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(54) **ULTRASOUND TRANSDUCER UNIT, ULTRASOUND PROBE, AND METHOD OF PRODUCING ULTRASOUND TRANSDUCER UNIT**

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(52) **U.S. Cl.**

CPC ***A61B 8/4461*** (2013.01); ***A61B 8/14*** (2013.01); ***A61B 8/12*** (2013.01)

(57) **ABSTRACT**

An ultrasound transducer unit includes: a transducer section including an ultrasound transducer including a plurality of piezoelectric elements arranged in an array; and a housing configured to house the transducer section such that the transducer section is rotatable along an arrangement direction of the plurality of piezoelectric elements.

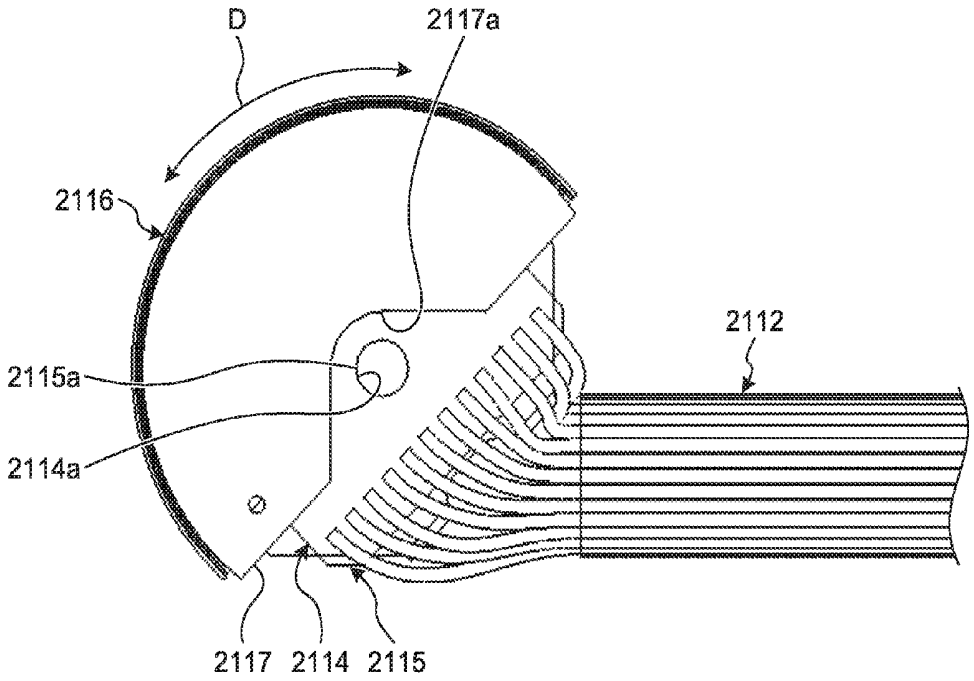


FIG.1

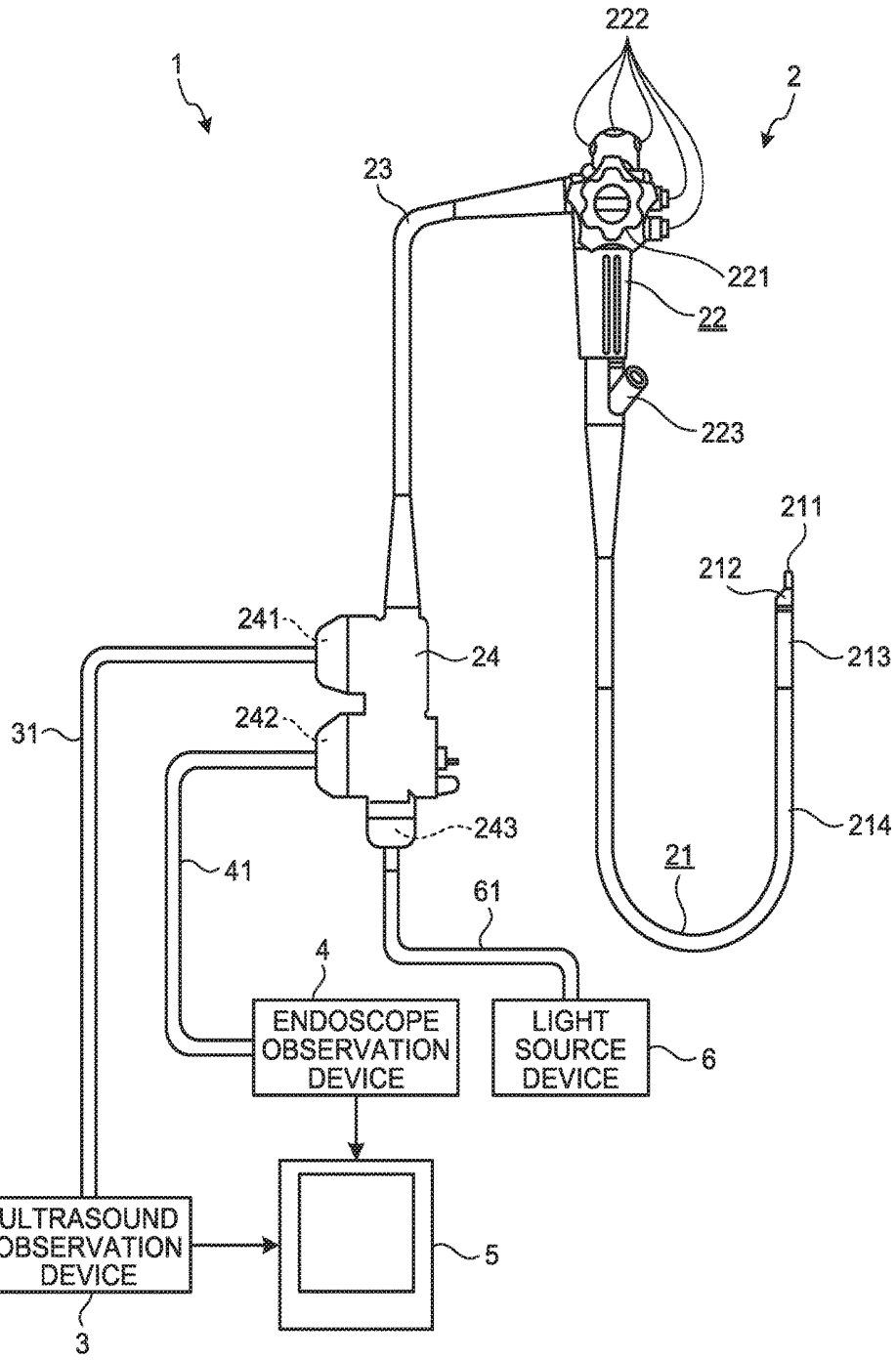

222
1
2
23
221
22
223
211
212
213
214
241
24
242
31
243
41
21
61
4
ENDOSCOPE OBSERVATION DEVICE
LIGHT SOURCE DEVICE
6
ULTRASOUND OBSERVATION DEVICE
3
5

