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(54) **ULTRASONIC ENDOSCOPE**

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(57) **ABSTRACT**

An ultrasonic endoscope capable of suppressing temperature rise of an insertion part without increase in diameter. The ultrasonic endoscope includes: an ultrasonic transducer part having plural ultrasonic transducers; an exterior member for holding the ultrasonic transducer part; an opening formed in the exterior member; a heat conducting member arranged inside of the exterior member and connected to the ultrasonic transducer part; and a heat radiating member provided on an outer surface of the exterior member and connected to the heat conducting member via the opening. For example, a part of the heat radiating member is located within the opening and the part is connected to the heat conducting member. The heat radiating member is electrically insulated from the ultrasonic transducer part.

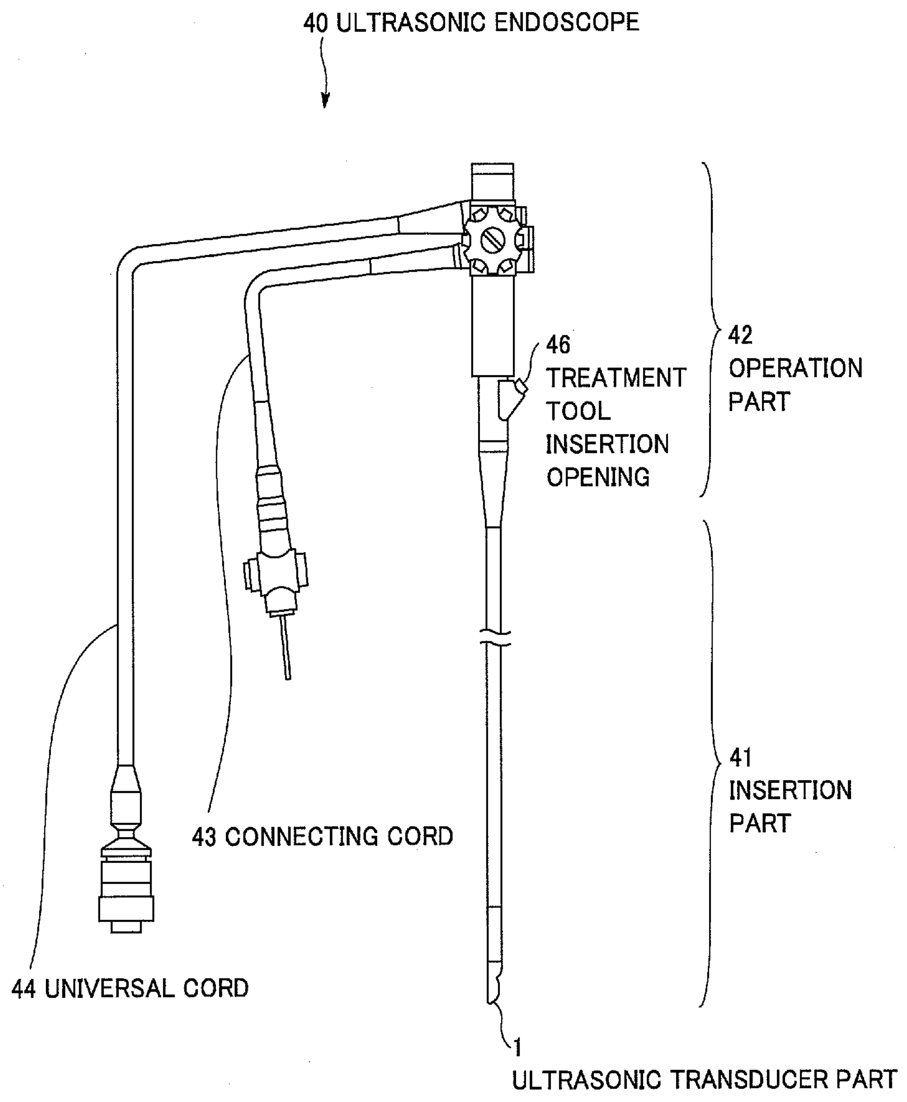
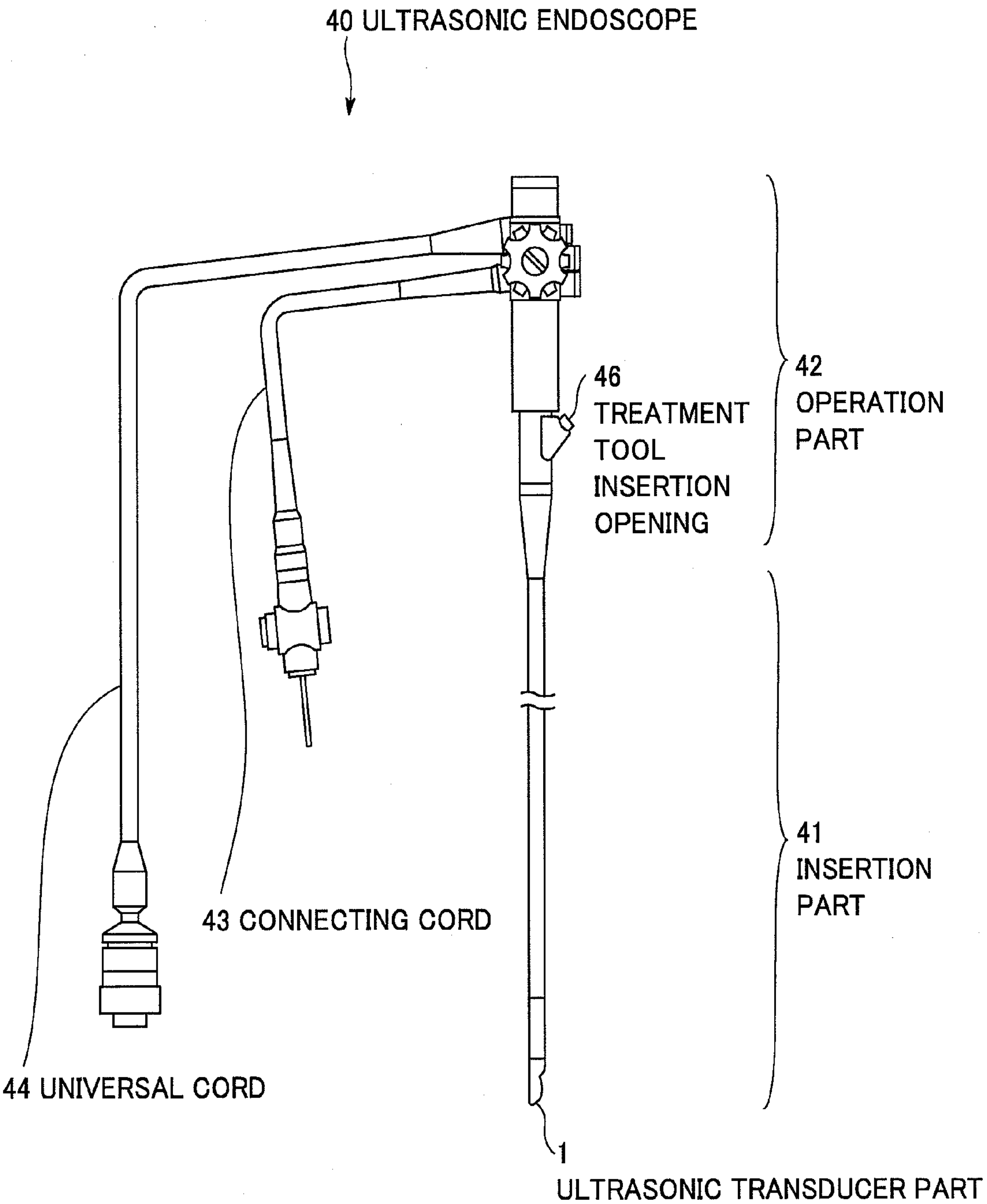


