

(19)



(11)

EP 3 165 168 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
30.01.2019 Bulletin 2019/05

(51) Int Cl.:
A61B 8/12 ^(2006.01) **G01N 29/24** ^(2006.01)
H04R 17/00 ^(2006.01) **H04R 31/00** ^(2006.01)

(21) Application number: **15830708.2**

(86) International application number:
PCT/JP2015/062255

(22) Date of filing: **22.04.2015**

(87) International publication number:
WO 2016/021244 (11.02.2016 Gazette 2016/06)

**(54) ULTRASOUND OBSERVATION APPARATUS AND MANUFACTURING METHOD OF AN
ULTRASOUND OBSERVATION APPARATUS**

ULTRASCHALLBEOBACHTUNGSVORRICHTUNG UND HERSTELLUNGSVERFAHREN FÜR EINE
ULTRASCHALLBEOBACHTUNGSVORRICHTUNG

APPAREIL D'OBSERVATION ULTRASONORE, ET PROCÉDÉ DE FABRICATION D'UN APPAREIL
D'OBSERVATION ULTRASONORE

(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: **08.08.2014 JP 2014162807**

(43) Date of publication of application:
10.05.2017 Bulletin 2017/19

(73) Proprietor: **Olympus Corporation
Tokyo 192-8507 (JP)**

(72) Inventor: **SATO, Sunao
Hachioji-shi, Tokyo 192-8507 (JP)**

(74) Representative: **Gunzelmann, Rainer
Wuesthoff & Wuesthoff
Patentanwälte PartG mbB
Schweigerstraße 2
81541 München (DE)**

(56) References cited:
**EP-A1- 1 918 027 JP-A- H02 265 533
JP-A- H02 271 839 JP-A- 2006 094 981**

EP 3 165 168 B1

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description

Technical Field

[0001] The present invention relates to an ultrasound observation apparatus and a manufacturing method of the ultrasound observation apparatus in which a plurality of ultrasound transducers including electrodes above and below a film portion are fixed on a sheet, and end portions of the sheet are bonded after the sheet is rounded.

Background Art

[0002] A well-known ultrasound observation apparatus exists in which ultrasound can be repeatedly emitted in a 360° direction from ultrasound transducers to an examined site, and the ultrasound transducers can receive an echo signal of the ultrasound reflected from the examined site. An ultrasound image that is a two-dimensional visible image of the examined site can be displayed on a screen of a display apparatus.

[0003] Japanese Patent Application Laid-Open Publication No. 2010-17229 discloses a configuration of an ultrasound endoscope provided with an ultrasound observation apparatus including electronic radial ultrasound transducers, the ultrasound observation apparatus provided on a distal end of an insertion portion inserted into a subject.

[0004] The electronic radial ultrasound transducers as disclosed in Japanese Patent Application Laid-Open Publication No. 2010-17229 are configured from a plurality of transducers. A plurality of electronic radial ultrasound transducers are arranged 360° in a circumferential direction of the insertion portion, at predetermined intervals.

[0005] More specifically, electrodes are usually provided on upper and lower surfaces of single-plate piezoelectric elements in the respective ultrasound transducers. Upper electrodes of the piezoelectric elements serving as acoustic emission surfaces are fixed to a film portion rounded 360°, at predetermined intervals in an arrangement direction of the plurality of ultrasound transducers.

[0006] Note that when an acoustic matching layer is provided on each upper electrode, each acoustic matching layer is fixed to the film portion rounded 360°, at predetermined intervals in the arrangement direction.

[0007] Therefore, the ultrasound observation apparatus includes a sheet in which the plurality of ultrasound transducers are fixed to the film portion rounded 360°, at predetermined intervals in the arrangement direction.

[0008] In the manufacture of the ultrasound observation apparatus described above, a joint of respective end portions of the sheet needs to be bonded and fixed such that the sheet on which at least a plurality of ultrasound transducers are fixed to the film portion has a circular shape after the sheet is rounded 360°.

[0009] In this case, in a transducer region of the sheet

in which at least the plurality of ultrasound transducers are fixed to the film portion, the joint needs to be bonded and fixed to prevent electrical short-circuit caused by contact of a lower electrode of the ultrasound transducer fixed on a first end portion in the arrangement direction among the plurality of ultrasound transducers and a lower electrode of the ultrasound transducer adjacent to the ultrasound transducer fixed to the first end portion at the joint and fixed to a second end portion in the arrangement direction. EP 1 918 027 A1 discusses further ultrasonic transducers, methods for manufacturing ultrasonic transducers and an ultrasonic endoscope including the ultrasonic transducers.

[0010] Although a method and a configuration of bonding and inserting a spacer into the joint of the sheet along with an adhesive are well-known, the joint of the sheet is, for example, several dozen μm, which is ultra-small. A problem is that it is difficult to insert the spacer.

[0011] The present invention has been made in view of the problem, and an object of the present invention is to provide an ultrasound observation apparatus and a manufacturing method of the ultrasound observation apparatus that can prevent, by simple configuration and method, contact of lower electrodes of adjacent ultrasound transducers at a joint of respective end portions of a rounded sheet.

Disclosure of Invention

Means for Solving the Problem

[0012] An aspect of the present invention provides an ultrasound observation apparatus including: a sheet including: a first transducer including a first lower electrode, a first piezoelectric element disposed on the first lower electrode, and a first upper electrode disposed on the first piezoelectric element in a predetermined arrangement direction; a first transducer region in which the first transducer in plurality are arranged at predetermined intervals; a columnar portion in which at least a first surface is non-conductive, the columnar portion disposed adjacent to the first transducer positioned on a first end portion in the arrangement direction in the first transducer region; and a film portion that is flexible and that connects at least the first upper electrode in plurality in the first transducer region and a second surface facing the first surface of the columnar portion in the arrangement direction; and a bonding portion configured to bond the columnar portion and the first transducer positioned on a second end portion in the arrangement direction in a state in which the sheet is rounded such that the film portion becomes an external surface, and the first transducer positioned on the second end portion among the first transducer in plurality in the first transducer region and the columnar portion are attached to each other.

[0013] An aspect of the present invention provides a manufacturing method of an ultrasound observation apparatus, the manufacturing method including: a step of

creating a sheet, the sheet including: a first transducer including a first lower electrode, a first piezoelectric element disposed on the first lower electrode, and a first upper electrode disposed on the first piezoelectric element; a first transducer region in which the first transducer in plurality are arranged at predetermined intervals; a columnar portion in which at least a first surface is non-conductive, the columnar portion disposed adjacent to the first transducer positioned on a first end portion in the arrangement direction of the first transducer in plurality among the first transducer in plurality in the first transducer region; and a film portion that is flexible and that connects at least the first upper electrode in plurality in the first transducer region and a second surface facing the first surface of the columnar portion in the arrangement direction; a step of rounding the sheet such that the film portion becomes an external surface, and the first transducer positioned on a second end portion in the arrangement direction among the first transducer in plurality in the first transducer region and the columnar portion are attached to each other; and a step of bonding, by a bonding portion, the columnar portion and the first transducer positioned on the second end portion in the state in which the sheet is rounded.

Brief Description of the Drawings

[0014]

Fig. 1 is a perspective view schematically showing an ultrasound observation apparatus of a first embodiment;

Fig. 2 is a partial cross-sectional view of the ultrasound observation apparatus along a line II-II in Fig. 1;

Fig. 3 is a cross-sectional view illustrated by removing a bonding portion from the ultrasound observation apparatus of Fig. 1 and developing a sheet;

Fig. 4 is a partial cross-sectional view showing a modification in which a first upper electrode of a first ultrasound transducer of Fig. 1 is directly fixed to a film portion;

Fig. 5 is a partial cross-sectional view near a joint in a sheet of an ultrasound observation apparatus of a second embodiment;

Fig. 6 is a cross-sectional view illustrated by removing the bonding portion from the ultrasound observation apparatus of Fig. 5 and developing the entire sheet; and

Fig. 7 is a diagram showing an ultrasound endoscope apparatus including the ultrasound observation apparatus of the first and second embodiments.

