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(71) Applicant: **Hakko Co., Ltd.**
Nagano-ken (JP)

(72) Inventors:
- **Maruyama, Masaru**
  Nagano 389-0806 (JP)
- **Kitagawa, Shiro**
  Tokyo 133-0033 (JP)
- **Komatsu, Masayoshi**
  Sendai-shi Miyagi 983-0852 (JP)

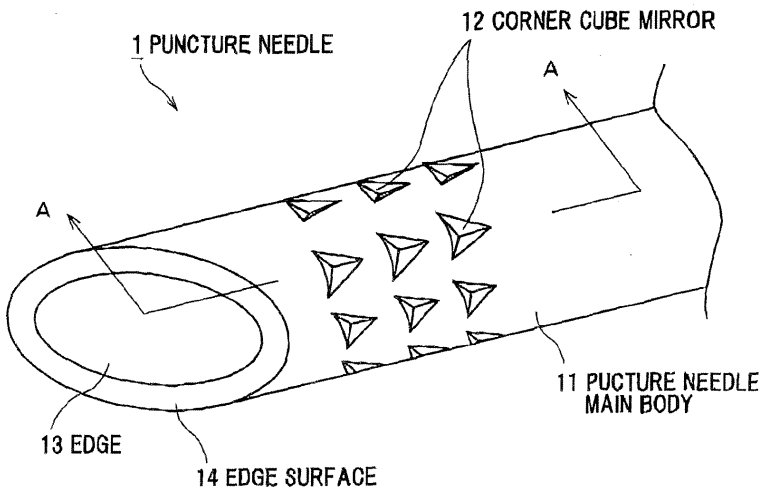
(74) Representative: **Gill, David Alan**
W.P. Thompson & Co.
55 Drury Lane
London WC2B 5SQ (GB)

Remarks:
•This application was filed on 27-07-2010 as a divisional application to the application mentioned under INID code 62.
•Claims 16-23 are deemed to be abandoned due to non-payment of the claims fees (Rule 45(3) EPC).

(54) Ultrasonic puncture needle

(57) A puncture needle capable of clear imaging even if an angle to the irradiation direction of a detection wave such as an ultrasonic wave of an ultrasonic probe is small. According to one embodiment, a ultrasonic puncture needle (1) that conducts puncturing while observing a puncturing condition by means of a ultrasonic image is formed with an edge (13) at the tip end of a puncture needle main body (11), and formed at a specified position of the puncture needle main body (11) with at least one corner cube mirror (12) formed by a triangular pyramid recess. Since a ultrasonic wave oscillated from the ultrasonic probe is reflected off the corner cube mirror (12) to be returned to the ultrasonic probe, the reflected wave progresses in the same direction as the incident direction of the ultrasonic wave to be positively returned to the probe even when an angle formed by the irradiation route of a ultrasonic wave and the axis of the puncture needle is small.

FIG.1A



EP 2 363 070 A1

Description

[0001] The present invention relates to a puncture needle for a medical application, and more particularly, to a puncture needle used under displaying ultrasonic image.

[0002] In the medical field, a puncture needle (biopsy needle, insulated electrode needle) is used, for example, for gathering a part of a tissue or a cell of a human organism is gathered for the purpose of diagnostic confirmation of a lesion, or for precisely finding a location of a nerve. For this case, an ultrasonic diagnostic equipment is used from a requirement of precisely recognizing a location of the puncture needle, particularly a location of tip end thereof. For example, in a case of using a biopsy needle, needle puncturing is conducted while observing an ultrasonic echo from the tip end of the puncture needle by displaying a pictorial image, to precisely finding as to whether a tissue collecting part of the tip end of the puncture needle (a needle point or a notch) reaches the lesion. Further, this biopsy needle often has a dual structure comprising an inner tube and an outer tube.

[0003] On the other hand, another puncture needle called as an insulated electrode block needle in general has a single tube structure (single-needle), in that an electrical insulation coating is provided on a surface of the needle tube except an edge surface thereof. The insulated electrode block needle is generally used for searching the nerve by using a muscle contraction caused by an electric stimulation, in order to conduct a nerve block by dosing anesthetics or painkiller to the nerve. In recent years, a manual technique to puncture the needle while observing the ultrasonic image together with energization by a conventional nerve stimulator (puncturing under irradiation of the ultrasonic wave and confirmation by the nerve stimulator) has been widely used in an approach of the nerve search.