FIG.2

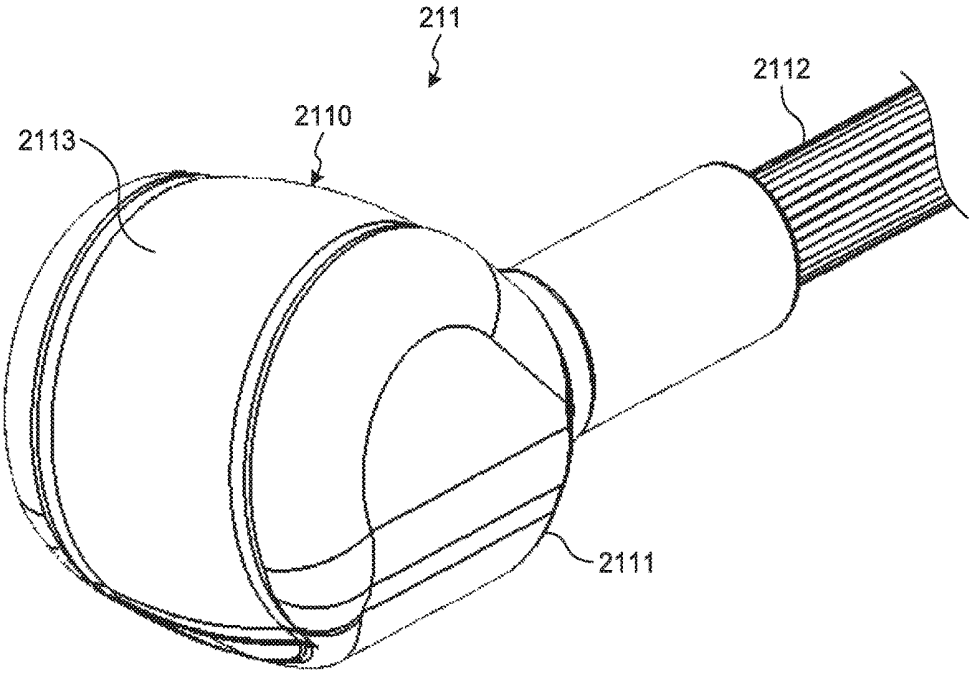

211
2112
2110
2113
2111

FIG.3

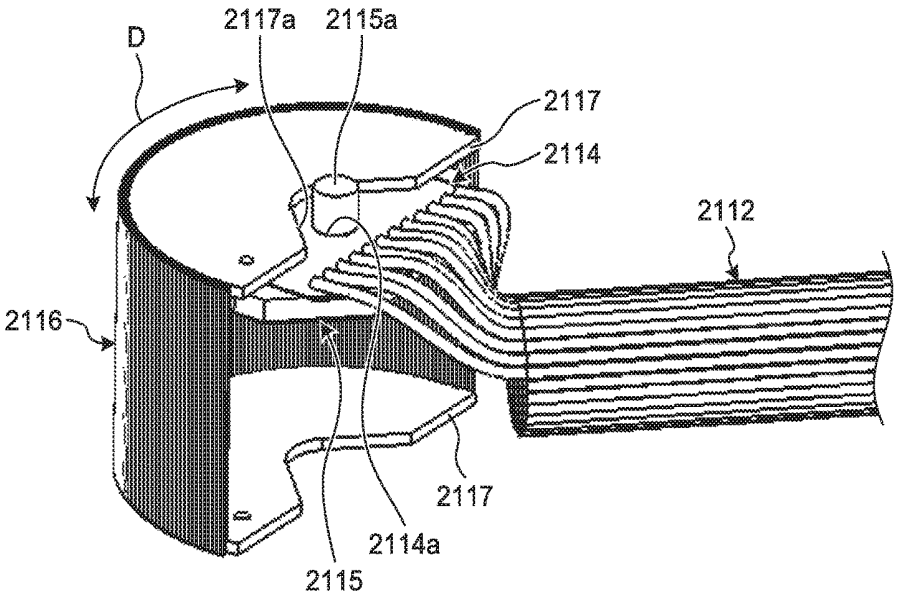

D
2117a
2115a
2117
2114
2112
2116
2117
2114a
2115

FIG.4

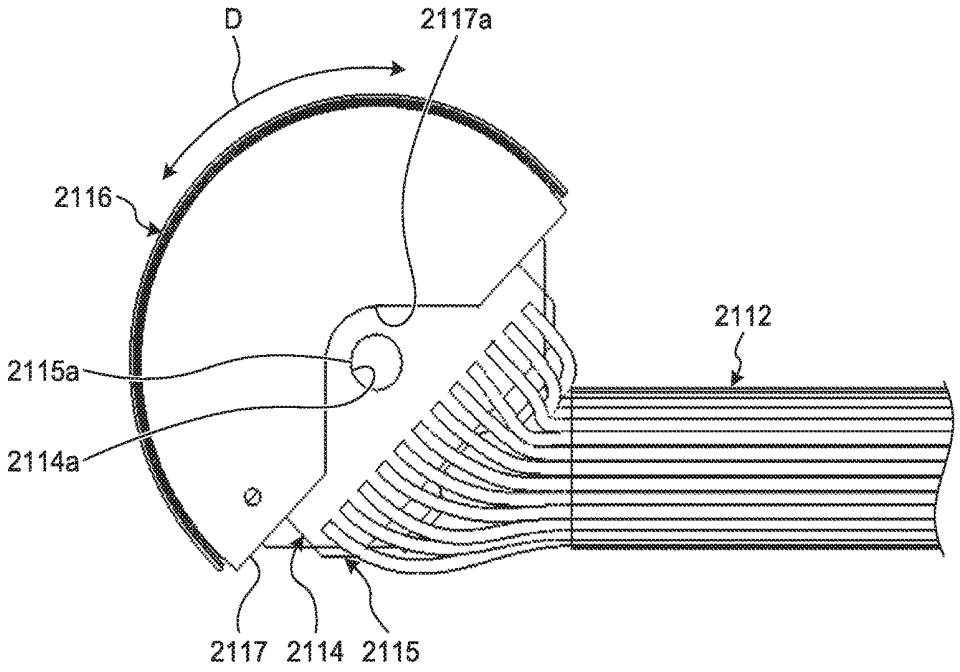

D
2117a
2116
2112
2115a
2114a
2117
2114
2115

FIG.5

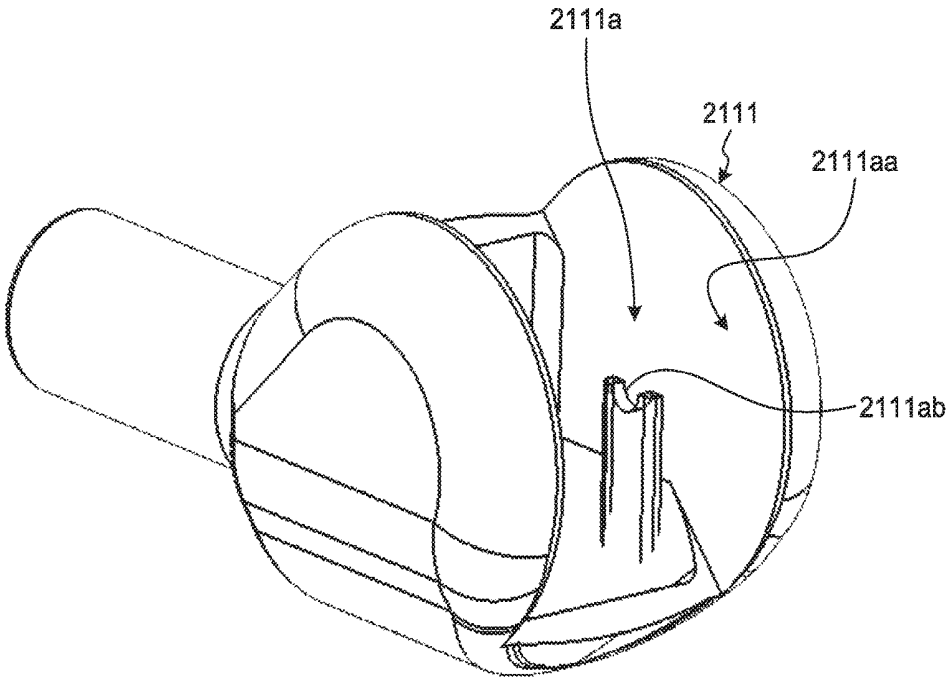

2111a
2111
2111aa
2111ab

FIG.6

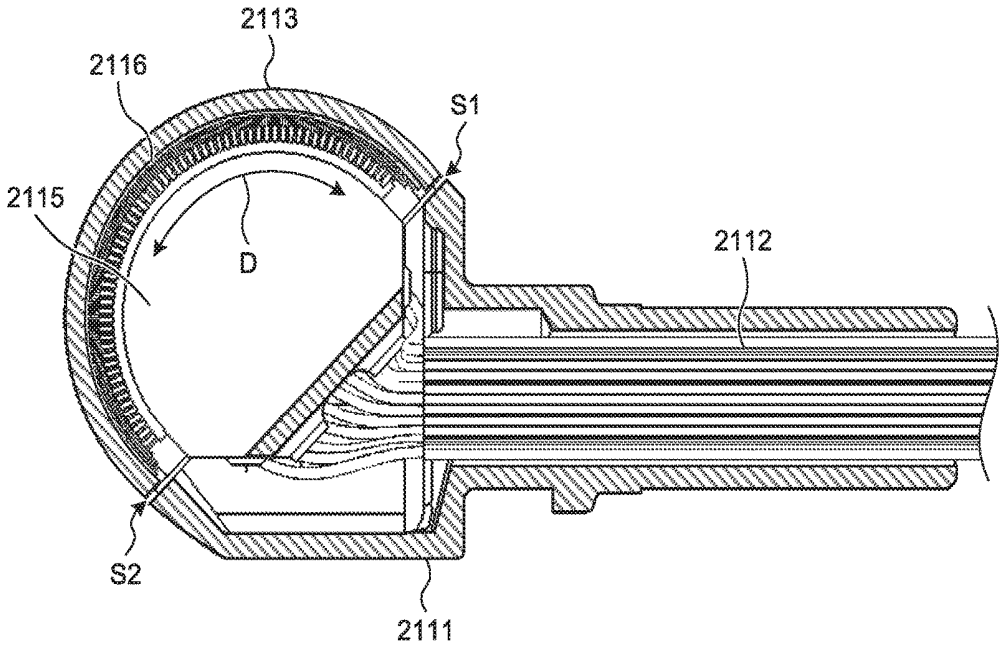

2113
2116
S1
2115
D
2112
S2
2111

FIG.7

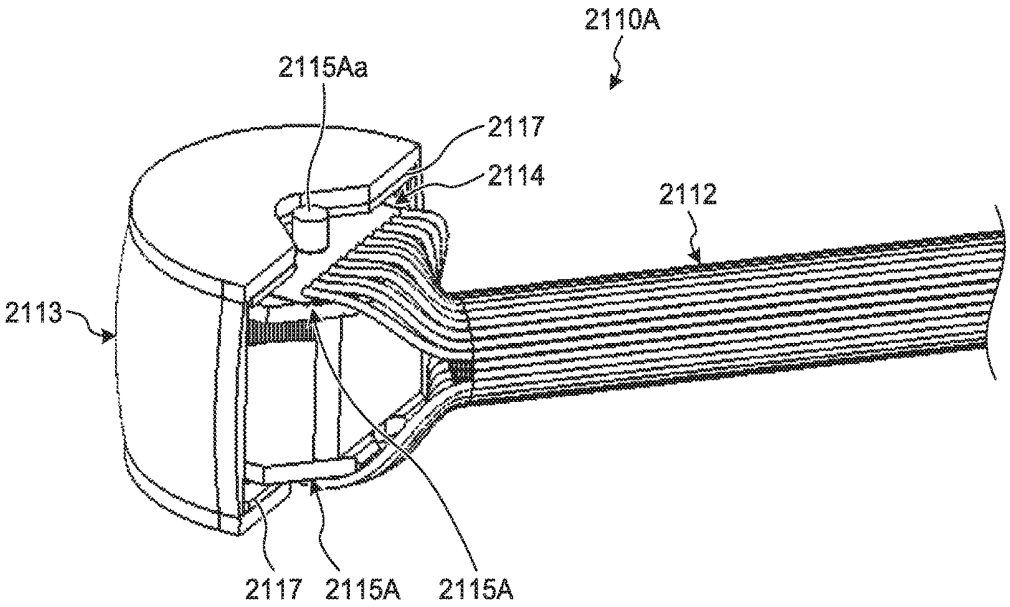