FIG.1



40 ULTRASONIC ENDOSCOPE
42 OPERATION PART
46 TREATMENT TOOL INSERTION OPENING
41 INSERTION PART
43 CONNECTING CORD
44 UNIVERSAL CORD
1 ULTRASONIC TRANSDUCER PART

FIG.2

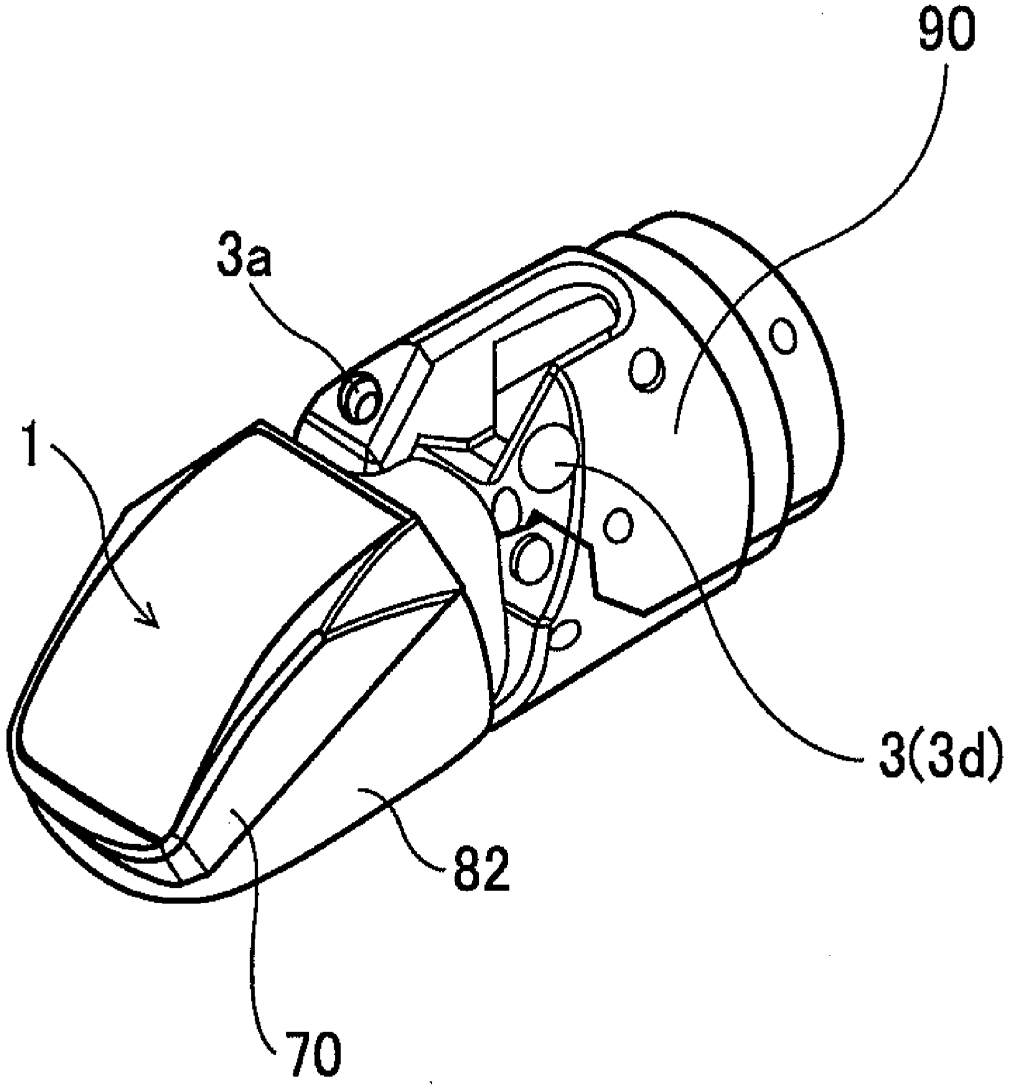
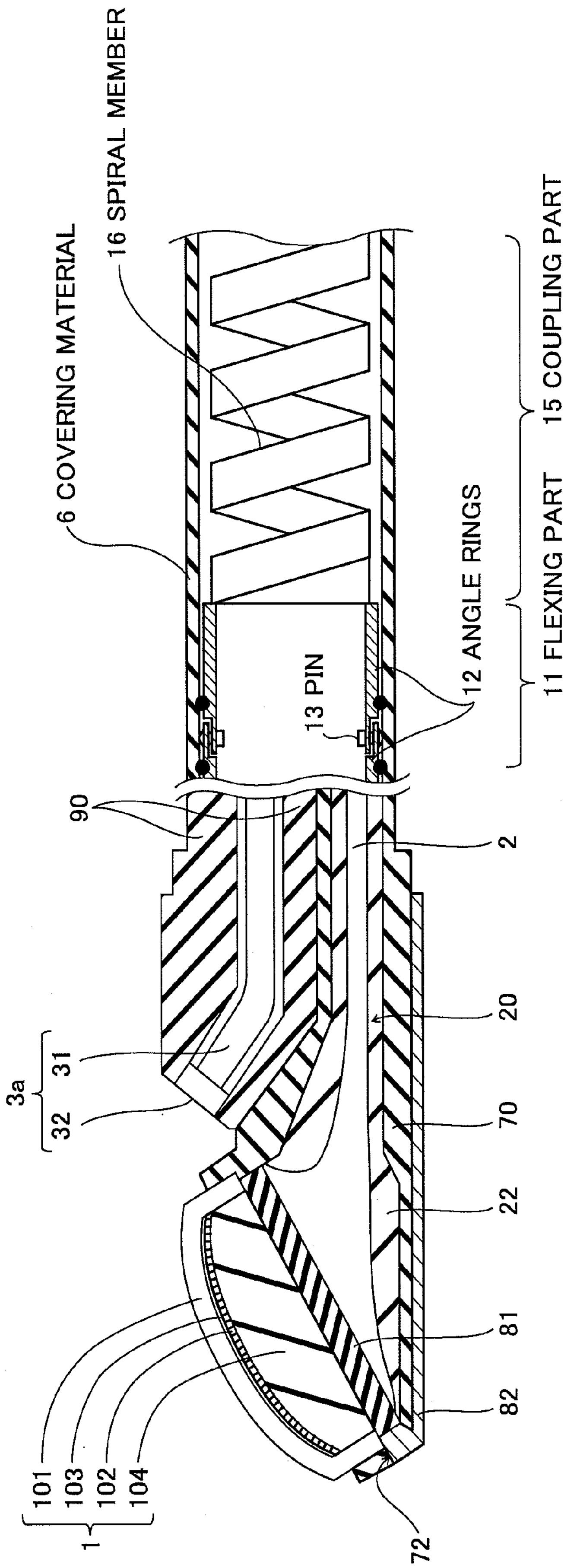


FIG.3



6 COVERING MATERIAL
16 SPIRAL MEMBER
15 COUPLING PART
11 FLEXING PART
12 ANGLE RINGS
13 PIN
90
2
20
3a
31
32
70
22
81
82
72
1
101
103
102
104