[0004] The ultrasonic image is an image obtained by irradiating an ultrasonic wave from an ultrasonic probe (ultrasonic transducer) as a transmitting and receiving device of the ultrasonic wave to the puncture needle via a medium, receiving a reflected wave (ultrasonic echo) from the puncture needle at the ultrasonic probe, and conducting an image processing on the reflected wave to display an image on a display unit.

[0005] As the conventional puncture needles to be used while displaying the ultrasonic image, for example, a puncture needle provided with a protrusion, a V-groove or the like at its outer periphery surface of the tip end (for example, see patent document 1), a puncture needle provided with a circular groove at its outer periphery surface (for example, see patent documents **2, 3**), a puncture needle provided with an enhanced portion comprising a cylindrical protruding portion and a circular groove at its tip end (for example, see patent documents **4, 5**) are known. Configuration of the protrusion, the groove and the like provided at the tip end of any of these puncture needles is designed for easily generating a reflection of the ultrasonic wave.

Patent document **1**: Japanese Patent Laid-Open No. 3-228748

Patent document **2**: Japanese Patent Laid-Open No. 11-76254

Patent document **3**: Japanese Utility Model Laid-Open No. 3-73113

Patent document **4**: Japanese Patent Laid-Open No. 2004-181095

Patent document **5**: Japanese Patent Laid-Open No. 2003-144436

[0006] However, according to the conventional puncture needles in which the ultrasonic wave is reflected back by machining the tip end, an angle made by an irradiation path of the ultrasonic wave and an axis of the puncture needle is small. In particular, when the angle is not great than **45**°, a level of the ultrasonic echo returned to the ultrasonic probe is decreased, so that the ultrasonic image of the puncture needle becomes unclear, and as a result, it is difficult to recognize a precise location of the puncture needle.

[0007] Accordingly, it is an object of the invention to provide a puncture needle, which can be clearly imaged, even though an angle made by an irradiation angle of a detection wave such as an ultrasonic wave of an ultrasonic probe and an axis of the puncture needle is small.

[0008] According to a feature of the present invention, so as to solve the above problem, an ultrasonic puncture needle for conducting puncturing while observing a puncturing condition by an ultrasonic image, comprising÷ a needle tube main body comprising an edge at its tip end characterized in that: at least one corner cube mirror configured by three mirror surfaces that are perpendicular to each other is provided at a predetermined position of the needle tube main body. Herein, the needle tube main body' may comprise an inner needle or an outer needle of a double needle, a single tube structure, or other kinds of needles. The corner cube mirror is provided at an outer surface or an edge surface thereof, regardless the needle tube main body comprises the inner needle, the outer needle, or the single tube structure.

[Effects of the Invention]

[0009] According to the puncture needle of the present invention, it is possible to clearly image a needle tube main body, particular a tip end of the needle tube main body, even though an angle made by an irradiation angle of a detection wave such as an ultrasonic wave of an ultrasonic probe and an axis of the puncture needle is small.

FIG.1 shows a puncture needle in a preferred embodiment according to the present invention, wherein **FIG.1A** is a perspective view thereof, and FIG.1B is a cross sectional view thereof along A-A line in **FIG.1A;**

FIG.2 shows a corner cube mirror shown in **FIG.1,**

wherein **FIG.2A** is an explanatory diagram showing a structure and a function of the corner cube mirror, and **FIG.2B** is an explanatory diagram showing an example of application; and

FIG.3 shows a double needle provided with the corner cube mirror, wherein **FIG.3A** is a perspective view of a structure in which the corner cube mirror is provided at an edge surface of an inner needle, and **FIG.3B** is a perspective view of a structure in which the corner cube mirror is provided at an inner periphery surface of an outer needle.

[Reference numerals]

[0010]

1	puncture needle
11	puncture needle main body
12	corner cube mirror
12a, **12**b, **12**c	first to third mirror surfaces
13	edge
14	edge surface
20	ultrasonic probe
21	outer needle
22	edge surface of the inner needle
24	edge surface of the outer needle
30	double needle

[0011] **FIG.1** shows a puncture needle in a preferred embodiment according to the present invention. In **FIG. 1, FIG.1A** is a perspective view thereof, and **FIG.1B** is a cross sectional view thereof along A-A line in **FIG.1A**

[0012] An ultrasonic puncture needle (hereinafter referred as "puncture needle") **1**, which is a needle tube, comprises a puncture needle main body **11** which is a needle tube main body comprising a metal capillary made of stainless steel or the like, and a plurality of corner cube mirrors **12** provided at an outer surface (outer periphery surface) of a tip end of the puncture needle main body **11**.