Best Mode for Carrying Out the Invention

[0015] Hereinafter, embodiments of the present invention will be described with reference to the drawings. Note that the drawings are schematic drawings, and a rela-

tionship between a thickness and a width of each member, a ratio of the thickness of respective members, and the like are different from the reality. It is obvious that the relationship and the ratio of dimensions between the drawings are different in some parts of the drawings.

(First Embodiment)

[0016] Fig. 1 is a perspective view schematically showing an ultrasound observation apparatus of the present embodiment. Fig. 2 is a partial cross-sectional view of the ultrasound observation apparatus along a line II-II in Fig. 1.

[0017] Fig. 3 is a cross-sectional view illustrated by removing a bonding portion from the ultrasound observation apparatus of Fig. 1 and developing a sheet. Fig. 4 is a partial cross-sectional view showing a modification in which a first upper electrode of a first ultrasound transducer of Fig. 1 is directly fixed to a film portion.

[0018] As shown in Fig. 1, an ultrasound observation apparatus 30 includes a sheet 39 and a bonding portion 50.

[0019] The sheet 39 is rounded 360° in an arrangement direction C described later and is elongated in an extension direction H.

[0020] More specifically, as shown in Fig. 3, main parts of the sheet 39 include a plurality of first transducers 34, a first transducer region 38, a columnar portion 37, an acoustic matching layer 36, and a film portion 35.

[0021] The plurality of first transducers 34 are electronic radial ultrasound transducers extending from one end 39i to the other end 39t in the extension direction H, each of the first transducers 34 including a first lower electrode 33, a first piezoelectric element 31 disposed on the first lower electrode 33, and a first upper electrode 32 disposed on the first piezoelectric element 31.

[0022] Each of the plurality of first transducers 34 has a width of C1 in the arrangement direction C and is arranged at a predetermined interval C2 in the arrangement direction C.

[0023] The first piezoelectric element 31 emits ultrasound toward the first upper electrode 32 along with vibration and receives a sound wave reflected from an examined site.

[0024] The first upper electrode 32 and the first lower electrode 33 are configured to apply a pulse voltage to the first piezoelectric element 31 to vibrate the first piezoelectric element 31. In addition, the first upper electrode 32 configures a GND electrode, and the first lower electrode 33 configures a positive electrode.

[0025] The first transducer region 38 is configured by arranging the plurality of first transducers 34 at the predetermined intervals C2 in the arrangement direction C.

[0026] Note that the smaller the predetermined intervals C2 are, the larger C1 can be. As a result, the sensitivity of each of the first transducers 34 improves.

[0027] At least a first surface 37x of the columnar portion 37 is non-conductive. The columnar portion 37 is

disposed, at the predetermined interval C2, adjacent to a first transducer 34a positioned on a first end portion 38a in the arrangement direction C among the plurality of first transducers 34 in the first transducer region 38.

[0028] The columnar portion 37 has a width of C1 in the arrangement direction C and extends from the one end 39i to the other end 39t in the extension direction H. Note that the columnar portion 37 may be individually provided only near the one end 39i and the other end 39t in the extension direction H.

[0029] The film portion 35 is flexible and connects, in the arrangement direction C, the plurality of first upper electrodes 32 in the first transducer region 38 and a second surface 37y facing the first surface 37x of the columnar portion 37. Note that the film portion 35 may function as an acoustic matching layer or an acoustic lens.

[0030] As shown in Figs. 1 to 3, the present embodiment illustrates an example of a configuration in which the acoustic matching layer 36 is disposed between each of the first upper electrodes 32 and the film portion 35, that is, the present embodiment illustrates an example of a configuration in which each of the first upper electrodes 32 is connected by the second surface 37y and the film portion 35 through each acoustic matching layer 36.

[0031] The arrangement is not limited to this, and as shown in Fig. 4, each of the first upper electrodes 32 may be directly fixed to the film portion 35 to connect each of the first upper electrodes 32 by the second surface 37y and the film portion 35.

[0032] The bonding portion 50 bonds a joint T between respective end portions 39a and 39b in the arrangement direction C that is a space extending from the one end 39i to the other end 39t in the extension direction H in the sheet 39. The bonding portion 50 bonds the joint T from the one end 39i to the other end 39t of the sheet 39 in the extension direction H.

[0033] More specifically, in a state in which the sheet 39 is rounded such that the film portion 35 becomes an external surface as shown in Fig. 1, and a first transducer 34b positioned on a second end portion 38b and part of the non-conductive first surface 37x of the columnar portion 37 are attached to each other as shown in Fig. 2, the bonding portion 50 is configured to bond, in the extension direction H, the columnar portion 37 and the first transducer 34b at the joint T between the respective end portions 39a and 39b in the arrangement direction C of the sheet 39.

[0034] Note that the bonding portion 50 is configured from, for example, an adhesive. The bonding portion 50 may be configured from the same material as the film portion 35.

[0035] Next, a manufacturing method of the ultrasound observation apparatus 30 configured in this way will be simply described.

[0036] First, a step of creating the sheet 39 shown in Fig. 3 is executed. To create the sheet 39, the film portion 35 is formed first. Next, when the acoustic matching layer

36 is used on the film portion 35, the acoustic matching layer 36 is formed by excluding a part where the columnar portion 37 is to be formed.

[0037] Next, the first piezoelectric element 31 provided with the electrodes 32 and 33 on upper and lower surfaces is bonded on the acoustic matching layer 36 at the same width as the acoustic matching layer 36 in the arrangement direction C, and the columnar portion 37 with the width C1 in the arrangement direction C is bonded on the film portion 35.

[0038] Subsequently, a plurality of grooves with the width C2 in the arrangement direction C are formed on the electrodes 32 and 33, the first piezoelectric element 31, and the acoustic matching layer 36 by using a dicing blade with the blade width C2, for each width C1 in the arrangement direction C.

[0039] As a result, the plurality of first transducers 34 with the width C1 are arranged on the film portion 35 at the predetermined intervals C2 in the arrangement direction C through the acoustic matching layer 36, and the sheet 39 with the predetermined interval C2 between the first transducer 34a and the columnar portion 37 in the arrangement direction C is created.

[0040] Next, a step of rounding the sheet 39 360° is executed as shown in Figs. 1 and 2 such that the film portion 35 becomes the external surface, and the first transducer 34b positioned on the second end portion 38b and part of the first surface 37x of the columnar portion 37 are attached to each other.

[0041] Lastly, in the state in which the sheet 39 is rounded, a step of bonding by the bonding portion 50 is executed by injecting the bonding portion 50 between the columnar portion 37 and the first transducer 34b in the arrangement direction C. As a result, the ultrasound observation apparatus 30 is manufactured.

[0042] In this way, the present embodiment has illustrated that the columnar portion 37 in which at least the first surface 37x is non-conductive is disposed adjacent to the first transducer 34a positioned on the first end portion 38a at the predetermined interval C2 in the arrangement direction C among the plurality of first transducers 34 in the first transducer region 38 in the sheet 39 of the ultrasound observation apparatus 30.

[0043] The present embodiment has also illustrated that the bonding portion 50 bonds, in the extension direction H, the columnar portion 37 and the first transducer 34b in the arrangement direction C at the joint T of the sheet 39 in the state in which the sheet 39 is rounded such that the film portion 35 becomes the external surface, and the first transducer 34b positioned on the second end portion 38b and part of the non-conductive first surface 37x of the columnar portion 37 are attached to each other.

[0044] According to this, part of the non-conductive first surface 37x of the columnar portion 37 is in contact with the lower electrode 33 of the first transducer 34b at the joint T of the sheet 39, and unlike in the conventional techniques, the lower electrode 33 of the first transducer

34a does not come into contact.

[0045] Therefore, the columnar portion 37 can surely prevent electrical short-circuit at the joint T of the first transducer 34b and the first transducer 34a without separately using the spacer or the like, and the manufacturing yield of the ultrasound observation apparatus 30 improves.

[0046] Note that this is particularly effective when the predetermined intervals C2 are reduced to improve the sensitivity of each of the first transducers 34.

[0047] In addition, part of the first surface 37x of the columnar portion 37 is attached to the first transducer 34b, and the bonding portion 50 injected to the joint T does not flow out toward the inner circumference of the sheet 39. Therefore, there is a possibility that operation of compensating the outflow of the adhesive does not have to be additionally performed.