FIG.4

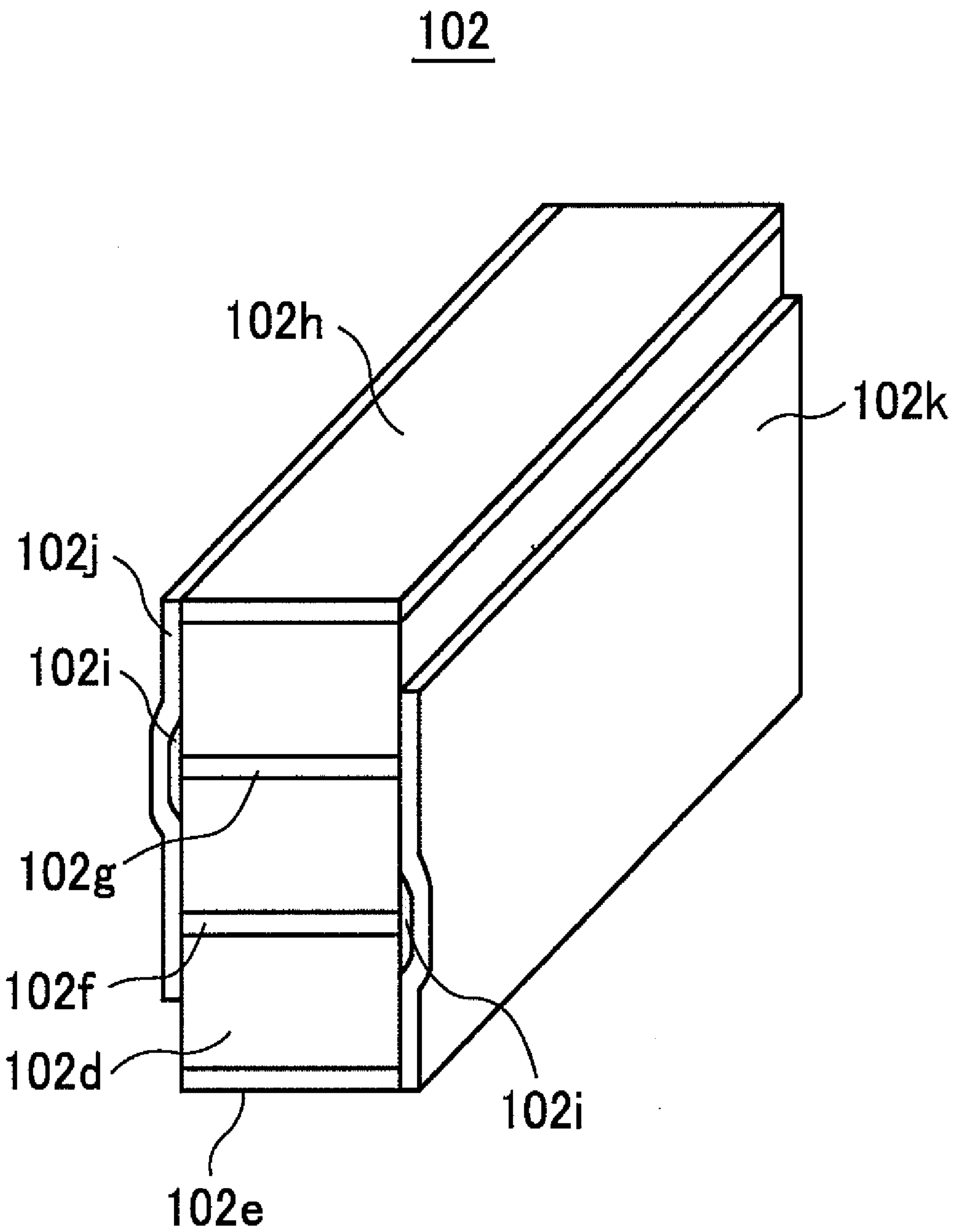
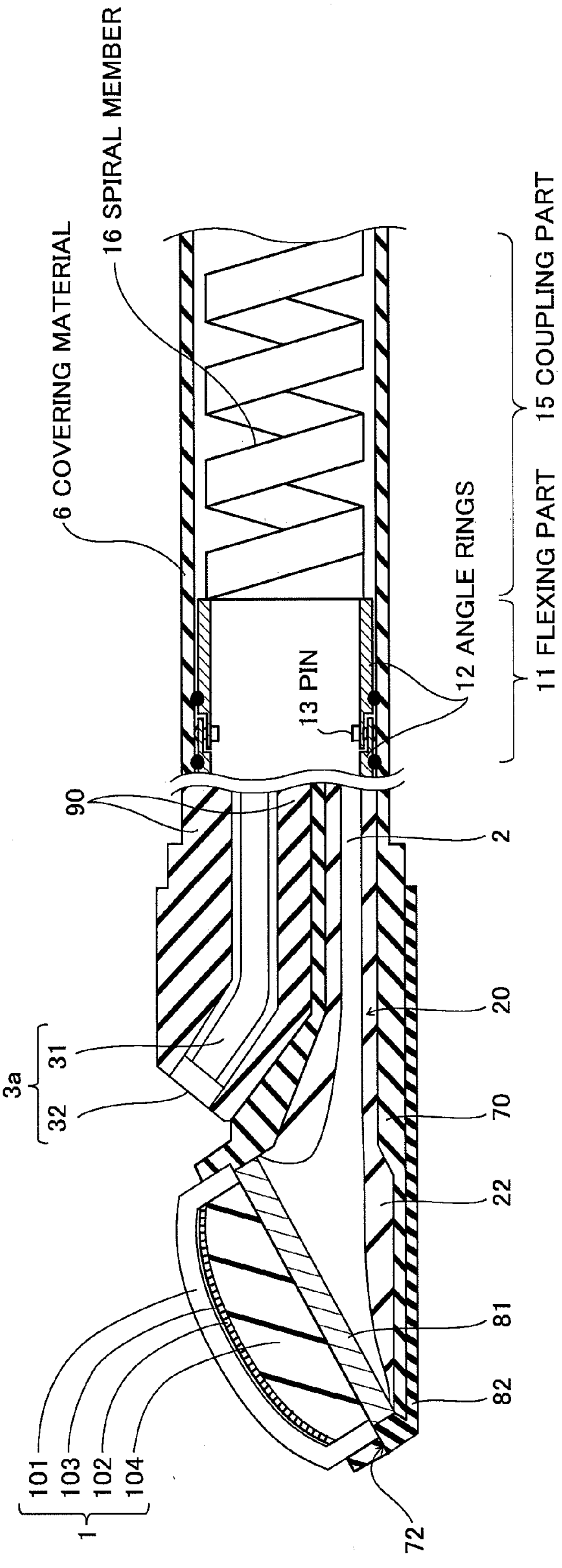