[0013] The puncture needle main body **11** comprises an edge **13** including an edge surface 14 made by diagonally cutting its tip portion. The corner cube mirror **12** comprises a triangular pyramid-shaped recess provided at a surface of the puncture needle main body 11 at a region in vicinity of the edge **13**, and the corner cube mirrors **12** are formed along three lines with a predetermined interval in a circumferential direction of the puncture needle main body **11**. For example, the corner cube mirrors **12** are disposed with an interval of **45**° with respect to a center of the needle tube, and eight mirrors are formed per one line. In addition, the number of the corner cube mirrors **12** to be used and the number of lines are not limited to eight and three respectively as described above, and may be arbitrary numbers. The corner cube mirrors **12** are provided at the surface of the puncture needle main body **11**, however, the present invention is not limited thereto, and may be provided at an inner periphery surface of the puncture needle main body **11** or both of them.

[0014] It is preferable to form the corner cube mirror **12** in vicinity of the edge **13**, so as to clarify an imaging of the tip end. For example, the corner cube mirror **12** may be formed by electric discharge machining. Alternatively, the corner cube mirror **12** may be punched by a tool such as punches.

[0015] **FIG.2** shows a function of the corner cube mirror. This corner cube mirror **12** is configured by three mirror surfaces that are perpendicular to each other, and an incident wave is reflected back by the three mirror surfaces, and emitted as an output wave that is parallel to the incident wave.

[0016] As shown in **FIG.2A**, three faces (ABFE, EFGH, AEHD) of a cube (ABCD-EFGH) are provided as mirror surfaces, and AFH is opened. An opening with a triangular-pyramid shape having a base point E and a top face AFH is provided as the corner cube mirror **12**.

[0017] In **FIG.2A**, an incident wave L_1 which is incident to the corner cube mirror **12** is reflected at a reflecting point R_1 of a first mirror surface **12**a in the AEHD face to provide a reflected wave L_2, the reflected wave L_2 is reflected at a reflecting point R_2 of a second mirror surface **12**b in the ABFE face to provide a reflected wave L_3, and the reflected wave L_3 is reflected at a reflecting point R_3 of a third mirror surface **12**c in the EFGH face to provide an output wave L_4.

[0018] In **FIG.2B**, the incident wave L_1 is emitted from an ultrasonic probe 20, and the output wave L_4 is received by the ultrasonic probe **20**. According to this structure it is possible to detect the edge **13** including the edge surface **14** of the puncture needle main body **11** of the puncture needle **1** by virtue of the corner cube mirrors **12**.

[0019] As described above, the incident wave and the reflected wave of the ultrasonic wave which is incident to the corner cube mirrors **12** are parallel or substantially parallel to each other. Therefore, the ultrasonic wave transmitted from the ultrasonic probe **20** is necessarily reflected at the corner cube mirror **12** to be returned to the ultrasonic probe **20**, so that the reflected wave is directed to an output direction of the incident wave of the ultrasonic wave and surely returned to the ultrasonic probe **20** that is an emitting side of the ultrasonic wave, even when the angle made by the irradiation path of the ultrasonic wave and the axis of the puncture needle is small.

[0020] **FIG.3** shows a double needle **30** provided with the corner cube mirrors, wherein **FIG.3A** is a perspective

view of the double needle **30** in which an inner needle (no reference numeral) having an edge surface **22** is inserted into an outer needle **21** having an edge surface **24**, and **FIG.3B** is a perspective view of the outer needle **21** from which the inner needle is detached.

[0021] In **FIG.3A**, the inner needle comprises the corner cube mirrors **12** provided on the edge surface **22**. According to this structure, it is possible to precisely detect a tip end of the double needle **30**.

[0022] In **FIG.3B**, the corner cube mirror **12** is provided on an inner periphery surface of the edge surface **24** of the outer needle **21**. According to this structure, it is possible to precisely detect a tip end of the outer needle **21** in the state that the inner needle is detached.

[0023] According to this preferred embodiment, following effects can be obtained.

