragraph 1 *	1-6	
X	* page 249, column 1, paragraph 3 - column 2, paragraph 1 *	9	
Y	* page 249, column 1, paragraph 3 - column 2, paragraph 1 *	10	TECHNICAL FIELDS SEARCHED (Int.Cl.7)
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X	SMITH W A: "The role of piezocomposites in ultrasonic transducers" IEEE 1989 ULTRASONICS SYMPOSIUM PROCEEDINGS (CAT. NO.89CH2791-2), MONTREAL, QUE., CANADA, 3-6 OCT. 1989, pages 755-766 vol.2, XP002269035 1989, New York, NY, USA, IEEE, USA * page 756, column 1, paragraph 3 - page 757, column 1, paragraph 2; figure 5 *	1-5	
X	* page 761; figures 12,15 *	9	
Y	* page 761; figures 12,15 *	10	
A	* page 756, column 1, paragraph 3 - page 757, column 1, paragraph 2; figure 5 *	16,17	

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	26 April 2004	Steiner, M

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 02 00 1590

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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X	US 5 340 510 A (BOWEN LESLIE J) 23 August 1994 (1994-08-23) * column 3, line 16 - column 7, line 16; figures 1,5 *	11	
X	DE 34 37 862 A (HITACHI LTD ;HITACHI MEDICAL CORP (JP)) 23 May 1985 (1985-05-23) * page 7, line 27 - page 11, line 29 *	15	
X	US 5 539 965 A (SAFARI AHMAD ET AL) 30 July 1996 (1996-07-30) * column 4, line 65 - column 6, line 11 *	20	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	26 April 2004	Steiner, M

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EPO FORM 1503 03.82 (P04C01)

European Patent Office

Application Number
EP 02 00 1590

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

European Patent Office

LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 02 00 1590

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claims: 1-12,18-20

The method of preparing piezocomposites as claimed in claims 1-8 by lamination is already disclosed in EP 0137529 A (=D1) (see below for full reasoning). The invention here therefore relates to how the individual sheets to be stacked are produced.
The invention here is to prepare sintered piezoelectric wires directly from a piezoelectric powder by using a mould. After sintering, a resin layer is directly bonded to the wires and the sheet then separated from the mould in one piece.

2. Claims: 13-15,18-20

The piezoelectric wires are cut from a sintered plate which either has a resin layer directly bonded to it (claims 13 and 14) or is provisionally attached to an adhesive layer for cutting which is then used to transfer the wires to a resin sheet.

3. Claims: 16,17,18-20

The composite sheet units are produced using two layers of resin, either laying sintered piezoelectric wires in a uniform manner on one sheet and then placing another resin sheet on top of these wires and integrating these such that the grooves between the wires are filled with resin (claim 16), or laminating two resin sheets with sintered piezoelectric wires already attached to them, such that one set of wires is sandwiched inbetween the resin layers, and the other set is on the surface of the resulting composite sheet and in parallel with the other set of wires.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 02 00 1590

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

26-04-2004

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

专利名称(译)	Piezocomposite，超声波诊断设备用超声波探头，超声波诊断设备和压电复合材料的制造方法		
公开(公告)号	EP1227525A3	公开(公告)日	2004-06-23
申请号	EP2002001590	申请日	2002-01-23
申请(专利权)人(译)	松下电器产业有限公司.		
当前申请(专利权)人(译)	松下电器产业株式会社		
[标]发明人	SHIRAISHI SEIGO TAKAHARA NORIHISA IGAKI EMIKO NAGAHARA HIDETOMO SAITO KOETSU		
发明人	SHIRAISHI, SEIGO TAKAHARA, NORIHISA IGAKI, EMIKO NAGAHARA, HIDETOMO SAITO, KOETSU		
IPC分类号	G01N29/24 A61B8/00 B06B1/06 H01L41/08 H01L41/09 H01L41/338 H01L41/43 H01L41/45 H04R17/00 H01L41/18 H01L41/22		
CPC分类号	B06B1/0629 H01L41/183 H01L41/37 Y10T29/42 Y10T29/49194 Y10T29/49798		
优先权	2001176026 2001-06-11 JP 2001017559 2001-01-25 JP		
其他公开文献	EP1227525B1 EP1227525A2		
外部链接	Espacenet		

摘要(译)

制备复合片单元（6），其中多个烧结的压电细线（33）以均匀的方向布置在树脂层（22）的表面上，并且将多个烧结的压电细线层叠并集成在一起，使得烧结的压电细线（33）位于树脂层（22）之间。这里，可以在其中浸渍固化树脂，以形成树脂浸渍固化部分（23）。然后，在与烧结的压电细线（33）的长度方向交叉的方向上切割叠层，从而获得压电复合材料。可以研磨切割表面。通过这样做，可以以低成本提供具有精细结构的高度可靠的压电复合材料，并提供用于超声诊断设备的超声探头，以及超声诊断设备。

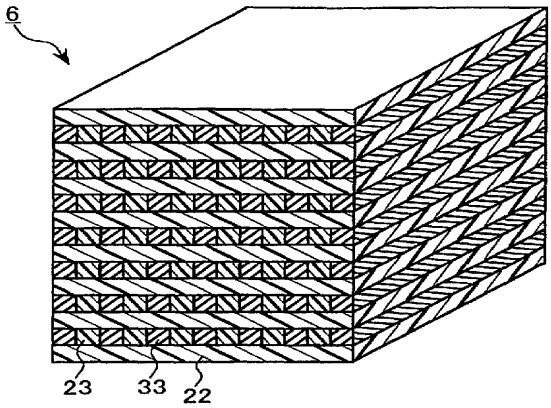

FIG. 14