FIG.5


6 COVERING MATERIAL
16 SPIRAL MEMBER
15 COUPLING PART
11 FLEXING PART
12 ANGLE RINGS
13 PIN
90
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3a
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32
70
22
81
82
101
103
102
104
1
72

FIG.6

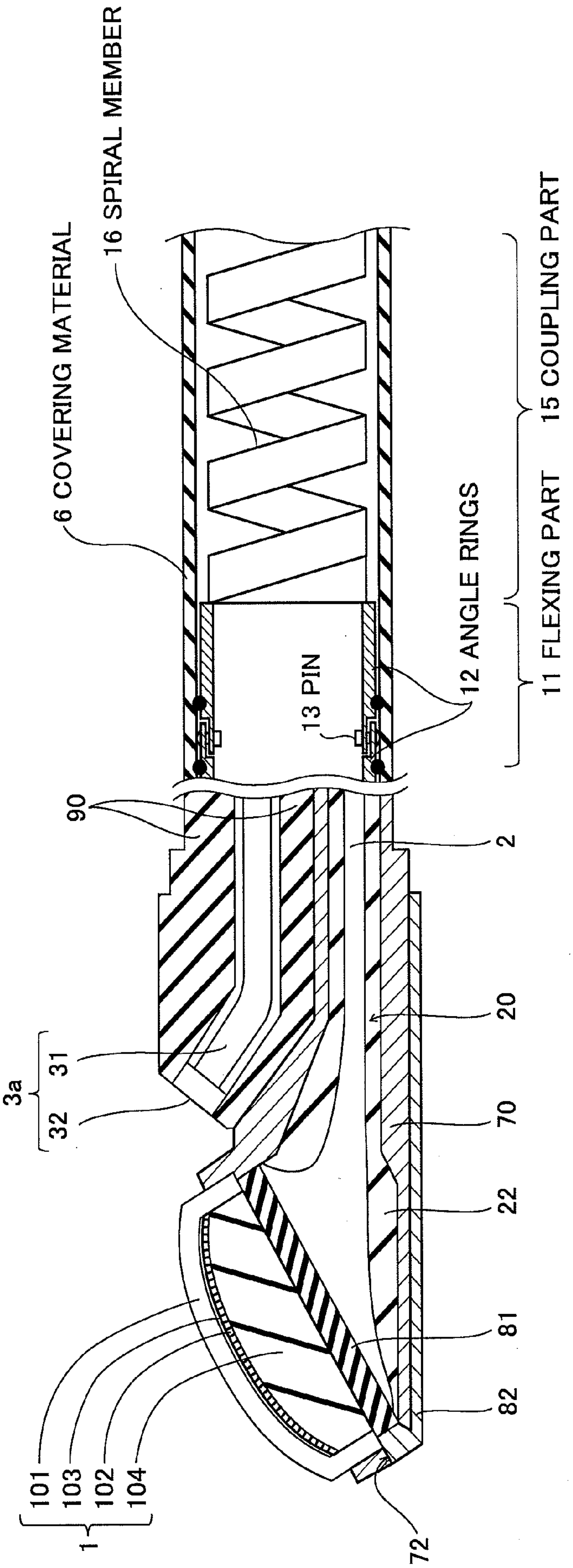
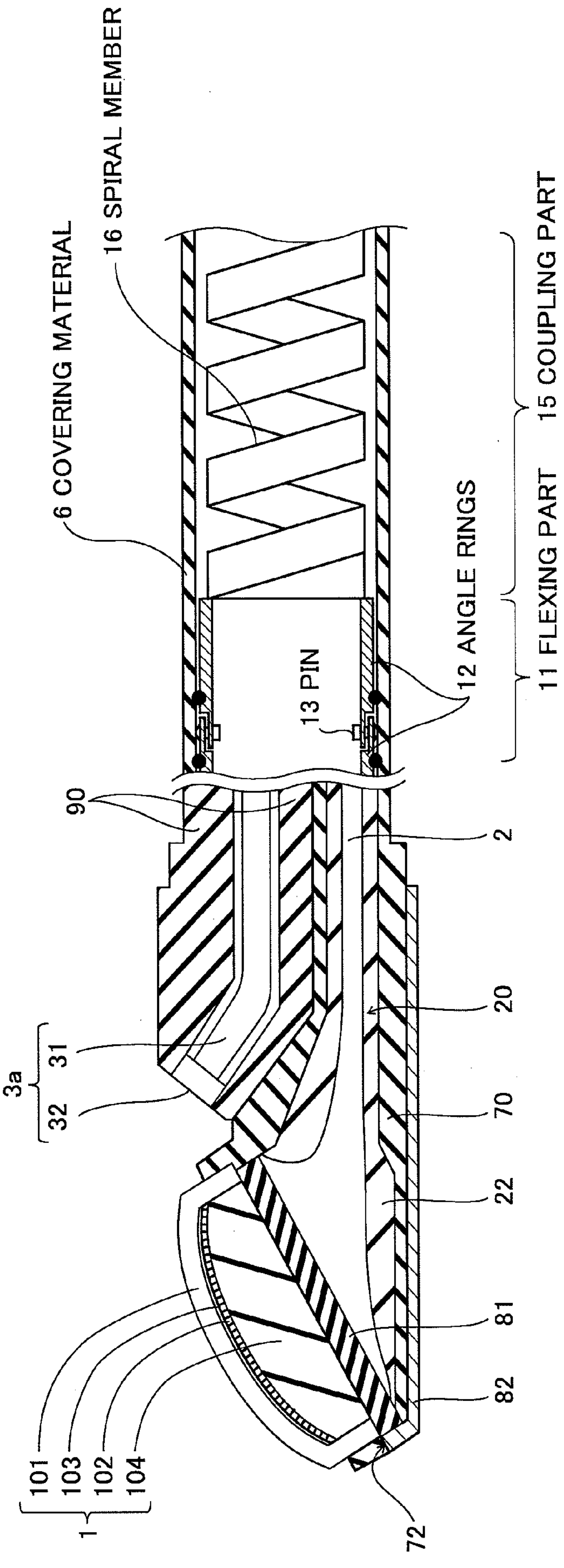