(a) By providing the puncture needle with the corner cube mirror, the incident wave and the reflected wave of the ultrasonic wave in the puncture needle are made parallel or substantially parallel to each other, so that the ultrasonic wave output from the ultrasonic probe is reflected at the puncture needle and returned to the ultrasonic probe. Therefore, even though the angle made by the irradiation path of the ultrasonic wave and the axis of the puncture needle is reduced, the ultrasonic wave is reflected by the corner cube mirror and returned to the ultrasonic probe, so that it is possible to clearly image the puncture needle, particularly, the tip end thereof.

(b) By providing the corner cube mirror in vicinity of the edge, it is possible to clarify the imaging of the tip end.

(c) By providing a plurality of the corner cube mirrors at a periphery of the puncture needle, the incident wave and the reflected wave of the ultrasonic wave in the puncture needle are made parallel or substantially parallel to each other regardless the orientation of the puncture needle, so that it is possible to clearly image the puncture needle regardless the orientation of the puncture needle.

(d) By providing the corner cube mirrors in plural lines, it is possible to surely generate the reflected wave.

(e) Since the corner cube mirror has a good reflecting efficiency, so that it is possible to obtain a good reflecting property regardless the type of the puncture needle. In particular, by providing the corner cube mirror at the outer surface of the inner needle of the double needle, it was possible to obtain an excellent reflecting property by a synergistic effect with an air layer existing between the inner needle and the outer needle. However, it was also possible to obtain the excellent reflecting property according to a structure in which the corner cube mirror is provided at an outer surface of the single tube structure and a coating is provided at the outer periphery thereof.

[0024] The present invention is not limited to the preferred embodiment described above, and may be modified without going beyond or transforming a technical concept of the present invention.

[0025] For example, the present invention may be applied to all puncture needles to be punctured to a target while observing a location of the needle tube punctured into the human body by the ultrasonic echo, such as a PTC (Percutaneous Transhepatic Cholangiography) needle for cholangiography, a puncture needle for an ultrasonic endoscope, and the like.

[0026] In case that a fluorine resin is coated on a part other than the edge 13 in the puncture needle provided with the corner cube mirror **12**, in order to compose an insulated electrode block needle, it possible to clearly image the insulated electrode block needle, similarly to the above. By the way, since the conventional insulated electrode block needle does not comprise the corner cube mirror **12**, the image was unclear due to an attenuation caused by the insulation coating.

[0027] In addition, the present invention is not limited to the use of the ultrasonic wave, and may be applied, for example, to a light such as a laser beam, electron beam, or the like. Therefore, the present invention may be applied to an application for confirming a location of an article to be detected such as needle by using the reflected wave of an electromagnetic wave by the corner cube mirror. Further, the reflecting surface of the corner cube mirror **12** is not necessarily a plane surface.

[0028] The corner cube mirror formed at the outer surface of the needle tube can generate the reflected wave that is parallel or substantially parallel to the incident wave of the detection wave of the ultrasonic wave or the like, so that it is applicable to a purpose for clarifying the image of the needle tube existing in a range to which the detection wave of the ultrasonic wave or the like output from the ultrasonic probe or the like reaches, for example, a medical apparatus and a medical equipment.

Claims

1. An ultrasonic puncture needle for conducting puncturing while observing a puncturing condition by an ultrasonic image, comprising:

a needle tube main body comprising an edge at its tip end; and
at least one mirror portion provided at a predetermined position of the needle tube main body,

characterized in that the mirror portion comprises a first mirror surface, a second mirror surface and a third mirror surface, each of which has a reflecting direction of a detection wave different from each other, the first to third mirror surfaces are located to be adjacent to each other, and the first to third mirror surfaces have a base point E as a common point.

2. The ultrasonic puncture needle, according to Claim 1, wherein the mirror portion comprises a triangular-pyramid shape.

3. The ultrasonic puncture needle, according to Claim 1, wherein an apex of an opening of the mirror portion and the base point E are formed along a straight line parallel to a pipe axis.

4. The ultrasonic puncture needle, according to Claim 1, wherein the mirror portion receives the detection wave and reflects a reflected wave which is parallel or substantially parallel to the detection wave.

5. The ultrasonic puncture needle, according to Claim 1, wherein the first mirror surface receives the detection wave and reflects a first reflected wave, and the third mirror surface receives the first reflected wave via the second mirror surface and reflects a second reflected wave that is parallel or substantially parallel to the detection wave.