2110A
2115Aa
2117
2114
2112
2113
2117
2115A
2115A

FIG.8

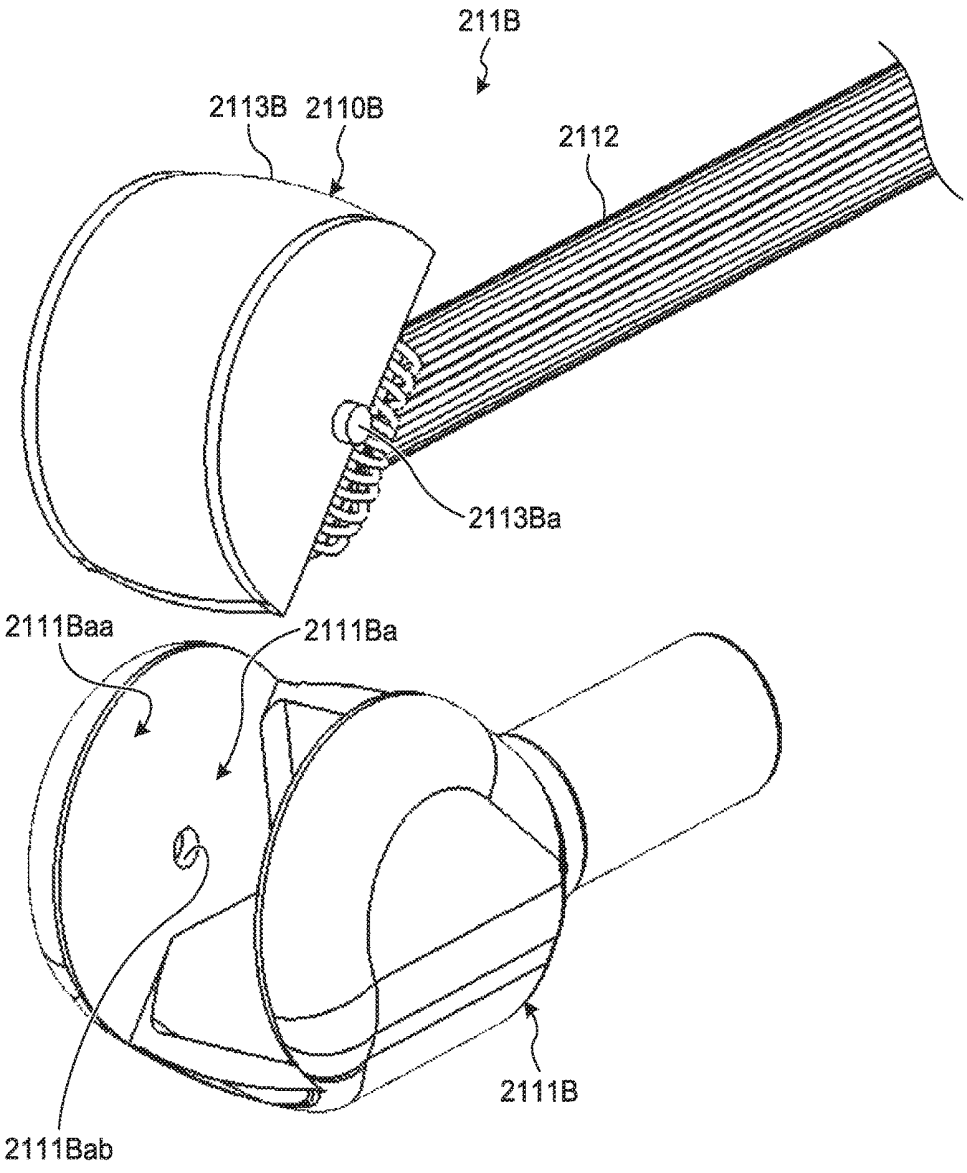


FIG.9

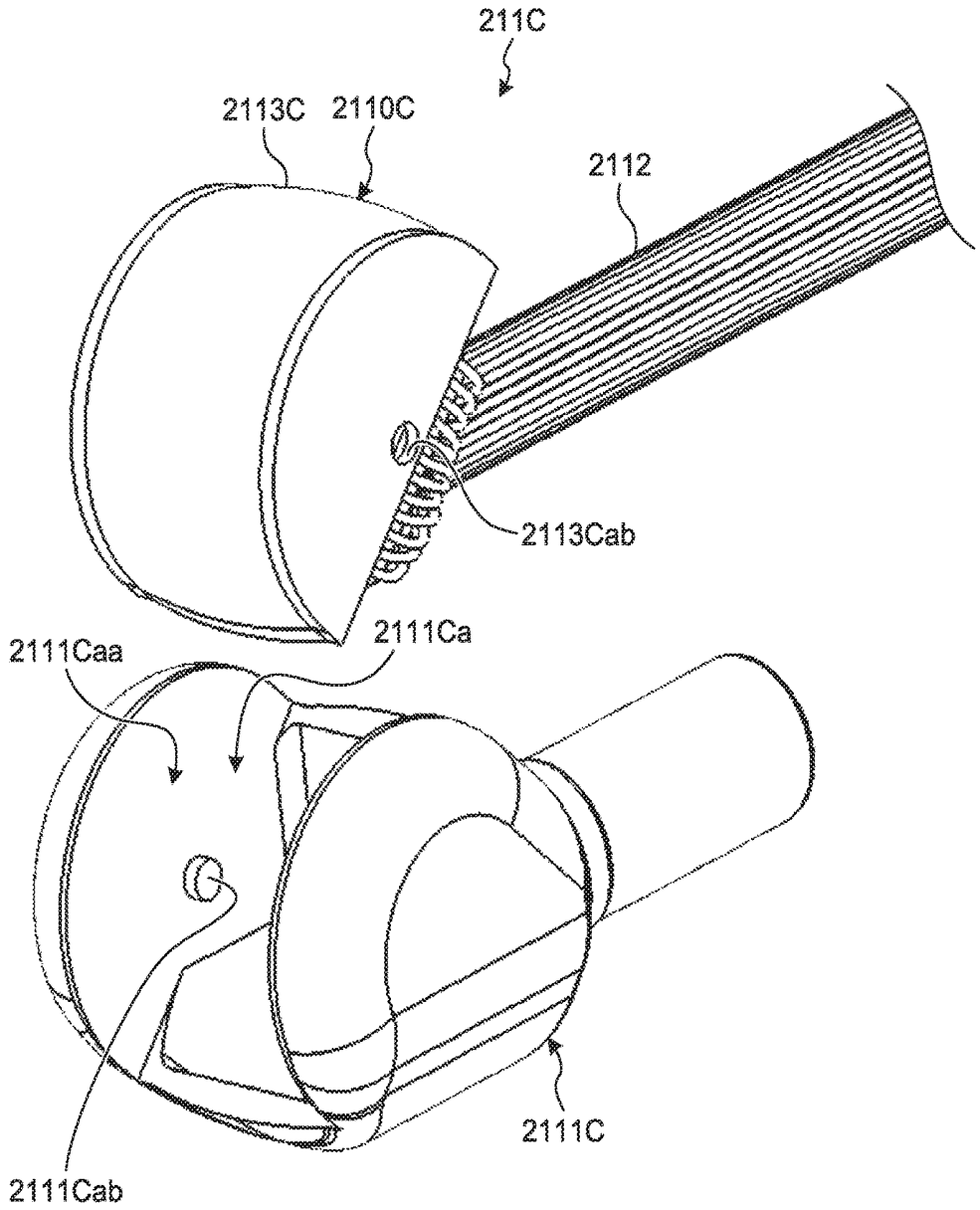

211C
2113C
2110C
2112
2113Cab
2111Ca
2111Caa
2111C
2111Cab

FIG.10

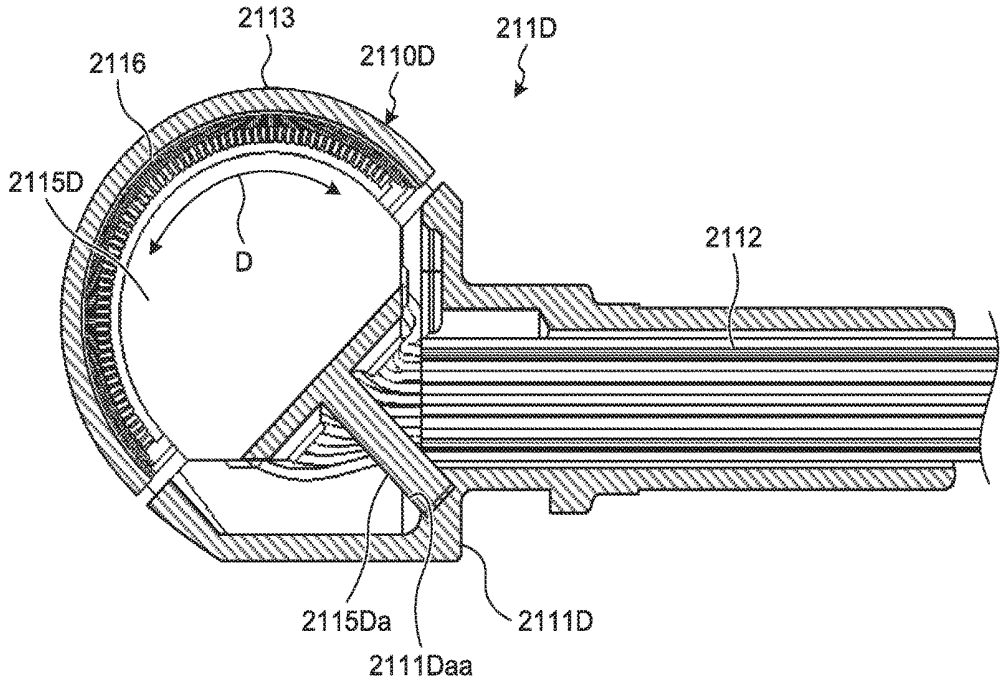

2113
211D
2116
2110D
2115D
D
2112
2115Da
2111D
2111Daa

FIG.11

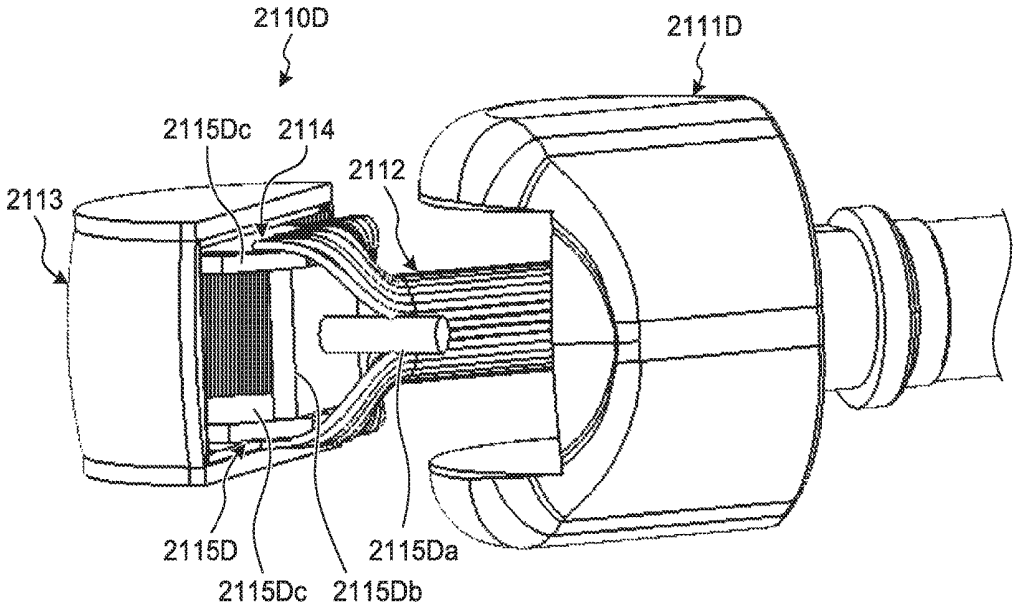

2110D
2111D
2115Dc
2114
2112
2113
2115D
2115Da
2115Dc
2115Db

FIG.12