6 COVERING MATERIAL
16 SPIRAL MEMBER
15 COUPLING PART
11 FLEXING PART
12 ANGLE RINGS
13 PIN
90
2
20
70
22
81
82
72
3a
31
32
1
101
103
102
104

FIG. 7



16 SPIRAL MEMBER
6 COVERING MATERIAL
15 COUPLING PART
11 FLEXING PART
12 ANGLE RINGS
13 PIN
90
2
20
70
22
81
82
72
3a
31
32
1
101
103
102
104

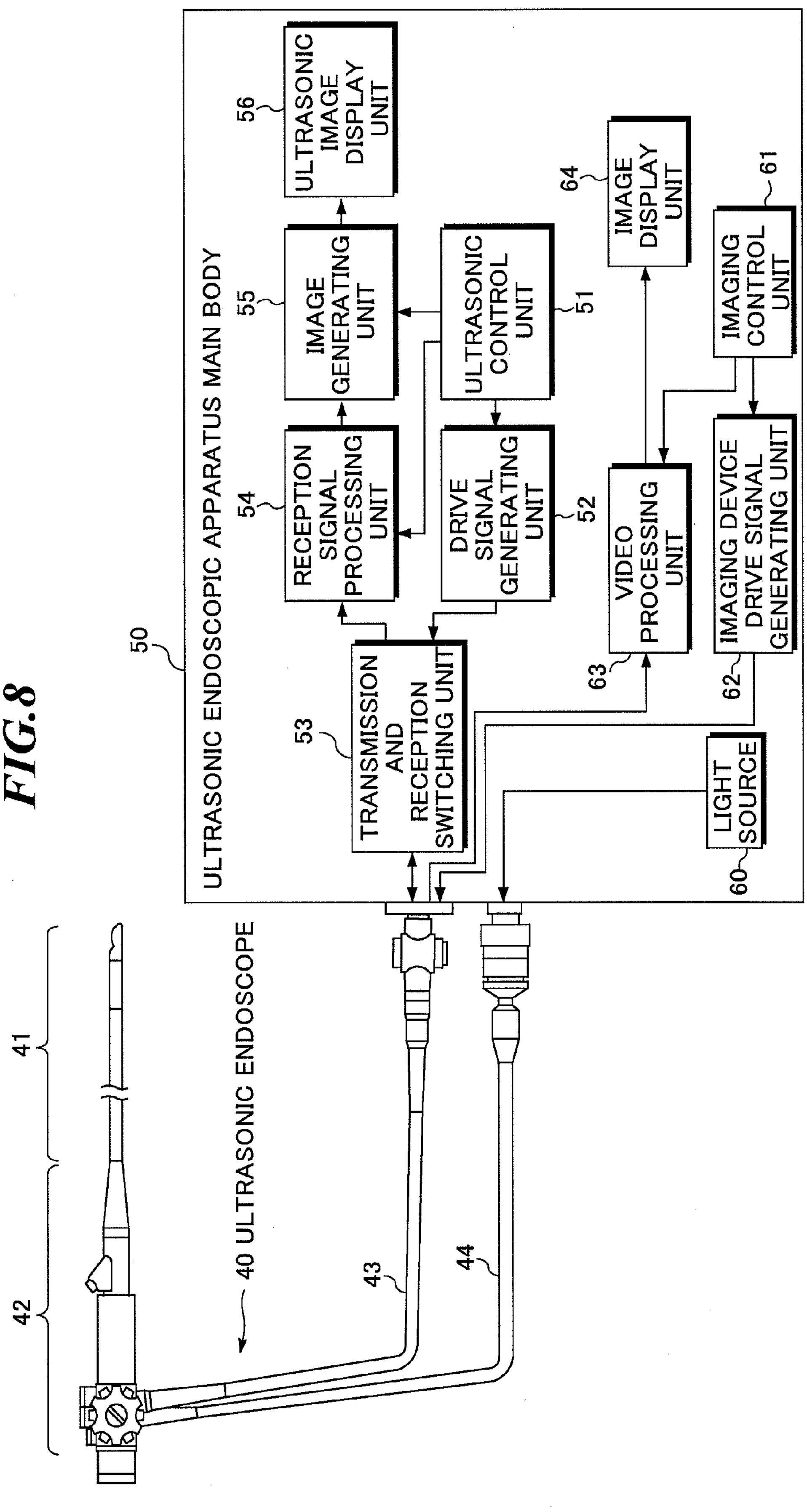

50
ULTRASONIC ENDOSCOPIC APPARATUS MAIN BODY
56
ULTRASONIC IMAGE DISPLAY UNIT
55
IMAGE GENERATING UNIT
54
RECEPTION SIGNAL PROCESSING UNIT
51
ULTRASONIC CONTROL UNIT
52
DRIVE SIGNAL GENERATING UNIT
53
TRANSMISSION AND RECEPTION SWITCHING UNIT
64
IMAGE DISPLAY UNIT
63
VIDEO PROCESSING UNIT
61
IMAGING CONTROL UNIT
62
IMAGING DEVICE DRIVE SIGNAL GENERATING UNIT
60
LIGHT SOURCE
41
42
40 ULTRASONIC ENDOSCOPE
43
44

FIG.8

ULTRASONIC ENDOSCOPE

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to an ultrasonic endoscope to be used for body cavity examination of upper digestive organs, bronchial tube, and so on.

[0003] 2. Description of a Related Art

[0004] In medical fields, various imaging technologies have been developed in order to observe the interior of an object to be inspected and make diagnoses. Among them, especially, ultrasonic imaging for acquiring interior information of the object by transmitting and receiving ultrasonic waves enables image observation in real time and provides no exposure to radiation unlike other medical image technologies such as X-ray photography or RI (radio isotope) scintillation camera. Accordingly, ultrasonic imaging is utilized as an imaging technology at a high level of safety in a wide range of departments including not only the fetal diagnosis in the obstetrics, but also gynecology, circulatory system, digestive system, etc.

[0005] The ultrasonic imaging is an image generation technology utilizing the nature of ultrasonic waves that the waves are reflected at a boundary between regions with different acoustic impedances (e.g., a boundary between structures) Typically, an ultrasonic diagnostic apparatus using ultrasonic imaging is provided with a body surface ultrasonic probe to be used in contact with the object or an intracavity ultrasonic probe to be used by being inserted into a body cavity of the object. Further, in recent years, an ultrasonic endoscope in combination of an endoscope for optically observing the interior of the object and an ultrasonic probe for intracavity has been used.

[0006] Ultrasonic beams are transmitted toward the object such as a human body and ultrasonic echoes generated in the object are received by using the ultrasonic endoscope, and thereby, ultrasonic image information is acquired. On the basis of the ultrasonic image information, ultrasonic images of structures (e.g., internal organs, diseased tissues, or the like) existing within the object are displayed on a display unit of an ultrasonic endoscopic apparatus main body connected to the ultrasonic endoscope.