6. The ultrasonic puncture needle, according to Claim 5, wherein second reflected wave is directed to an output direction of the detection wave.

7. The ultrasonic puncture needle, according to Clam 1, wherein the mirror portion is provided at an outer surface of the needle tube main body.

8. The ultrasonic puncture needle, according to Claim 1, wherein the mirror portion is provided at an edge surface of the needle tube main body.

9. The ultrasonic puncture needle, according to Claim 7, wherein a plurality of mirror portions are formed in plural lines in a longitudinal direction of the outer surface of the needle tube main body.

10. The ultrasonic puncture needle, according to Claim 1, wherein the needle tube main body comprises a single tube structure, an inner needle of a double needle or an outer needle of the double needle.

11. The ultrasonic puncture needle, according to Claim 10, wherein the mirror portion is provided at an inner surface of an edge of the outer needle.

12. The ultrasonic puncture needle, according to Claim 1, wherein the needle tube main body is provided with a resin coating at a part other than the edge.

13. The ultrasonic puncture needle, according to Claim 1, wherein the mirror portion is formed by electric discharge machining.

14. The ultrasonic puncture needle, according to Claim 1, wherein the mirror portion is punched.

15. The ultrasonic puncture needle, according to Claim 1, wherein at least one of the first to third mirror surfaces is not a plane surface.

16. An ultrasonic puncture needle for conducting puncturing while observing a puncturing condition by an ultrasonic image, comprising:

a needle tube main body comprising an edge at its tip end; and
at least one corner cube mirror provided at a predetermined position of the needle tube main body.

17. The ultrasonic puncture needle, according to Clam 16, wherein the corner cube mirror is provided at an outer surface of the needle tube main body.

18. The ultrasonic puncture needle, according to Claim 16 or 17, wherein the corner cube mirror is provided at an edge surface of the needle tube main body.

19. The ultrasonic puncture needle, according to Claim 17, wherein a plurality of the corner cube mirrors are formed in plural lines in a longitudinal direction of the outer surface of the needle tube main body.

20. The ultrasonic puncture needle, according to any one of Claims 16 to 19, wherein the needle tube main body comprises a single tube structure, an inner needle of a double needle or an outer needle of the double needle.

21. The ultrasonic puncture needle, according to Claim 20, wherein the corner cube mirror is provided at an inner surface of an edge of the outer needle.

22. The ultrasonic puncture needle, according to Claim 16 or 21, wherein the needle tube main body is provided with a resin coating at a part other than the edge.

23. A puncture needle comprising a detection hole for reflecting a detection wave, wherein the detection hole comprises a first reflecting surface for receiving the detection wave from outside the puncture needle and reflecting a first reflected wave, and a third reflecting surface for receiving the first reflected wave via a second reflecting surface and reflecting a second reflected wave that is parallel or substantially parallel to the detection wave.