[0048] Furthermore, an operator can perform the bonding operation of the joint T just by abutting part of the first surface 37x of the columnar portion 37 to the first transducer 34b and injecting the bonding portion 50 to the joint T. Therefore, the operator can easily adjust the position of the joint T, and the bonding operability improves.

[0049] As a result, the simple configuration and method can provide an ultrasound observation apparatus and a manufacturing method of the ultrasound observation apparatus that can prevent lower electrodes of adjacent ultrasound transducers from coming into contact with each other at a joint of respective end portions of a rounded sheet.

(Second Embodiment)

[0050] Fig. 5 is a partial cross-sectional view near the joint in a sheet of an ultrasound observation apparatus of the present embodiment. Fig. 6 is a cross-sectional view illustrated by removing the bonding portion from the ultrasound observation apparatus of Fig. 5 and developing the entire sheet.

[0051] Compared to the ultrasound observation apparatus of the first embodiment illustrated in Figs. 1 to 4, the configuration of the ultrasound observation apparatus of the second embodiment is different in that a columnar portion is configured from at least a second transducer. Therefore, only the difference will be described. The same reference signs are provided to the same components as in the first embodiment, and the description will not be repeated.

[0052] As shown in Fig. 6, main parts of a sheet 139 include the plurality of first transducers 34, the first transducer region 38, a columnar portion 137, acoustic matching layers 36 and 136, and the film portion 35 in the present embodiment.

[0053] At least a first surface 137x described later of the columnar portion 137 is non-conductive. The columnar portion 137 is disposed, at the predetermined interval C2, adjacent to the first transducer 34a positioned on the

first end portion 38a in the arrangement direction C among the plurality of first transducers 34.

[0054] The columnar portion 137 has a width of C3 larger than the width C1 by C2 in the arrangement direction C and extends from the one end 39i to the other end 39t in the extension direction H.

[0055] More specifically, the columnar portion 137 includes at least the second transducers, each of the second transducers including a second lower electrode 133, a second piezoelectric element 131 disposed on the second lower electrode 133, and a second upper electrode 132 disposed on the second piezoelectric element 131. The second transducers are electronic radial ultrasound transducers with the width of C3 in the arrangement direction C.

[0056] Like the first piezoelectric element 31, the second piezoelectric element 131 emits ultrasound toward the second upper electrode 132 along with the vibration and receives a sound wave reflected from the examined site.

[0057] The second upper electrode 132 and the second lower electrode 133 are configured to apply a pulse voltage to the second piezoelectric element 131 to vibrate the second piezoelectric element 131. In addition, the second upper electrode 132 configures a GND electrode, and the second lower electrode 133 configures a positive electrode.

[0058] As shown in Fig. 5, an end portion 133a in the arrangement direction C of the second lower electrode 133 in the columnar portion 137 is at a position separated by the predetermined distance C2 from the second end portion 38b of the first transducer region 38. As a result, part of the second piezoelectric element 131 is exposed, and the first surface 137x is configured under the exposed second piezoelectric element 131.

[0059] Note that the predetermined distance C2 coincides with the predetermined intervals C2 in the arrangement direction C of the plurality of first transducers 34 in the first transducer region 38.

[0060] A dicing blade with the blade width C2 is used to dice the sheet 139 in the second lower electrode 133 closer to an end portion 139a in the arrangement direction C along with part of the second piezoelectric element 131, and a cutout K is formed to configure the first surface 137x under the second piezoelectric element 131 exposed by the cutout K, the first surface 137x having the predetermined distance C2 in the arrangement direction C. For the first surface 137X described above, the second lower electrode 133 may be etched to provide an exposed section K.

[0061] Note that the columnar portion 137 may be individually provided only near the one end and the other end in the extension direction H of the sheet 139 in the extension direction H.

[0062] The film portion 35 is flexible and connects, in the arrangement direction C, the plurality of first upper electrodes 32 in the first transducer region 38 and a second surface 137y facing the first surface 137x of the co-

lumnar portion 137.

[0063] As shown in Figs. 5 and 6, the present embodiment illustrates an example of a configuration in which the columnar portion 137 includes the acoustic matching layer 136 between the second upper electrode 132 and the film portion 35. However, the arrangement is not limited to this, and the second upper electrode 132 may be directly fixed to the film portion 35.

[0064] In a state in which the sheet 139 is rounded such that the film portion 35 becomes the external surface, and the first transducer 34b positioned on the second end portion 38b and part of the non-conductive first surface 137x of the columnar portion 137 are attached to each other as shown in Fig. 5, the bonding portion 50 is configured to bond, in the extension direction H, the columnar portion 137 and the first transducer 34b at the joint T between respective end portions 139a and 139b in the arrangement direction C of the sheet 139.

[0065] Note that the bonding portion 50 is also configured from, for example, an adhesive in the present embodiment. The bonding portion 50 may be configured from the same material as the film portion 35.

[0066] In the present embodiment, as shown in Fig. 5, the predetermined distance C2 also exists which coincides with the predetermined intervals C2 in the arrangement direction C of the plurality of first transducers 34 in the first transducer region 38 as described above at the joint T where the first transducer 34b and part of the non-conductive first surface 137x of the columnar portion 137 are attached to each other.

[0067] Next, a manufacturing method of the ultrasound observation apparatus 30 configured in this way will be simply described.

[0068] First, a step of creating the sheet 139 shown in Fig. 6 is executed. To create the sheet 139, the film portion 35 is formed first. Next, when the acoustic matching layers 36 and 136 are used on the film portion 35, the acoustic matching layers 36 and 136 are formed at the same time.

[0069] Next, the first piezoelectric element 31 and the second piezoelectric element 132 provided with the electrodes 32 and 33 and the electrodes 132 and 133 on upper and lower surfaces are bonded on the acoustic matching layer 36 and the acoustic matching layer 136 at the same width as the acoustic matching layer 36 and the acoustic matching layer 136 in the arrangement direction C.

[0070] Subsequently, a plurality of grooves with the width C2 in the arrangement direction C are formed on the electrodes 32 and 33, the first piezoelectric element 31, and the acoustic matching layer 36 by using the dicing blade with the blade width C2, for each width C1 in the arrangement direction C.

[0071] Furthermore, the dicing blade with the blade width C2 is used for part of the electrode 133 closer to the end portion 139a of the sheet 139 and part of the second piezoelectric element 131 to form a groove with the width C2 in the arrangement direction C to thereby

form the cutout K. Alternatively, the exposed section K is formed by etching at the etching width C2.

[0072] As a result, the sheet 139 is created, in which the plurality of first transducers 34 with the width C1 are arranged on the film portion 35 at the predetermined intervals C2 in the arrangement direction C through the acoustic matching layer 36. The sheet 139 has the predetermined interval C2 between the first transducer 34a and the columnar portion 137 in the arrangement direction C and is provided with the cutout K with the predetermined distance C2 between the end portion 133a and the end portion 139a closer to the end portion 139a of the sheet 139 of the columnar portion 137.

[0073] Next, a step of rounding the sheet 139 360° is executed as shown in Fig. 5 such that the film portion 35 becomes the external surface, and the first transducer 34b positioned on the second end portion 38b and part of the first surface 137x of the columnar portion 137 are attached to each other.

[0074] Lastly, in the state in which the sheet 139 is rounded, a step of bonding by the bonding portion 50 is executed by injecting the bonding portion 50 between the columnar portion 137 and the first transducer 34b in the arrangement direction C. As a result, the ultrasound observation apparatus 30 is manufactured.

[0075] In this way, the present embodiment has illustrated that the columnar portion 137 in which at least the first surface 137x is non-conductive is disposed adjacent to the first transducer 34a positioned on the first end portion 38a at the predetermined interval C2 in the arrangement direction C among the plurality of first transducers 34 in the first transducer region 38 in the sheet 139 of the ultrasound observation apparatus 30.

[0076] The present embodiment has also illustrated that the columnar portion 137 includes the second transducers, each of the second transducers including at least the second lower electrode 133, the second piezoelectric element 131 disposed on the second lower electrode 133, and the second upper electrode 132 disposed on the second piezoelectric element 131.