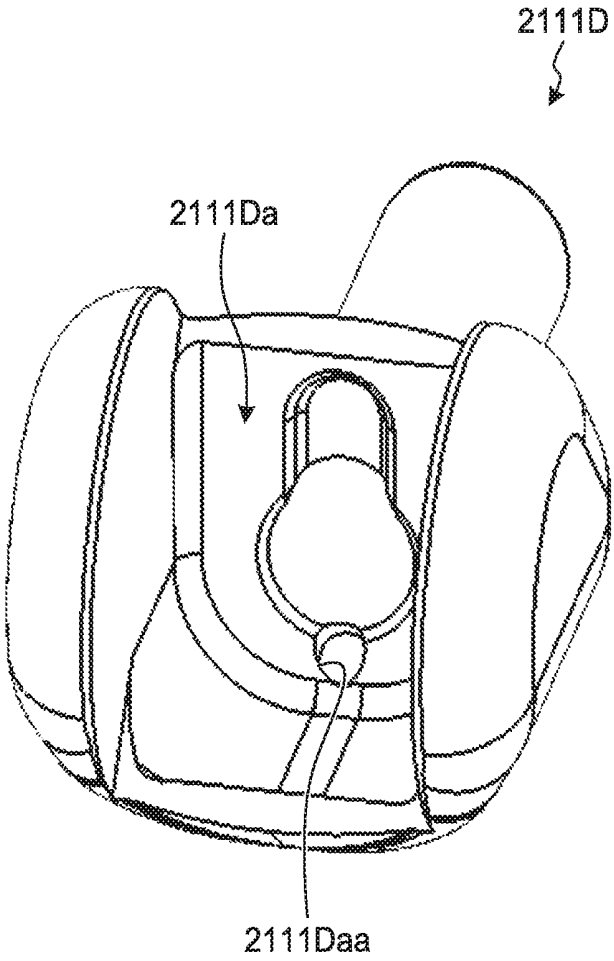


FIG.13

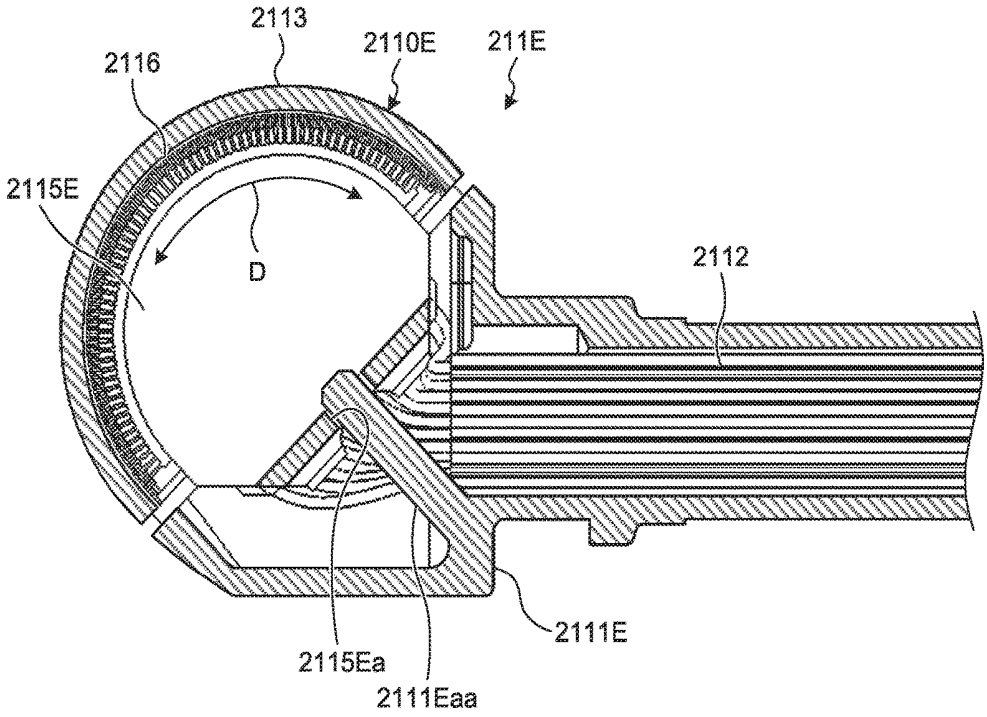

2113
2110E
211E
2116
2115E
D
2112
2111E
2115Ea
2111Eaa

FIG.14

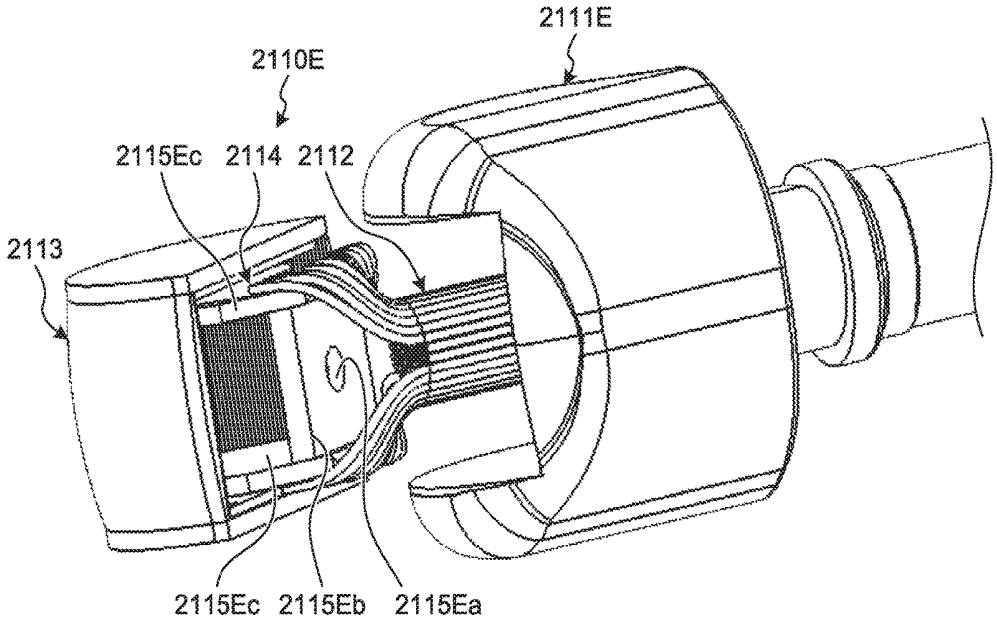
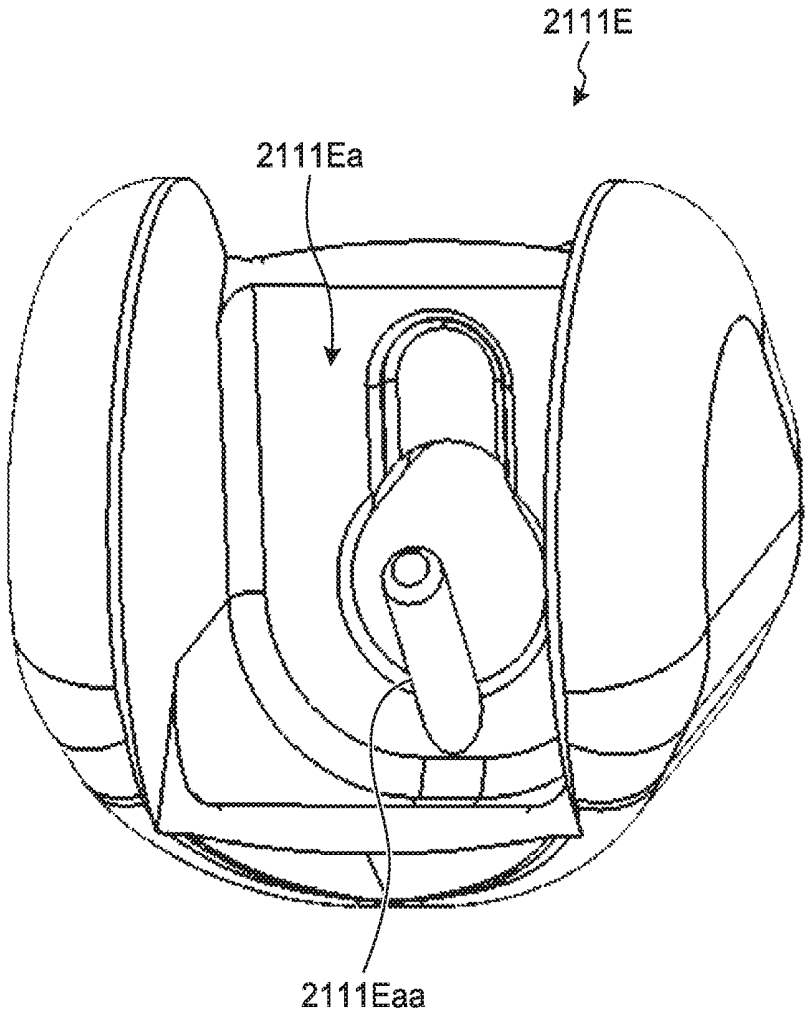

2111E
2110E
2115Ec
2114
2112
2113
2115Ec
2115Eb
2115Ea

FIG.15



ULTRASOUND TRANSDUCER UNIT, ULTRASOUND PROBE, AND METHOD OF PRODUCING ULTRASOUND TRANSDUCER UNIT

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is a continuation of PCT international application Ser. No. PCT/JP2016/084242 filed on Nov. 18, 2016 which designates the United States, incorporated herein by reference, and which claims the benefit of priority from Japanese Patent Applications No. 2015-236129, filed on Dec. 2, 2015, incorporated herein by reference.

BACKGROUND

[0002] The present disclosure relates to an ultrasound transducer unit, an ultrasound probe, and a method of producing an ultrasound transducer unit.