[0007] As an ultrasonic transducer for transmitting and receiving ultrasonic waves, a vibrator (piezoelectric vibrator) having electrodes formed on both sides of a material that expresses a piezoelectric property (a piezoelectric material) is generally used. When a voltage is applied to the electrodes of the vibrator, the piezoelectric material expands and contracts due to the piezoelectric effect and generates ultrasonic waves. Accordingly, plural vibrators are one-dimensionally or two-dimensionally arranged and the vibrators are sequentially driven, and thereby, an ultrasonic beam to be transmitted in a desired direction can be formed. Further, the vibrators expand and contract by receiving propagating ultrasonic waves and generate electric signals. These electric signals are used as reception signals of the ultrasonic waves.

[0008] When ultrasonic waves are transmitted, drive signals having great energy are supplied to the ultrasonic transducers. In this regard, not the entire energy of the drive signals is converted into acoustic energy but a significant proportion of the energy becomes heat, and there has been a problem that the temperature rises in use of the ultrasonic endoscope. However, the insertion part of the ultrasonic endoscope is used in direct contact with the living body such as a human body, and a request that the surface temperature of the insertion part of the ultrasonic endoscope is controlled to a predetermined temperature or less has been made for safety reasons of low-temperature burn and so on.

[0009] As a related technology, Japanese Patent Application Publication JP-A-9-140706 discloses a technology of collecting heat generated from a heat source within a probe by using heat collecting means within the probe and guiding the heat collected by the heat collecting means to a location apart from the heat source by using heat transfer means such as a heat pipe. However, the outer diameter of the ultrasonic probe needs to be smaller in the case where the ultrasonic probe is inserted into a human body, while the diameter of the heat transfer means such as a heat pipe needs to be larger for sufficiently high heat transfer coefficient of the heat transfer means. Accordingly, it is difficult to apply the technology of JP-A-9-140706 to an ultrasonic endoscope.

[0010] Japanese Patent Application Publication JP-P2006-204552A discloses a technology of cooling a vibrator part by transferring the heat generated in the vibrator part and a circuit board to a shield case via a heat conducting part, and allowing the heat transferred to the shield case to be absorbed by a heat absorbing part including a refrigerant feeder and a refrigerant pipe. However, the outer diameter of the ultrasonic probe needs to be smaller in the case where the ultrasonic probe is inserted into a human body, and it is difficult to apply the technology of JP-P2006-204552A to an ultrasonic endoscope to be inserted into a human body.