[0077] Furthermore, the present embodiment has illustrated that the dicing blade with the blade width C2 is used to dice the sheet 139 in the second lower electrode 133 closer to the end portion 139a along with part of the second piezoelectric element 131 to form the cutout K, or the etching is performed at the etching width C2, and the first surface 137x is configured under the second piezoelectric element 131 exposed by the cutout K or the exposed section K, with the predetermined distance C2 in the arrangement direction C.

[0078] Note that the present embodiment has illustrated that the predetermined distance C2 coincides with the predetermined interval C2 in the arrangement direction C of the plurality of first transducers 34 in the first transducer region 38.

[0079] The present embodiment has also illustrated that the bonding portion 50 bonds, in the extension direction H, the columnar portion 137 and the first trans-

ducer 34b in the arrangement direction C at the joint T of the sheet 139 in the state in which the sheet 139 is rounded such that the film portion 35 becomes the external surface, and the first transducer 34b positioned on the second end portion 38b and part of the non-conductive first surface 137x of the columnar portion 137 are attached to each other.

[0080] According to this, part of the non-conductive first surface 137x of a second transducer 134 is in contact with the lower electrode 33 of the first transducer 34b at the joint T of the sheet 139, and the lower electrode 33 of the first transducer 34a does not come into contact with the lower electrode 133 of the second transducer 134.

[0081] Therefore, the columnar portion 137 can also surely prevent electrical short-circuit at the joint T of the first transducer 34b and the second transducer 134 without separately using the spacer or the like in the present embodiment.

[0082] In addition, part of the first surface 137x of the columnar portion 137 is attached to the first transducer 34b, and the bonding portion 50 injected to the joint T does not flow out toward the inner circumference of the sheet 139.

[0083] In addition, the cutout K with the predetermined distance C2 is formed on the second transducer 134 in the columnar portion 137. Therefore, the predetermined distance C2 also exists which coincides with the predetermined intervals C2 in the arrangement direction C of the plurality of first transducers 34 in the first transducer region 38 as described above at the joint T where the first transducer 34b and part of the non-conductive first surface 137x of the columnar portion 137 are attached to each other.

[0084] As a result, the sheet 139 is provided with a plurality of transducers at equal intervals at the intervals C2 throughout the whole circumference. This can prevent distortion of an ultrasound image of the examined site acquired by the ultrasound observation apparatus 30.

[0085] Furthermore, the operator can perform the bonding operation of the joint T just by abutting part of the first surface 137x of the columnar portion 137 to the first transducer 34b and injecting the bonding portion 50 to the joint T, and the operator can simply adjust the position of the predetermined distance C2 in the joint T. Therefore, the bonding operability improves.

[0086] In addition, the part of the second transducer 134 configuring the columnar portion 137 excluding the cutout K or the exposed section K in the arrangement direction C also has the width C1 as in the first transducer 34, and the second transducer 134 is separated by the predetermined interval C2 from the first transducer 34a that is the same as the predetermined intervals C2 among the plurality of first transducers 34a. Therefore, the columnar portion 137 can be provided to prevent distortion of an ultrasound image of the examined site acquired by the ultrasound observation apparatus 30.

[0087] Note that the other effects are the same as in

the first embodiment.

[0088] Hereinafter, an example of a configuration of an ultrasound endoscope apparatus including the ultrasound observation apparatus 30 used in the first and second embodiments will be described with reference to Fig. 7. Fig. 7 is a diagram showing the ultrasound endoscope apparatus including the ultrasound observation apparatus of the first and second embodiments.

[0089] As shown in Fig. 7, an ultrasound endoscope apparatus 100 includes an ultrasound endoscope 1, a light source apparatus 11, a video processor 12, a monitoring apparatus 14, a suction pump 15, and a water feeding tank 16.

[0090] Main parts of the ultrasound endoscope 1 include an elongated insertion portion 2, an operation portion 3, a flexible universal cord 4 extended from the operation portion 3, and an endoscope connector 5 provided on an extension end of the universal cord 4.

[0091] The endoscope connector 5 is provided with a light source connector 6, an electrical connector 7, an ultrasound connector 8, a suction pipe sleeve 9, and an air/water feeding pipe sleeve 10.

[0092] The light source apparatus 11 configured to supply illumination light into a subject through a light guide not shown can be attached to and detached from the light source connector 6.

[0093] In addition, the video processor 12 configured to execute various types signal processing and the like through an image guide or a signal cable not shown can be attached to and detached from the electrical connector 7.

[0094] Furthermore, a connector 45 provided on a proximal end side of an ultrasound transducer cable 40 extending from the transducers 34 and 134 in the ultrasound observation apparatus 30 is electrically connected to the ultrasound connector 8, and the monitoring apparatus 14 can be attached to and detached from the ultrasound connector 8 through an ultrasound cable 13.

[0095] In addition, the suction pipe sleeve 9 is provided on an opening of the other end of a treatment instrument insertion channel not shown, and the suction pump 15 can be attached to and detached from the suction pipe sleeve 9 through a suction tube not shown. Furthermore, the air/water feeding pipe sleeve 10 is connected to a fluid supply conduit not shown, and the water feeding tank 16 can be attached to and detached from the air/water feeding pipe sleeve 10 through an air/water feeding tube not shown.

[0096] The monitoring apparatus 14 is configured to perform various operation controls of the ultrasound endoscope 1. For example, the monitoring apparatus 14 controls the drive of the ultrasound transducers or executes operation of generating a video signal by executing signal processing of an electrical signal acquired by controlling the drive of the ultrasound transducers.

[0097] Note that the video signal generated by the monitoring apparatus 14 is outputted to a display apparatus not shown. As a result, an ultrasound image is dis-

played on a screen of the display apparatus that has received the video signal.

[0098] The insertion portion 2 of the ultrasound endoscope 1 is continuously provided with, in order from a distal end side: a distal end portion 21; a bending portion 22 bendable in, for example, up and down directions and left and right directions; and a long flexible tube portion 23 with flexibility. Note that the ultrasound observation apparatus 30 is positioned in the distal end portion 21.

[0099] Bending operation knobs 25 and 26 for performing bending operation of the bending portion 22 are provided on the operation portion 3. A treatment instrument insertion pipe sleeve 27 for introducing a treatment instrument into the body through the treatment instrument insertion channel is provided on a position of the operation portion 3 closer to the insertion portion 2.

[0100] The video processor 12 is configured to apply signal processing to an electrical signal transmitted from an image pickup unit not shown provided in the distal end portion 21 to generate a standard video signal. The video processor 12 is configured to output the video signal to the display apparatus not shown to display an endoscopic observation image on the screen of the display apparatus.

[0101] Note that the configuration of the ultrasound endoscope 1 is just an example, and it is obvious that the configuration is not limited to the configuration of Fig. 7.

[0102] The ultrasound observation apparatus 30 can also be applied to an apparatus other than the ultrasound endoscope apparatus 100, such as an apparatus including an ultrasound treatment instrument.

[0103] Although the first transducers 34 and the second transducers 134 are electronic radial ultrasound transducers in the first and second embodiments, the transducers are not limited to these, and it is obvious that the first and second embodiments can also be applied to C-MUT (capacitive micromachined ultrasonic transducers).

Claims

1. An ultrasound observation apparatus comprising:

a sheet including:

a first transducer including a first upper electrode that is a GND electrode, a first piezoelectric element disposed on the first upper electrode, and a first lower electrode that is arranged in a predetermined arrangement direction on the first piezoelectric element and that is a positive electrode;
a first transducer region in which the first transducer in plurality are arranged at predetermined intervals;
a columnar portion in which at least a first surface is non-conductive, the columnar

portion disposed adjacent to the first transducer positioned on a first end portion in the arrangement direction in the first transducer region; and

a film portion that is flexible and that connects at least the first upper electrode in plurality in the first transducer region and a second surface facing the first surface of the columnar portion in the arrangement direction; and

a bonding portion provided between the first transducer positioned on a second end portion in the arrangement direction among the first transducer in plurality in the first transducer region and the columnar portion and configured to maintain a state in which the sheet is rounded such that the film portion of the sheet becomes an external surface, and the first transducer positioned on the second end portion and the first surface of the columnar portion are attached to each other.