[0003] An ultrasound transducer unit is known to have an ultrasound transducer disposed at a distal end of an insertion section inserted into a subject's body (e.g., see JP 2002-199494 A). In such an ultrasound transducer unit, a transducer section including an ultrasound transducer, a substrate, a signal cable, and the like are housed in a housing.

SUMMARY

[0004] An ultrasound transducer unit according to one aspect of the present disclosure includes: a transducer section including an ultrasound transducer including a plurality of piezoelectric elements arranged in an array; and a housing configured to house the transducer section such that the transducer section is rotatable along an arrangement direction of the plurality of piezoelectric elements.

[0005] The above and other features, advantages and technical and industrial significance of this disclosure will be better understood by reading the following detailed description of presently preferred embodiments of the disclosure, when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. **1** is a schematic diagram of an endoscope system according to a first embodiment;

[0007] FIG. **2** is a perspective view of an ultrasound transducer unit;

[0008] FIG. **3** is a diagram of a transducer section of FIG. **2** from which an acoustic lens is removed;

[0009] FIG. **4** is a side view of the transducer section of FIG. **3** viewed from above;

[0010] FIG. **5** is an enlarged perspective view of a housing of FIG. **2**;

[0011] FIG. **6** is a diagram illustrating positioning of the transducer section to the housing;

[0012] FIG. **7** is a perspective view of a transducer section of an ultrasound transducer unit according to modification 1-1;

[0013] FIG. **8** is a perspective view of an ultrasound transducer unit according to a second embodiment, in which a transducer section is disassembled from a housing;

[0014] FIG. **9** is a perspective view of an ultrasound transducer unit according to modification 2-1, in which a transducer section is disassembled from a housing;

[0015] FIG. **10** is a cross-sectional view of an ultrasound transducer unit according to a third embodiment;

[0016] FIG. **11** is a perspective view of a transducer section of FIG. **10**, which is disassembled from a housing;

[0017] FIG. **12** is an enlarged perspective view of the housing of FIG. **10**;

[0018] FIG. **13** is a cross-sectional view of an ultrasound transducer unit according to modification 3-1;

[0019] FIG. **14** is a perspective view of a transducer section of FIG. **13**, which is disassembled from a housing; and

[0020] FIG. **15** is an enlarged perspective view of the housing of FIG. **13**.

DETAILED DESCRIPTION

[0021] Hereinafter, embodiments of an ultrasound transducer unit, an ultrasound probe, and a method of producing an ultrasound transducer unit according to the present disclosure will be described with reference to the drawings. Note that the present disclosure is not limited to these embodiments. The present disclosure is generally applicable to ultrasound transducer units including a transducer section with an ultrasound transducer and a housing for storing the transducer section.

[0022] Furthermore, in the drawings, the same or corresponding elements are appropriately denoted by the same reference signs. In addition, each drawing is schematically illustrated, and dimensional relationships, ratios, and the like between the elements may be different from actual dimensional relationships, ratios, and the like. Some drawings may include portions having different dimensional relationships and ratios between the drawings.

First Embodiment

[0023] Outline of Configuration of Endoscope System

[0024] FIG. **1** is a schematic diagram of an endoscope system according to a first embodiment. An endoscope system **1** is a system performing ultrasound diagnosis in a subject, such as a human, using an ultrasound endoscope. As illustrated in FIG. **1**, the endoscope system **1** includes an endoscope **2**, an ultrasound observation device **3**, an endoscope observation device **4**, a display device **5**, and a light source device **6**. The endoscope **2** is an ultrasound endoscope configured to be partially inserted into the subject, and having a function of transmitting an ultrasound pulse toward a body wall in the subject, receiving an ultrasound echo reflected from the subject, and outputting an echo signal, and a function of imaging inside the subject and outputting an image signal. Note that a detailed configuration of the endoscope **2** will be described later.

[0025] The ultrasound observation device **3** is electrically connected to the endoscope **2** through an ultrasound cable **31**, and outputs a pulse signal to the endoscope **2** and receives input of an echo signal from the endoscope **2** through the ultrasound cable **31**. Then, the ultrasound observation device **3** performs predetermined processing on the echo signal to generate an ultrasound image.

[0026] The endoscope observation device **4** is electrically connected to the endoscope **2** through a video cable **41**, and receives input of an image signal from the endoscope **2** through the video cable **41**. Then, the endoscope observation device **4** performs predetermined processing on the image signal to generate an endoscopic image.

[0027] The display device **5** includes liquid crystal or organic electro luminescence (EL), and displays an ultrasound image generated by the ultrasound observation device **3**, an endoscopic image generated by the endoscope observation device **4**, or the like.

[0028] The light source device **6** is connected to the endoscope **2** through an optical fiber cable **61**, and supplies illumination light illuminating inside the subject to the endoscope **2** through the optical fiber cable **61**.

[0029] Configuration of Endoscope

[0030] As illustrated in FIG. **1**, the endoscope **2** includes an insertion section **21**, an operating unit **22**, a universal cable **23**, and a connector **24**. Note that "distal end" described below represents an end portion positioned on a distal end side of the insertion section **21**. In addition, "proximal end" described below represents an end portion positioned on a side away from the distal end of the insertion section **21** (on the side of the operating unit **22**).

[0031] The insertion section **21** is a portion inserted into the subject. As illustrated in FIG. **1**, the insertion section **21** includes an ultrasound transducer unit **211** provided on the distal end side, a rigid member **212** connected to the proximal end side of the ultrasound transducer unit **211**, a bending section **213** bendably connected on the proximal end side of the rigid member **212**, and a flexible tube portion **214** flexibly connected to the proximal end side of the bending section **213**.

[0032] Here, in the insertion section **21**, a light guide (not illustrated), an image guide (not illustrated), a plurality of signal cables, and a tube (not illustrated) are routed. The light guide transmits illumination light supplied from the light source device **6**, the image guide conducts an optical image captured inside the subject, which is described later, the plurality of signal cables transmits various signals (e.g., a signal cable **2112** (see FIG. **2**) electrically connected to the ultrasound cable **31** through the universal cable **23**, which is described later), and the tube receives insertion of various treatment instruments (not illustrated). Note that detailed configuration of the distal end side of the ultrasound transducer unit **211** will be described later.

[0033] The bending section **213** is a portion having a cylindrical shape and bent in accordance with operation of a bending knob **221** by a physician or the like.

[0034] The rigid member **212** functions as a distal end member according to the present disclosure, is a rigid member made of a resin material, and has a substantially columnar shape.

[0035] The operating unit **22** is a portion connected to the proximal end of the insertion section **21** to receive various operations from the physician or the like. As illustrated in FIG. **1**, the operating unit **22** includes the bending knob **221** for bendably operating the bending section **213**, and a plurality of operation members **222** for performing various operations. Further, in the operating unit **22**, a treatment instrument insertion opening **223** is formed. The treatment instrument insertion opening **223** communicates with the tube (not illustrated) disposed in the insertion section **21** to insert the various treatment instruments through the tube. Still further, in the operating unit **22**, an imaging sensor (not illustrated) and an optical system (not illustrated) are disposed. The imaging sensor outputs an image signal in accordance with an optical image captured inside the subject, and the optical system forms, on the imaging sensor, an optical image conducted by the image guide.

[0036] The universal cable **23** is a cable connected to the operating unit **22** at one end. In the universal cable **23**, a plurality of signal cables transmitting various signals, an optical fiber for transmitting illumination light supplied from the light source device **6**, and the like are disposed.

[0037] The connector **24** is provided at the other end of the universal cable **23**. The connector **24** includes first to third connector portions **241** to **243** to which the ultrasound cable **31**, the video cable **41**, and the optical fiber cable **61** are connected respectively.

[0038] Configuration of Ultrasound Transducer Unit

[0039] FIG. **2** is a perspective view of an ultrasound transducer unit. As illustrated in FIG. **2**, the ultrasound transducer unit **211** includes a transducer section **2110** being a convex ultrasound probe, and a housing **2111** for storing the transducer section **2110**.

[0040] Firstly, a configuration of the transducer section **2110** will be described. The transducer section **2110** includes the signal cable **2112** for transmitting a pulse signal from the ultrasound observation device **3** and transmitting an echo signal from the transducer section **2110** to the ultrasound observation device **3**, and an acoustic lens **2113** provided on an outer surface of the transducer section **2110**.