FIG.1A

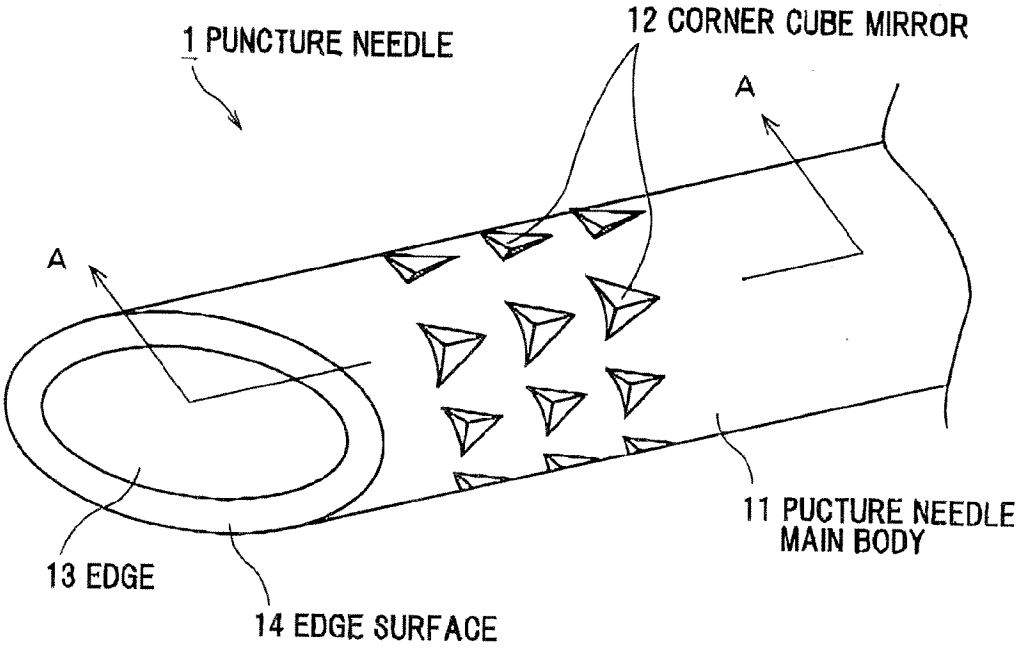

1 PUNCTURE NEEDLE
12 CORNER CUBE MIRROR
A
A
11 PUCTURE NEEDLE MAIN BODY
13 EDGE
14 EDGE SURFACE

FIG.1B

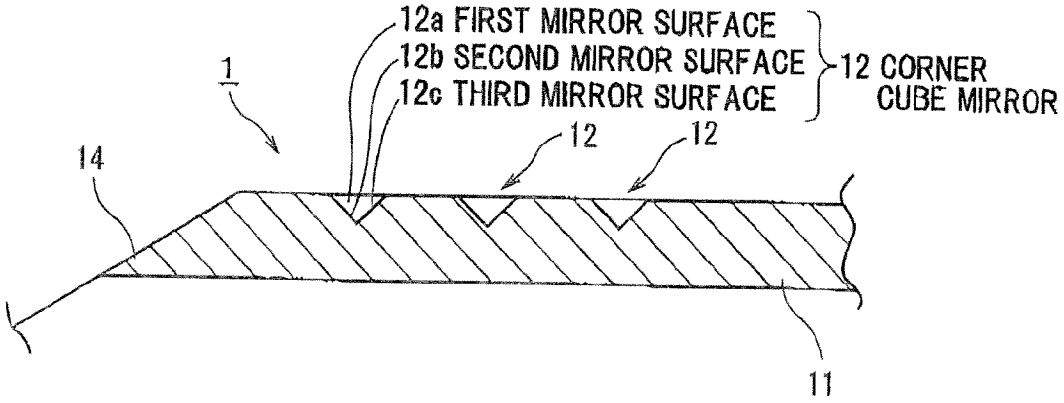

12a FIRST MIRROR SURFACE
12b SECOND MIRROR SURFACE
12c THIRD MIRROR SURFACE
12 CORNER CUBE MIRROR
1
12
12
14
11

FIG.2A

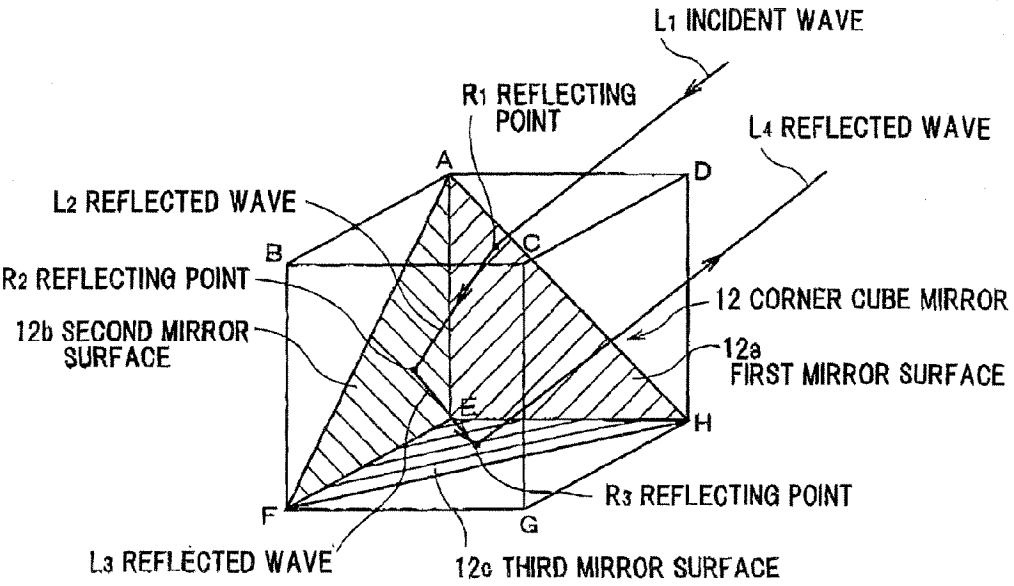

L1 INCIDENT WAVE
R1 REFLECTING POINT