2. The ultrasound observation apparatus according to claim 1, wherein

the columnar portion is configured of a second transducer including at least a second lower electrode, a second piezoelectric element disposed on the second lower electrode, and a second upper electrode disposed on the second piezoelectric element, the second lower electrode is positioned at a predetermined distance from the second end portion to expose part of the second piezoelectric element, and the first surface is configured under the exposed second piezoelectric element.

3. The ultrasound observation apparatus according to claim 2, wherein

the predetermined distance coincides with the predetermined intervals in the arrangement direction of the first transducer in plurality in the first transducer region.

4. The ultrasound observation apparatus according to claim 1, wherein

an acoustic matching layer is disposed between the first upper electrode and the film portion.

5. A manufacturing method of an ultrasound observation apparatus, the manufacturing method comprising:

a step of creating a sheet, the sheet including:

a first transducer including a first upper electrode that is a GND electrode, a first piezoelectric element disposed on the first upper electrode, and a first lower electrode that is

arranged on the first piezoelectric element and that is a positive electrode;
 a first transducer region in which the first transducer in plurality are arranged at pre-determined intervals;
 a columnar portion in which at least a first surface is non-conductive, the columnar portion disposed adjacent to the first transducer positioned on a first end portion in an arrangement direction of the first transducer in plurality among the first transducer in plurality in the first transducer region; and
 a film portion that is flexible and that connects at least the first upper electrode in plurality in the first transducer region and a second surface facing the first surface of the columnar portion in the arrangement direction;

a step of rounding the sheet such that the film portion of the sheet becomes an external surface, and the first transducer positioned on a second end portion in the arrangement direction among the first transducer in plurality in the first transducer region and the first surface of the columnar portion are attached to each other; and
 a step of maintaining, by a bonding portion, the state in which the sheet is rounded in the state in which the columnar portion and the first transducer positioned on the second end portion are attached to each other.

Patentansprüche

1. Ultraschallbeobachtungs Vorrichtung, umfassend:

eine Platte, umfassend:

einen ersten Wandler, der eine erste obere Elektrode, die eine Masseelektrode ist, ein erstes piezoelektrisches Element, das auf der ersten oberen Elektrode angeordnet ist, und eine erste untere Elektrode umfasst, die in einer vorgegebenen Anordnungsrichtung auf dem ersten piezoelektrischen Element angeordnet ist, und die eine positive Elektrode ist;
 einen ersten Wandlerbereich, in dem der erste Wandler in Mehrzahl in vorgegebenen Intervallen angeordnet ist;
 einen säulenartigen Abschnitt, in dem mindestens eine erste Oberfläche nichtleitend ist, wobei der säulenartige Abschnitt dem ersten Wandler benachbart angeordnet ist, der auf einem ersten Endabschnitt in Anordnungsrichtung im ersten Wandlerbereich positioniert ist; und

einen Folienabschnitt, der flexibel ist und der mindestens die erste obere Elektrode in Mehrzahl im ersten Wandlerbereich und eine zweite Oberfläche verbindet, die der ersten Oberfläche des säulenartigen Abschnitts in der Anordnungsrichtung zugewandt ist; und

einen Zusammenfügungsabschnitt, der zwischen dem ersten Wandler, der auf einem zweiten Endabschnitt in der Anordnungsrichtung aus dem ersten Wandler in Mehrzahl im ersten Wandlerbereich positioniert ist, und dem säulenartigen Abschnitt vorgesehen und zum Aufrechterhalten eines Zustands konfiguriert ist, in dem die Platte so gerundet ist, dass der Folienabschnitt der Platte eine äußere Oberfläche wird, und der erste Wandler, der auf dem zweiten Endabschnitt positioniert ist, und die erste Oberfläche des säulenartigen Abschnitts miteinander verbunden sind.

2. Ultraschallbeobachtungs Vorrichtung nach Anspruch 1, wobei

der säulenartige Abschnitt aus einem zweiten Wandler konfiguriert ist, der mindestens eine zweite untere Elektrode, ein zweites piezoelektrisches Element, das auf der zweiten unteren Elektrode angeordnet ist, und eine zweite obere Elektrode umfasst, die auf dem zweiten piezoelektrischen Element angeordnet ist, die zweite untere Elektrode mit einem vorgegebenen Abstand vom zweiten Endabschnitt positioniert ist, um einen Teil des zweiten piezoelektrischen Elements freizulegen, und die erste Oberfläche unter dem freiliegenden zweiten piezoelektrischen Element konfiguriert ist.

3. Ultraschallbeobachtungs Vorrichtung nach Anspruch 2, wobei

der vorgegebene Abstand mit den vorgegebenen Intervallen in der Anordnungsrichtung des ersten Wandlers in Mehrzahl im ersten Wandlerbereich übereinstimmt.

4. Ultraschallbeobachtungs Vorrichtung nach Anspruch 1, wobei

ein akustische Anpassungsschicht zwischen der ersten oberen Elektrode und dem Folienabschnitt angeordnet ist.

5. Herstellungsverfahren für eine Ultraschallbeobachtungs Vorrichtung, das Herstellungsverfahren umfassend:

einen Schritt eines Erzeugens einer Platte, wobei die Platte umfasst:

einen ersten Wandler, der eine erste obere Elektrode, die eine Masseelektrode ist, ein erstes piezoelektrisches Element, das auf der ersten oberen Elektrode angeordnet ist, und eine erste untere Elektrode umfasst, die auf dem ersten piezoelektrischen Element angeordnet ist, und die eine positive Elektrode ist; 5

einen ersten Wandlerbereich, in dem der ersten Wandler in Mehrzahl in vorgegebenen Intervallen angeordnet ist; 10

einen säulenartigen Abschnitt, in dem mindestens eine erste Oberfläche nichtleitend ist, wobei der säulenartige Abschnitt dem ersten Wandler benachbart angeordnet ist, der auf einem ersten Endabschnitt in einer Anordnungsrichtung des ersten Wandlers in Mehrzahl aus dem ersten Wandler in Mehrzahl im ersten Wandlerbereich positioniert ist; und 20

einen Folienabschnitt, der flexibel ist und der mindestens die erste obere Elektrode in Mehrzahl im ersten Wandlerbereich und eine zweite Oberfläche verbindet, die der ersten Oberfläche des säulenartigen Abschnitts in der Anordnungsrichtung zugewandt ist; 25

einen Schritt, in dem die Platte gerundet wird, sodass der Folienabschnitt der Platte eine äußere Oberfläche wird und der erste Wandler, der an einem zweiten Endabschnitt in der Anordnungsrichtung aus dem ersten Wandler in Mehrzahl im ersten Wandlerbereich positioniert ist, und die erste Oberfläche des säulenartigen Abschnitts miteinander verbunden sind; und 30

einen Schritt, in dem durch einen Zusammenfügungsabschnitt der Zustand aufrechterhalten wird, in dem die Bahn in dem Zustand gerundet ist, in dem der säulenartige Abschnitt und der erste Wandler, der auf dem zweiten Endabschnitt positioniert ist, miteinander verbunden sind. 40

Revendications

1. Appareil d'observation ultrasonore comprenant :

une feuille comprenant :

un premier transducteur comprenant une première électrode supérieure qui est une électrode de terre, un premier élément piézoélectrique disposé sur la première électrode supérieure, et une première électrode inférieure qui est agencée dans une direction d'agencement prédéterminée sur le 55

premier élément piézoélectrique et qui est une électrode positive ;
une région de premiers transducteurs dans laquelle une pluralité de premiers transducteurs sont agencés à intervalles prédéterminés ;
une partie en colonne dans laquelle au moins une première surface est non conductrice, la partie en colonne étant disposée adjacente au premier transducteur positionné sur une première partie d'extrémité dans la direction d'agencement dans la région de premiers transducteurs ; et
une partie de film qui est souple et qui relie au moins la pluralité de premières électrodes supérieures dans la région de premiers transducteurs et une seconde surface faisant face à la première surface de la partie en colonne dans la direction d'agencement ; et

une partie de liaison prévue entre le premier transducteur positionné sur une seconde partie d'extrémité dans la direction d'agencement parmi la pluralité de premiers transducteurs dans la région de premiers transducteurs et la partie en colonne, et configurée pour maintenir un état dans lequel la feuille est arrondie de telle sorte que la partie de film de la feuille devient une surface externe, et le premier transducteur positionné sur la seconde partie d'extrémité et la première surface de la partie en colonne sont fixés l'un à l'autre.