[0041] FIG. **3** is a diagram of the transducer section of FIG. **2** from which the acoustic lens is removed. As illustrated in FIG. **3**, the transducer section **2110** includes a substrate **2114**, a substrate supporting portion **2115** for supporting the substrate **2114**, an ultrasound transducer **2116** having a plurality of piezoelectric elements arranged in an array, and side boards **2117** arranged on both side surfaces of the ultrasound transducer **2116**.

[0042] The signal cable **2112** has a plurality of cables at a distal end at which each cable is electrically connected to the substrate **2114** by soldering or the like to transmit and receive signals to and from each piezoelectric element of the ultrasound transducer **2116**.

[0043] The acoustic lens **2113** includes silicone, polymethylpentene, epoxy resin, polyetherimide, or the like, and has one side surface having a convex or concave shape. When outputting an ultrasound wave from the ultrasound transducer **2116** to the outside, the acoustic lens **2113** diffuses the ultrasound wave, and when capturing an ultrasound echo into the ultrasound transducer **2116** from outside, the acoustic lens **2113** concentrates the ultrasound wave. Note that between the acoustic lens **2113** and the ultrasound transducer **2116**, one or a plurality of acoustic matching layers may be disposed to match acoustic impedances of the piezoelectric elements and an object to be observed.

[0044] The substrate **2114** is formed on one of side surfaces at both ends of the piezoelectric elements to electrically connect the plurality of cables of the signal cable **2112** to the respective piezoelectric elements of the ultrasound transducer **2116**. The substrate **2114** includes a hole **2114***a* configured to receive insertion of a protruding portion **2115***a* of the substrate supporting portion **2115**, which is described later.

[0045] The substrate supporting portion **2115** is formed into a flat plate shape and has a main surface for supporting the substrate **2114** thereon. The substrate supporting portion **2115** includes the protruding portion **2115***a* having a columnar shape projecting in a direction perpendicular to the main surface.

[0046] FIG. **4** is a side view of the transducer section of FIG. **3** viewed from above. As illustrated in FIG. **4**, the ultrasound transducer **2116** includes the plurality of piezoelectric elements arcuately arranged in an arrangement direction D, and each piezoelectric element transmits an ultrasound pulse to a body wall in the subject, receives an ultrasound echo reflected from the subject, and outputs an echo signal. Here, the protruding portion **2115***a* is disposed at the center of curvature of the arcuately arranged piezoelectric elements, and protrudes in a direction perpendicular to the arrangement direction D of the piezoelectric elements.

[0047] In a side board **2117**, a cutout portion **2117***a* is formed to prevent interference between the side board **2117** and the protruding portion **2115***a* of the substrate supporting portion **2115**.

[0048] FIG. **5** is an enlarged perspective view of the housing of FIG. **2**. As illustrated in FIG. **5**, the housing **2111** includes an opening portion **2111***a* configured to house the transducer section **2110**. The opening portion **2111***a* has an inner wall surface **2111***aa* perpendicular to the protruding portion **2115***a*, facing the protruding portion **2115***a*, and further extending in the arrangement direction D of the piezoelectric elements. Furthermore, the inner wall surface **2111***aa* includes a supporting portion **2111***ab* configured to support the protruding portion **2115***a* of the substrate supporting portion **2115**.

[0049] In this ultrasound transducer unit **211**, the protruding portion **2115***a* of the substrate supporting portion **2115** is rotatably supported by the supporting portion **2111***ab* of the housing **2111**, the transducer section **2110** is positioned to the housing **2111**, and then the positioned transducer section **2110** is fixed to the housing **2111**. FIG. **6** is a diagram illustrating positioning of the transducer section to the housing. FIG. **6** is a cross-sectional view of a state in which the protruding portion **2115***a* of the substrate supporting portion **2115** is rotatably supported by the supporting portion **2111***ab* of the housing **2111**. As illustrated in FIG. **6**, between the transducer section **2110** and the housing **2111**, a space S**1** and a space S**2** are formed. Then, the transducer section **2110** is rotated around the protruding portion **2115***a* to adjust the space S**1** and the space S**2** to have the same thickness by using a thickness gauge surely measuring thickness, or the like. Thus, the transducer section **2110** may be accurately positioned to the housing **2111**. After the positioning, to prevent a change in thickness of the space S**1** and the space S**2**, the transducer section **2110** is fixed to the housing **2111** with an adhesive or the like.

[0050] As described above, the ultrasound transducer unit **211** is an ultrasound transducer unit in which a transducer section is accurately positioned to a housing.

[0051] Note that the space S**1** and the space S**2** may be adjusted to have different thicknesses to position the transducer section **2110** to the housing **2111**.

[0052] Modification 1-1

[0053] FIG. **7** is a perspective view of a transducer section of an ultrasound transducer unit according to modification 1-1. A transducer section **2110**A of the ultrasound transducer unit according to modification 1-1 is provided with substrate supporting portions **2115**A formed on side surfaces at both ends of piezoelectric elements of the transducer section **2110**A. In each substrate supporting portion **2115**A, a protruding portion **2115**Aa is formed to have a columnar shape projecting outward (a protruding portion **2115**Aa positioned on a back side is not illustrated in FIG. **7**). Similarly, a housing, not illustrated, has an opening portion, and the opening portion has inner wall surfaces each perpendicular to a corresponding protruding portion **2115**Aa and facing the protruding portion **2115**Aa. On each inner wall surface, a supporting portion is formed to support a corresponding protruding portion **2115**Aa.

Second Embodiment

[0054] FIG. **8** is a perspective view of an ultrasound transducer unit according to a second embodiment, in which a transducer section is disassembled from a housing. As illustrated in FIG. **8**, an ultrasound transducer unit **211**B includes a transducer section **2110**B and a housing **2111**B. The transducer section **2110**B has side surfaces at both ends of piezoelectric elements of an acoustic lens **2113**B, and a protruding portion **2113**Ba of columnar shape is formed on the side surfaces (a protruding portion **2113**Ba positioned on a back side is not illustrated in FIG. **8**). An opening portion **2111**Ba is formed in the housing **2111**B to house the transducer section **2110**B, the opening portion **2111**Ba has inner wall surfaces **2111**Baa perpendicular to the protruding portions **2113**Ba and facing the protruding portions **2113**Ba, and on each inner wall surfaces **2111**Baa, a supporting portion **2111**Bab (a supporting portion **2111**Bab on the front side is not illustrated in FIG. **8**) is formed to be fitted to and support a corresponding protruding portion **2113**Ba of the acoustic lens **2113**B. Note that the acoustic lens **2113**B includes an elastic member, such as silicone, and when the transducer section **2110**B is fitted into the housing **2111**B, each protruding portion **2113**Ba is elastically deformed. Then, when each protruding portion **2113**Ba is positioned to a corresponding supporting portion **2111**Bab, the protruding portion **2113**Ba is fitted into the supporting portion **2111**Bab. Furthermore, the protruding portion **2113**Ba and the supporting portion **2111**Bab may be formed on only one of the side surfaces at both ends of the piezoelectric elements.

[0055] Modification 2-1

[0056] FIG. **9** is a perspective view of an ultrasound transducer unit according to modification 2-1, in which a transducer section is disassembled from a housing. As illustrated in FIG. **9**, an ultrasound transducer unit **211**C includes a transducer section **2110**C and a housing **2111**C. An opening portion **2111**Ca is formed in the housing **2111**C to house the transducer section **2110**C. In the opening portion **2111**Ca, a protruding portion **2111**Cab of columnar shape is formed (a protruding portion **2111**Cab on the front side is not illustrated in FIG. **9**) on a pair of inner wall surfaces **2111**Caa extending in an arrangement direction of piezoelectric elements. An acoustic lens **2113**C is provided on an outer surface of an ultrasound transducer of the transducer section **2110**C. The acoustic lens **2113**C has side surfaces at both ends of the piezoelectric elements, and on the side surfaces a supporting portion **2113**Cab is formed (a supporting portion **2113**Cab on a back side is not illustrated in FIG. **9**) to be fitted to and support a corresponding protruding portion **2111**Cab of the housing **2111**C. Note that the acoustic lens **2113**C includes an elastic member, such as silicone, and when the transducer section **2110**C is fitted into the housing **2111**C, the acoustic lens **2113**C pressed against the protruding portions **2111**Cab is elastically deformed. Then, when each protruding portion **2111**Cab is positioned to a corresponding supporting portion **2113**Cab, the protruding portion **2111**Cab is fitted into the supporting portion **2113**Cab. Furthermore, the protruding portion **2111**Cab and

the supporting portion **2113**Cab may be formed on only one of the side surfaces at both ends of the piezoelectric elements.