L4 REFLECTED WAVE
A
D
L2 REFLECTED WAVE
B
C
R2 REFLECTING POINT
12 CORNER CUBE MIRROR
12b SECOND MIRROR SURFACE
12a FIRST MIRROR SURFACE
E
H
R3 REFLECTING POINT
F
G
L3 REFLECTED WAVE
12c THIRD MIRROR SURFACE

FIG.2B

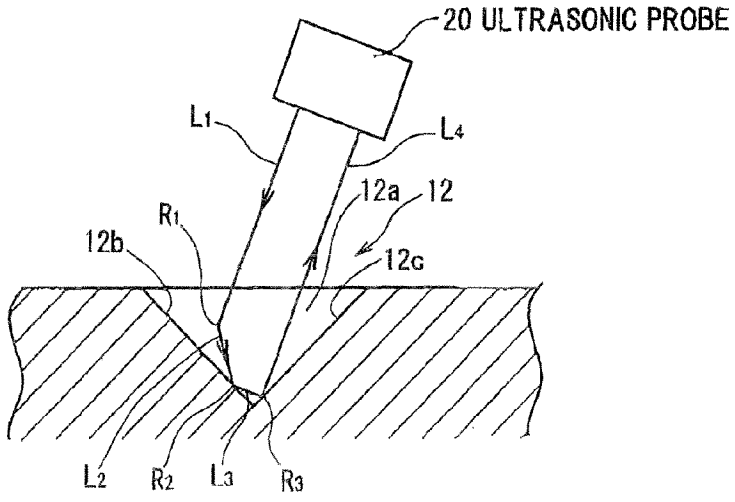

20 ULTRASONIC PROBE
L1
L4
12a
12
R1
12b
12c
L2
R2
L3
R3

FIG.3A

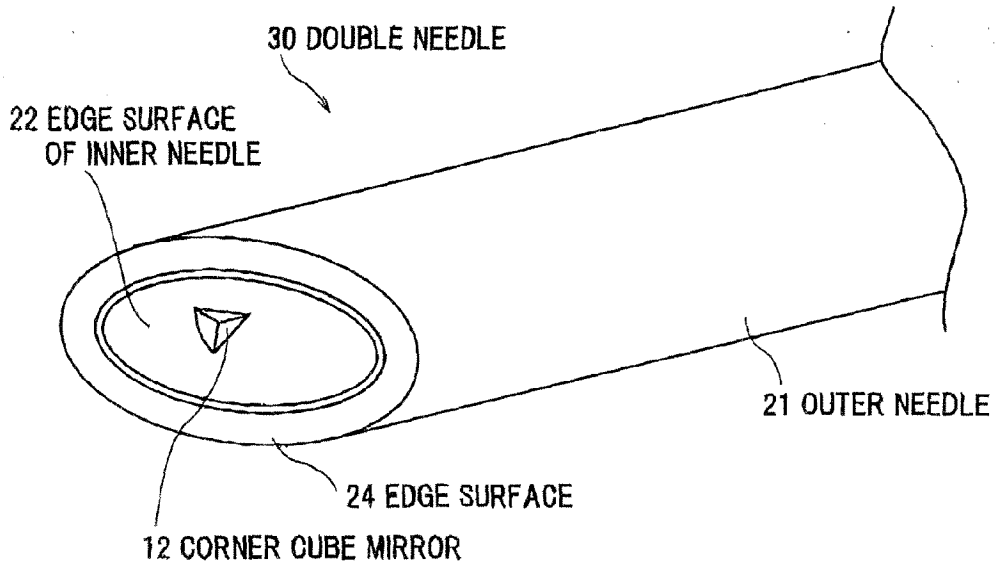
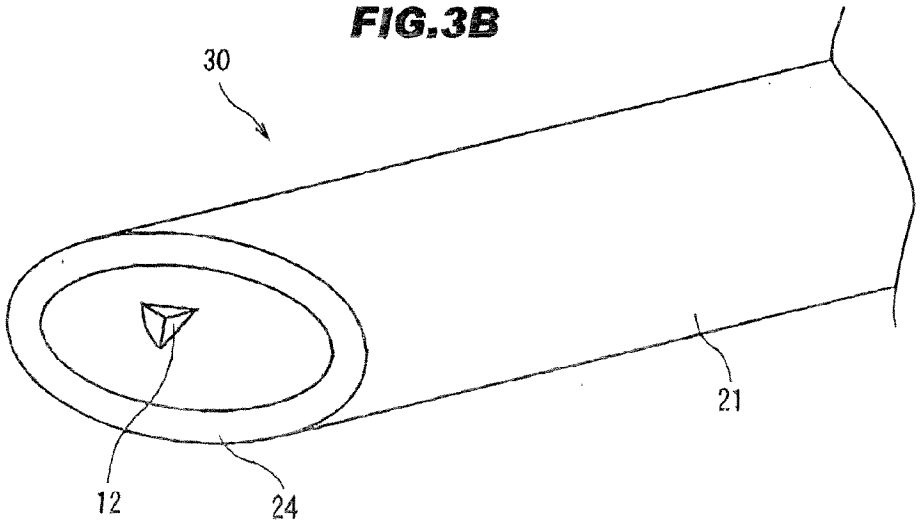