2. Appareil d'observation ultrasonore selon la revendication 1, dans lequel

la partie en colonne est configurée par un second transducteur comprenant au moins une seconde électrode inférieure, un second élément piézoélectrique disposé sur la seconde électrode inférieure, et une seconde électrode supérieure disposée sur le second élément piézoélectrique, la seconde électrode inférieure est positionnée à une distance prédéterminée de la seconde partie d'extrémité pour exposer une partie du second élément piézoélectrique, et la première surface est configurée sous le second élément piézoélectrique exposé. 45

3. Appareil d'observation ultrasonore selon la revendication 2, dans lequel

la distance prédéterminée coïncide avec les intervalles prédéterminés dans la direction d'agencement de la pluralité de premiers transducteurs dans la région de premiers transducteurs.

4. Appareil d'observation ultrasonore selon la revendication 1, dans lequel

une couche d'adaptation acoustique est disposée

entre la première électrode supérieure et la partie de film.

5. Procédé de fabrication d'un appareil d'observation ultrasonore, le procédé de fabrication comprenant :

une étape de création d'une feuille, la feuille comprenant :

un premier transducteur comprenant une première électrode supérieure qui est une électrode de terre, un premier élément piézoélectrique disposé sur la première électrode supérieure, et une première électrode inférieure qui est agencée sur le premier élément piézoélectrique et qui est une électrode positive ;

une région de premiers transducteurs dans laquelle une pluralité de premiers transducteurs sont agencés à intervalles prédéterminés ;

une partie en colonne dans laquelle au moins une première surface est non conductrice, la partie en colonne étant disposée adjacente au premier transducteur positionné sur une première partie d'extrémité dans une direction d'agencement de la pluralité de premiers transducteurs parmi la pluralité de premiers transducteurs dans la région de premiers transducteurs ; et

une partie de film qui est souple et qui relie au moins la pluralité de premières électrodes supérieures dans la région de premiers transducteurs et une seconde surface faisant face à la première surface de la partie en colonne dans la direction d'agencement ;

une étape d'arrondissement de la feuille de telle sorte que la partie de film de la feuille devient une surface externe, et le premier transducteur positionné sur une seconde partie d'extrémité dans la direction d'agencement parmi la pluralité de premiers transducteurs dans la région de premiers transducteurs et la première surface de la partie en colonne sont fixés l'un à l'autre ; et

une étape de maintien, par une partie de liaison, de l'état dans lequel la feuille est arrondie de telle sorte que la partie en colonne et le premier transducteur positionné sur la seconde partie d'extrémité sont fixés l'un à l'autre.