Third Embodiment

[0057] FIG. **10** is a cross-sectional view of an ultrasound transducer unit according to a third embodiment. FIG. **11** is a perspective view of a transducer section of FIG. **10**, which is disassembled from a housing. FIG. **12** is an enlarged perspective view of the housing of FIG. **10**. As illustrated in FIGS. **10** to **12**, an ultrasound transducer unit **211**D includes a transducer section **2110**D and a housing **2111**D. The transducer section **2110**D includes a substrate support **2115**D in which a cylindrical projecting portion **2115**Da is formed to project on a side opposite to an ultrasound transducer **2116** arranged in an array. The substrate support **2115**D includes the projecting portion **2115**Da, a supporting plate **2115**Db for supporting the projecting portion **2115**Da, and substrate supporting portions **2115**Dc connected to both ends of the supporting plate **2115**Db, each formed into a flat plate shape, and each having a main surface for supporting a substrate **2114** thereon. In an opening portion **2111**Da formed in the housing **2111**D to house the transducer section **2110**D, a recess portion **2111**Daa into which the projecting portion **2115**Da is fitted is formed. In the ultrasound transducer unit **211**D, the projecting portion **2115**Da and the recess portion **2111**Daa are fitted to each other to position the transducer section **2110**D to the housing **2111**D. Accordingly, the ultrasound transducer unit **211**D is an ultrasound transducer unit in which a transducer section is accurately positioned to a housing.

[0058] Modification 3-1

[0059] FIG. **13** is a cross-section of an ultrasound transducer unit according to modification 3-1. FIG. **14** is a perspective view of a transducer section of FIG. **13**, which is disassembled from a housing. FIG. **15** is an enlarged perspective view of the housing of FIG. **13**. As illustrated in FIGS. **13** to **15**, an ultrasound transducer unit **211**E includes a transducer section **2110**E and a housing **2111**E. In an opening portion **2111**Ea formed in the housing **2111**E to house the transducer section **2110**E, a cylindrical projecting portion **2111**Eaa is formed to project toward an ultrasound transducer **2116** arranged in an array. The transducer section **2110**E includes a substrate support **2115**E having a recess portion **2115**Ea into which the projecting portion **2111**Eaa is fitted. The substrate support **2115**E includes the recess portion **2115**Ea, a supporting plate **2115**Eb for supporting the recess portion **2115**Ea, and substrate supporting portions **2115**Ec connected to both ends of the supporting plate **2115**Eb, each formed into a flat plate shape, and each having a main surface for supporting a substrate **2114** thereon. In the ultrasound transducer unit **211**E, the projecting portion **2111**Eaa and the recess portion **2115**Ea are fitted to each other to position the transducer section **2110**E to the housing **2111**E. Accordingly, the ultrasound transducer unit **211**E is an ultrasound transducer unit in which a transducer section is accurately positioned to a housing.

[0060] Note that, in the first embodiment described above, the endoscope in which the ultrasound transducer unit is disposed in the insertion section inserted into a subject's body has been described, but the endoscope is not limited to the above description. The configurations described above may be applied to general ultrasound probes. For example, the configurations described above may be applied to extracorporeal ultrasound probes having a function of transmitting an ultrasound pulse into a subject's body from the body surface, receiving an ultrasound echo reflected from inside the subject's body, and outputting an echo signal.

[0061] Furthermore, in the first embodiment described above, the ultrasound transducer unit having the convex ultrasound transducer in which linear piezoelectric elements are arranged into a circular shape has been described, but the ultrasound transducer unit is not limited to the above description. The above configurations may be applied to linear or radial ultrasound transducers which require positioning of the transducer section to the housing.

[0062] The present disclosure achieves an ultrasound transducer unit with a transducer section accurately positioned to a housing, an ultrasound probe, and a method of producing an ultrasound transducer unit.

[0063] Additional advantages and modifications will readily occur to those skilled in the art. Therefore, the disclosure in its broader aspects is not limited to the specific details and representative embodiments shown and described herein. Accordingly, various modifications may be made without departing from the spirit or scope of the general inventive concept as defined by the appended claims and their equivalents.

What is claimed is:

1. An ultrasound transducer unit comprising:

a transducer section including an ultrasound transducer including a plurality of piezoelectric elements arranged in an array; and

a housing configured to house the transducer section such that the transducer section is rotatable along an arrangement direction of the plurality of piezoelectric elements.

2. The ultrasound transducer unit according to claim **1**, wherein

the transducer section includes a protruding portion that protrudes from at least one of side surfaces at both ends of the piezoelectric elements of the transducer section in a direction perpendicular to the arrangement direction of the plurality of piezoelectric elements, and

the housing includes a supporting portion configured to support the protruding portion.

3. The ultrasound transducer unit according to claim **1**, wherein

the housing includes a protruding portion that protrudes towards at least one of side surfaces at both ends of the piezoelectric elements of the transducer section in a direction perpendicular to the arrangement direction of the plurality of piezoelectric elements, and

the transducer section includes a supporting portion configured to support the protruding portion.

4. The ultrasound transducer unit according to claim **1**, wherein the supporting portion is formed on an inner wall surface of an opening portion, the opening portion is formed in the housing to house the transducer section, and the inner wall surface is perpendicular to the protruding portion and facing the protruding portion.

5. The ultrasound transducer unit according to claim **1**, wherein

the protruding portion is formed on at least one of a pair of inner wall surfaces of an opening portion, the opening portion is formed in the housing to store the

transducer section, and the pair of inner wall surfaces extends in the arrangement direction of the piezoelectric elements, and

the supporting portion is formed on one of side surfaces at both ends of the piezoelectric elements of the transducer section, and the one side surface faces the protruding portion.

6. The ultrasound transducer unit according to claim **1**, wherein

the plurality of piezoelectric elements are arcuately arranged, and

the protruding portion and the supporting portion are arranged at a center of curvature of the arcuately arranged piezoelectric elements.

7. The ultrasound transducer unit according to claim **1**, wherein

the protruding portion is formed on at least one of side surfaces at both ends of the piezoelectric elements of an acoustic lens provided on an outer surface of the ultrasound transducer, and

the supporting portion is formed on an inner wall surface of an opening portion, the opening portion is formed in the housing to house the transducer section, and the inner wall surface is perpendicular to the protruding portion and facing the protruding portion.

8. The ultrasound transducer unit according to claim **1**, wherein

the protruding portion is formed on at least one of a pair of inner wall surfaces of an opening portion, the opening portion is formed in the housing to house the transducer section, and the pair of inner wall surfaces extends in the arrangement direction of the piezoelectric elements, and

the supporting portion is formed on one of side surfaces at both ends of the piezoelectric elements of an acoustic lens provided on an outer surface of the ultrasound transducer, and the one side surface faces the protruding portion.

9. An ultrasound probe comprising

the ultrasound transducer unit according to claim **1**.

10. A method of producing an ultrasound transducer unit, comprising:

causing a supporting portion to rotatably support a columnar protruding portion, the columnar protruding portion being formed in one of a transducer section and a housing, the transducer section including an ultrasound transducer including a plurality of piezoelectric elements arranged in an array, the housing being configured to house the transducer section, the columnar protruding portion protruding in a direction perpendicular to an arrangement direction of the plurality of piezoelectric elements, the supporting portion being formed in another one of the transducer section and the housing to support the protruding portion;

positioning the transducer section by rotating the transducer section relative to the housing; and

fixing the positioned transducer section to the housing.

11. The method of producing an ultrasound transducer unit according to claim **10**, wherein

the protruding portion is formed on at least one of side surfaces at both ends of the piezoelectric elements of the transducer section, and

the supporting portion is formed on an inner wall surface of an opening portion, the opening portion is formed in the housing to store the transducer section, and the inner wall surface is perpendicular to the protruding portion and facing the protruding portion.

* * * * *

专利名称(译)	超声换能器单元，超声探头和制造超声换能器单元的方法		
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当前申请(专利权)人(译)	OLYMPUS CORPORATION		
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摘要(译)

一种超声换能器单元，包括：换能器部分，包括超声换能器，所述超声换能器包括以阵列布置的多个压电元件壳体，其构造成容纳换能器部分，使得换能器部分可沿多个压电元件的布置方向旋转。