30 DOUBLE NEEDLE
22 EDGE SURFACE
OF INNER NEEDLE
21 OUTER NEEDLE
24 EDGE SURFACE
12 CORNER CUBE MIRROR

FIG.3B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EUROPEAN SEARCH REPORT

Application Number
EP 10 17 0980

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	US 5 759 154 A (HOYNS DIRK V [US]) 2 June 1998 (1998-06-02) * figures 1,5 * * column 4, line 13 - column 6, line 43 * -----	23 1-22	INV. A61B8/00 A61B10/00
Y	WO 01/26554 A (BOSTON SCIENT LTD [BB]; MAMAYEK DONALD S [US]) 19 April 2001 (2001-04-19) * page 5, line 3 - page 6, line 30 * * page 10, lines 14-25 * -----	1-22	
			TECHNICAL FIELDS SEARCHED (IPC)
			A61B A61M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	13 July 2011	Rapp, Alexander

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

1

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 10 17 0980

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
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13-07-2011

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5759154 A	02-06-1998	WO 9827888 A1	02-07-1998
WO 0126554 A	19-04-2001	US 6358211 B1	19-03-2002

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 3228748 A **[0005]**
- JP 1176254 A **[0005]**
- JP 373113 A **[0005]**
- JP 2004181095 A **[0005]**
- JP 2003144436 A **[0005]**

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[标]申请(专利权)人(译)	白光株式会社		
申请(专利权)人(译)	HAKKO CO. , LTD.		
当前申请(专利权)人(译)	HAKKO CO. , LTD.		
[标]发明人	MARUYAMA MASARU KITAGAWA SHIRO KOMATSU MASAYOSHI		
发明人	MARUYAMA, MASARU KITAGAWA, SHIRO KOMATSU, MASAYOSHI		
IPC分类号	A61B8/00 A61B10/00		
CPC分类号	A61B8/0841 A61B5/15003 A61B5/150396 A61B5/150488 A61B5/150511 A61B5/150748 A61B5/153 A61B17/3417 A61B90/39 A61B2017/3413 A61B2090/3925 Y10T29/496		
代理机构(译)	GILL，DAVID ALAN		
优先权	PCT/JP2005/013603 2005-07-25 WO		
外部链接	Espacenet		

摘要(译)

即使与超声波探头的超声波等检测波的照射方向的角度小，也能够清晰拍摄的穿刺针。根据一个实施例，在穿刺针主体（11）的尖端处形成有边缘（13）的超声波穿刺针（1），其在通过超声波图像观察穿刺状态的同时进行穿刺，并且形成在穿刺针主体（11）的指定位置处，具有由三角锥形凹部形成的至少一个角隅棱镜（12）。由于从超声波探头振荡的超声波从角隅角镜（12）反射而返回到超声波探头，因此反射波在与超声波的入射方向相同的方向上前进，以确定地返回探头。即使当由超声波的照射路径和穿刺针的轴线形成的角度小时。

FIG.1A