55

Fig. 1

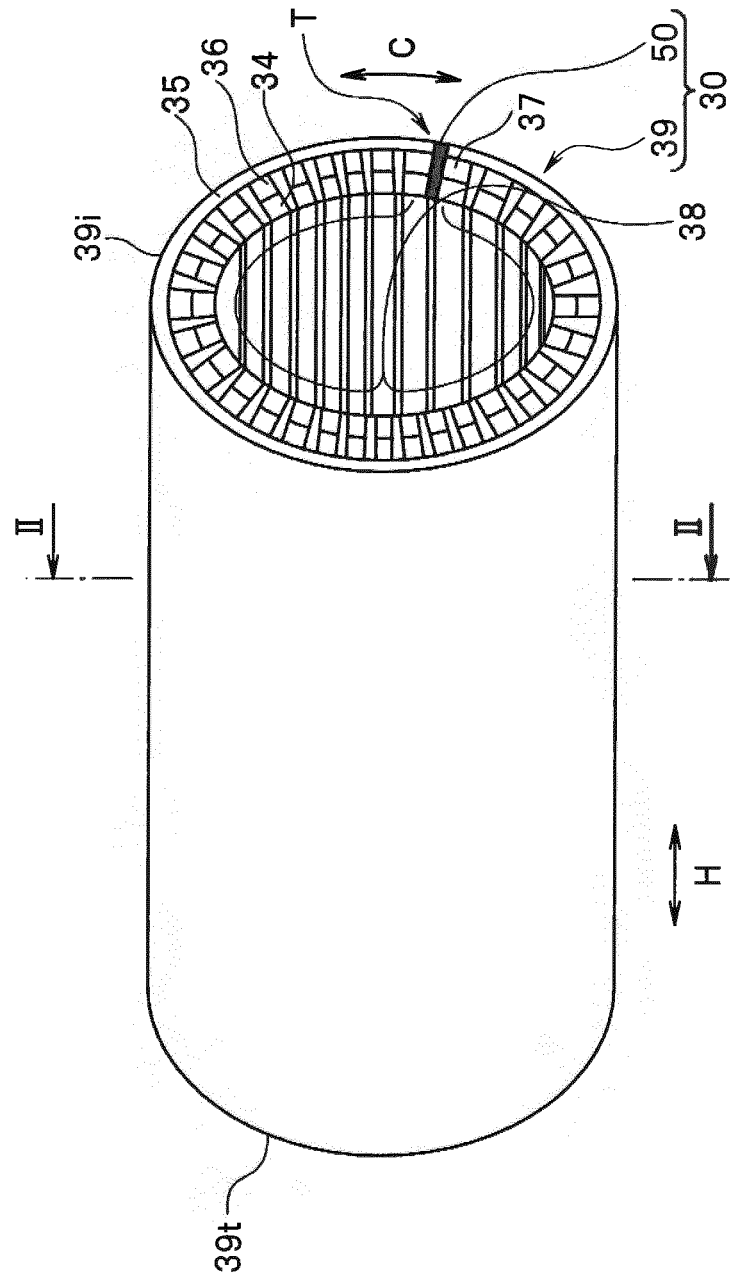


FIG. 2

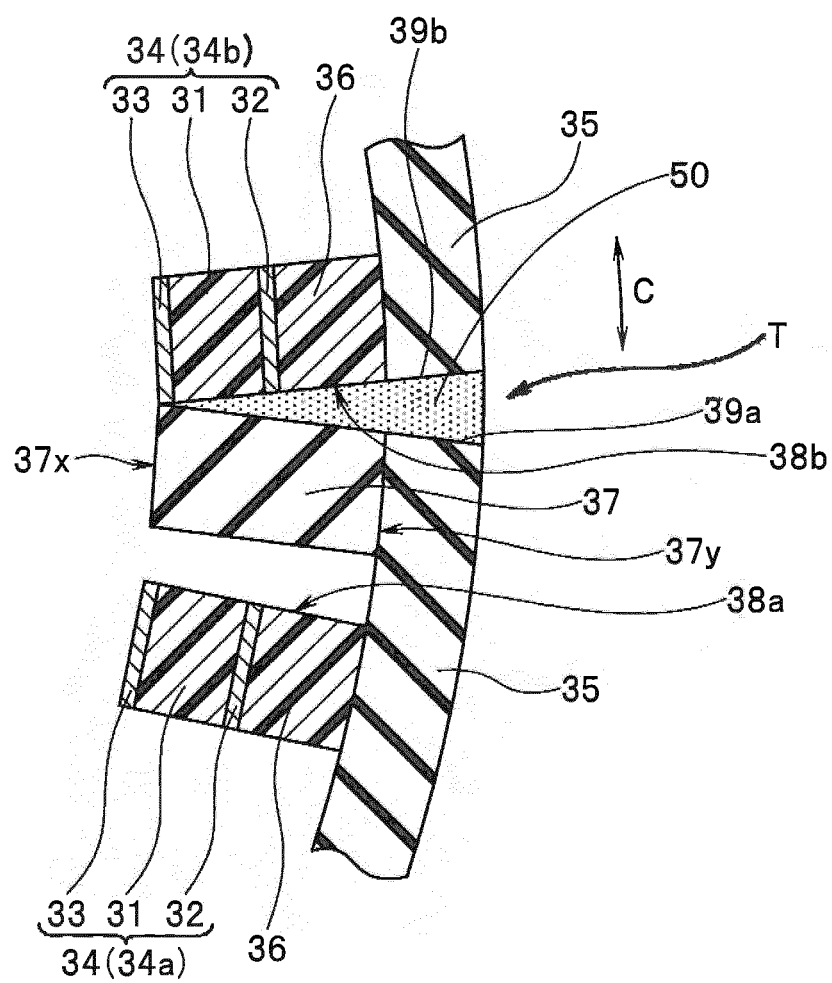


FIG. 3

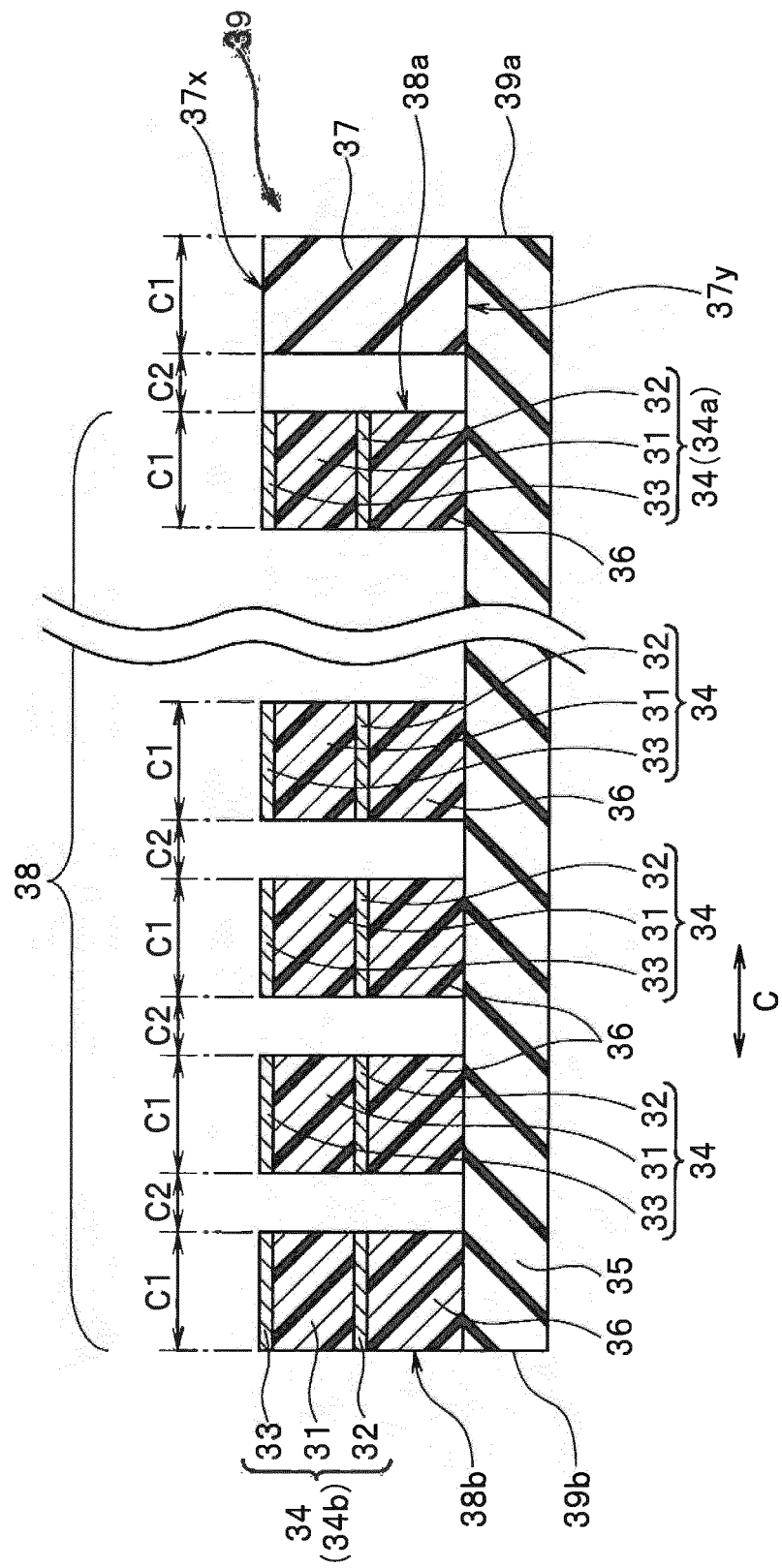


FIG. 4

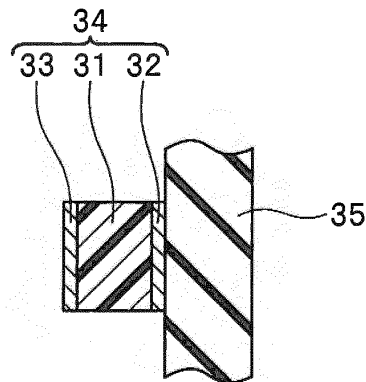


FIG. 5

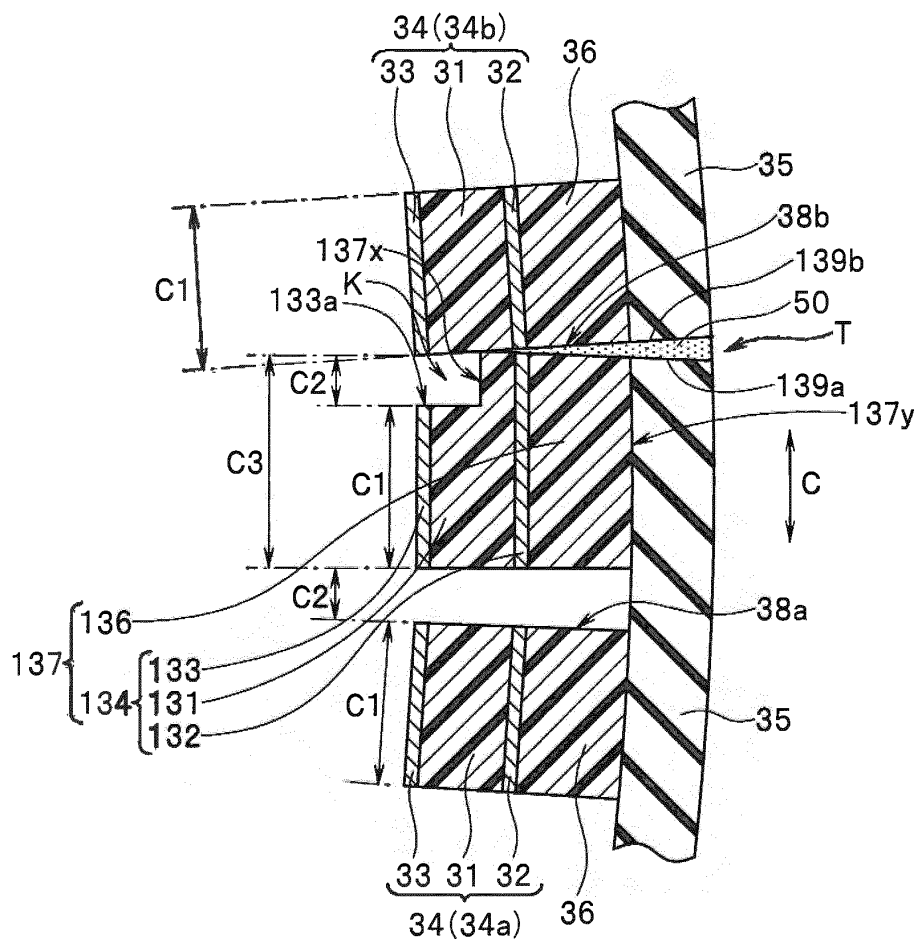


FIG. 6

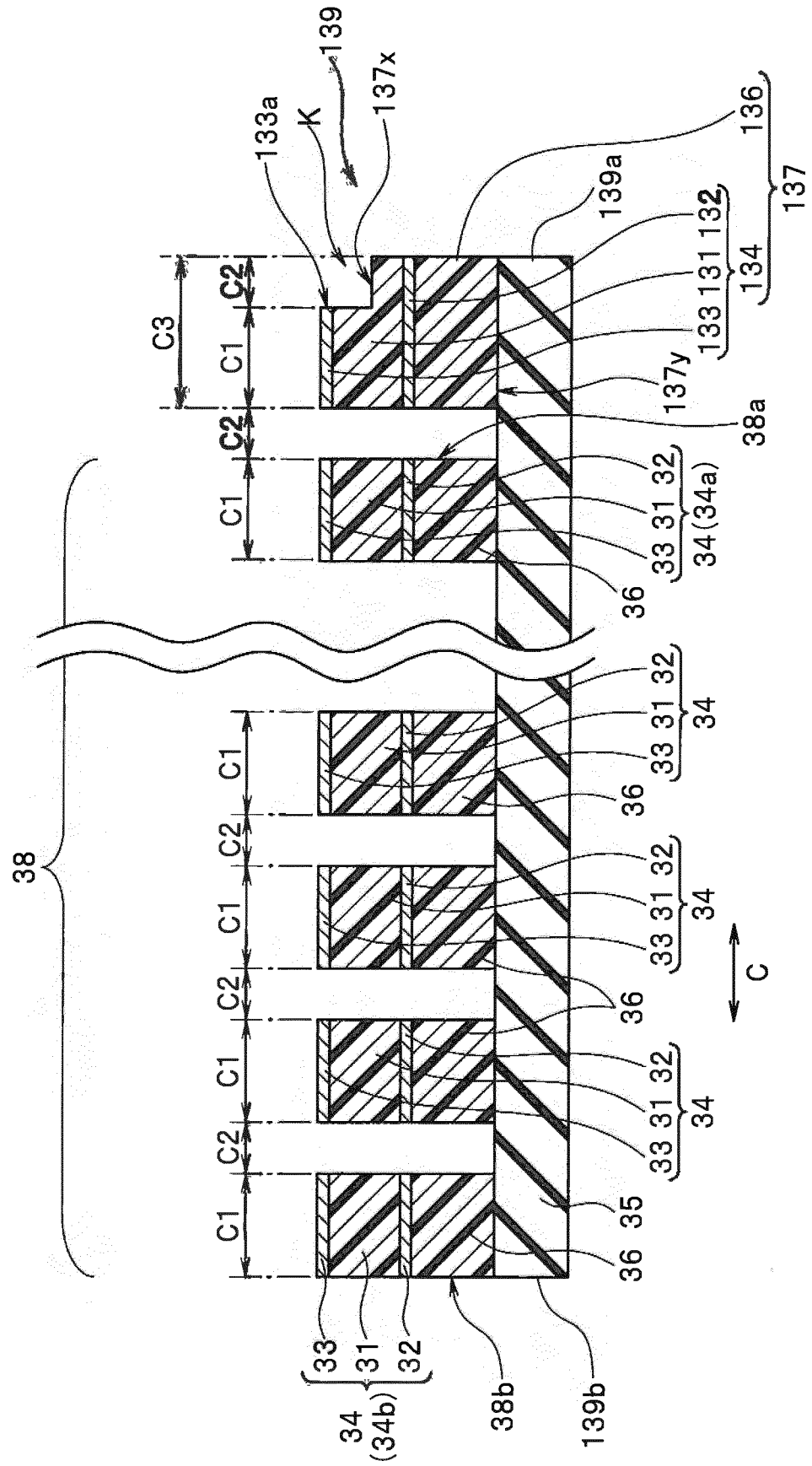
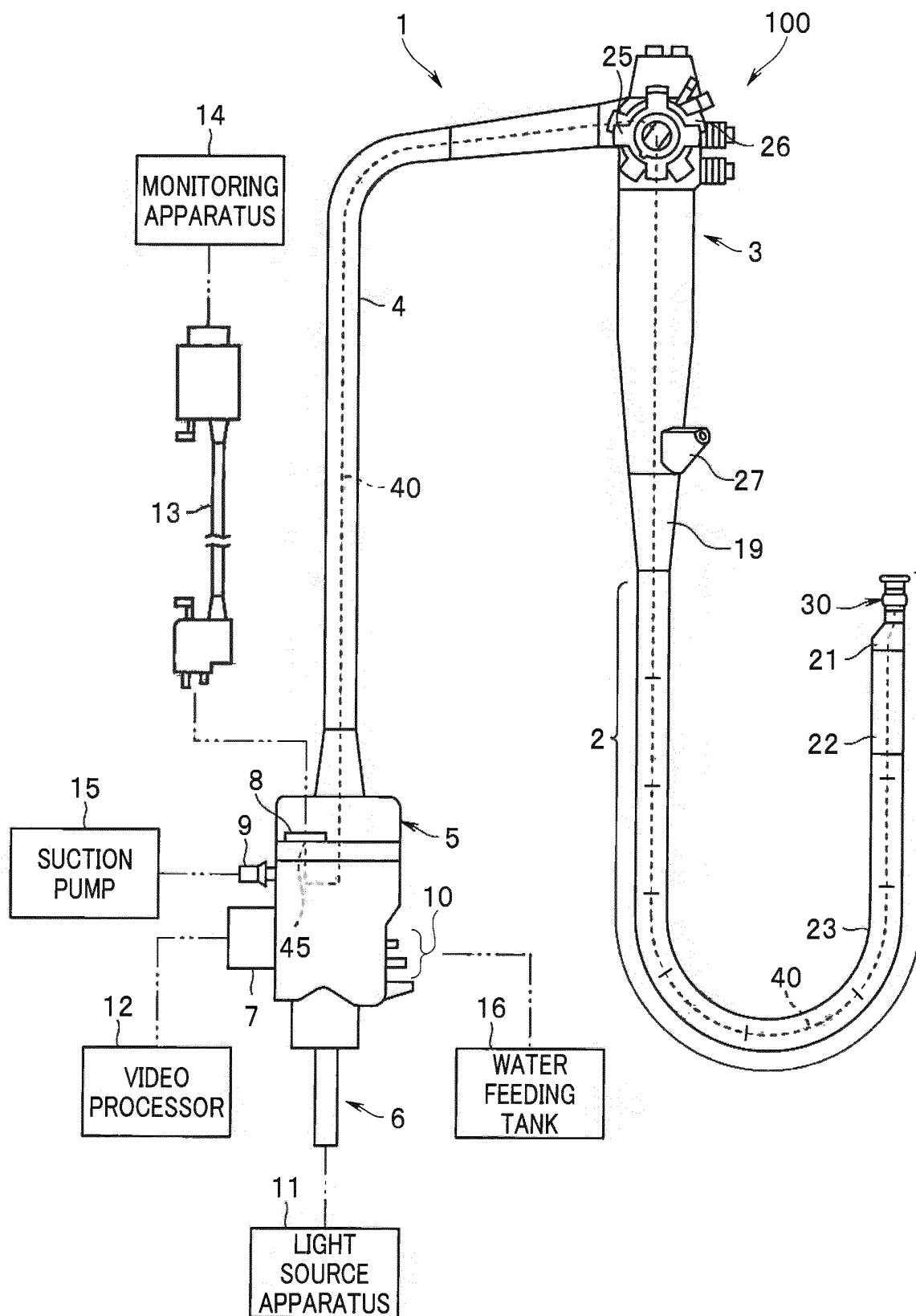


FIG. 7



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

- JP 2010017229 A [0003] [0004]
- EP 1918027 A1 [0009]

专利名称(译)	超声波观察装置和超声波观察装置的制造方法		
公开(公告)号	EP3165168B1	公开(公告)日	2019-01-30
申请号	EP2015830708	申请日	2015-04-22
[标]申请(专利权)人(译)	奥林巴斯株式会社		
申请(专利权)人(译)	OLYMPUS CORPORATION		
当前申请(专利权)人(译)	OLYMPUS CORPORATION		
[标]发明人	SATO SUNAO		
发明人	SATO, SUNAO		
IPC分类号	A61B8/12 G01N29/24 H04R17/00 H04R31/00		
优先权	2014162807 2014-08-08 JP		
其他公开文献	EP3165168A1 EP3165168A4		
外部链接	Espacenet		

摘要(译)

一种超声波观察装置，包括：片材，包括：第一换能器34;第一换能器区域38;柱状部分37;薄膜部分，其构造成在排列方向C上连接第一换能器区域38中的多个第一上电极32和柱状部分37的第二表面37y;接合部分50构造成在片材被圆化使得膜部分35变成外表面的状态下结合柱状部分37和第一换能器34b，并且第一换能器34b定位在第二端部分38b上第一换能器区域38和柱状部分37彼此连接。

FIG. 1