[0011] Japanese Registered Utility Model JP-Z-3061292 discloses that a heat transfer structure is provided in contact with an integrated circuit within an ultrasonic transducer for extracting heat generated there to the outside, and the heat extracted by the heat transfer structure is transferred to a conducting material that functions as a heat sink within a communication cable. However, in an ultrasonic endoscope, the signal cable has a small sectional area, and, if the signal cable is used for heat dissipation, no sufficient heat dissipation effect is obtained due to the small sectional area.

SUMMARY OF THE INVENTION

[0012] The present invention has been achieved in view of the above-mentioned problems. A purpose of the present invention is to provide an ultrasonic endoscope capable of suppressing temperature rise without increase in diameter.

[0013] In order to accomplish the purpose, an ultrasonic endoscope according to one aspect of the present invention includes: an ultrasonic transducer part having plural ultrasonic transducers; an exterior member for holding the ultrasonic transducer part; an opening formed in the exterior member; a heat conducting member arranged inside of the exterior member and connected to the ultrasonic transducer part; and a heat radiating member provided on an outer surface of the exterior member and connected to the heat conducting member via the opening.

[0014] According to the present invention, the heat generated in the ultrasonic transducer part transfers to the heat radiating member provided on the outer surface of the exterior member via the heat conducting member, and released to the outside from the heat radiating member. Thus, since the heat radiating member is provided on the outer surface of the exterior member, the temperature rise of the ultrasonic endoscope can be suppressed without increase in diameter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIG. **1** is a schematic diagram showing an appearance of an ultrasonic endoscope according to the respective embodiments of the present invention;

[0016] FIG. **2** is a perspective view showing a leading end of the ultrasonic endoscope according to the first embodiment;

[0017] FIG. **3** is a sectional view showing a structure of a leading end of an insertion part of the ultrasonic endoscope according to the first embodiment;

[0018] FIG. **4** is a perspective view for explanation of a configuration of an ultrasonic transducer;

[0019] FIG. **5** is a sectional view for explanation of a configuration of an ultrasonic endoscope according to the second embodiment;

[0020] FIG. **6** is a sectional view for explanation of a configuration of an ultrasonic endoscope according to the third embodiment;

[0021] FIG. **7** is a sectional view for explanation of a configuration of an ultrasonic endoscope according to the fourth embodiment; and

[0022] FIG. **8** shows an ultrasonic endoscopic apparatus including the ultrasonic endoscope and an ultrasonic endoscopic apparatus main body according to the respective embodiments of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0023] Hereinafter, embodiments of the present invention will be explained in detail with reference to the drawings. The same reference numbers will be assigned to the same component elements and the description thereof will be omitted.

[0024] FIG. **1** is a schematic diagram showing an appearance of an ultrasonic endoscope according to the respective embodiments of the present invention. As shown in FIG. **1**, an ultrasonic endoscope **40** includes an insertion part **41**, an operation part **42**, a connecting cord **43**, and a universal cord **44**. The insertion part **41** includes an elongated tube formed of a member having flexibility for insertion into the body (e.g., into the bronchial tube) of an object to be inspected, and an ultrasonic transducer part **1** at the leading end thereof.

[0025] The operation part **42** is provided at the base end of the insertion part **41** and connected to an ultrasonic endoscopic apparatus main body (not shown) via the connecting cord **43** and the universal cord **44**. A treatment tool insertion opening **46** provided in the operation part **42** is a hole for leading in a treatment tool such as a punctuation needle or forceps. Various treatments are performed within a body cavity of an object to be inspected by operating it with the operation part **42**.

[0026] FIG. **2** is a perspective view showing the leading end of the insertion part of the ultrasonic endoscope according to the first embodiment of the present invention. FIG. **3** is a sectional view showing a structure of the leading end of the insertion part of the ultrasonic endoscope according to the first embodiment. As shown in the drawings, the leading end of the insertion part of the ultrasonic endoscope according to the embodiment has an ultrasonic transducer part **1** for transmitting and receiving ultrasonic waves, signal lines **2** for transmitting signals between the ultrasonic transducer part **1** and the ultrasonic endoscopic apparatus main body, a light guide part **3***a* for applying light to an affected part, an imaging part **3** (shown in FIG. **2**) for optically imaging the affected part, an exterior member **70** for holding the ultrasonic transducer part **1** and the leading end of the signal lines **2**, an optics holding member **90** attached to the exterior member **70** and for holding the imaging part **3** and the light guide part **3***a*, a flexing part **11** flexible for supporting the exterior member **70** and the optics holding member **90**, a coupling part **15** for coupling the flexing part **11** to the operation part **42** (shown in FIG. **1**) , and a covering material **6** for covering at least the flexing part **11** and the coupling part **15**. The outer diameter of the leading end is ϕ6.9 mm or less, for example. The exterior member **70** and the optics holding member **90** are formed of a resin such as polyetherimide, for example.

[0027] The imaging part **3** has an observation window **3***d* provided in the optics holding member **90**, an objective lens fit in the observation window **3***d*, and an input end of a solid-state image sensor such as a CCD camera or an image guide provided in the imaging position of the objective lens. The light guide part **3***a* has an illumination window **32** provided in the optics holding member **90** and an optical fiber **31** for outputting light from the illumination window **32**. An illumination lens is fit in the illumination window **32**.

[0028] The flexing part **11** is configured by arranging points of support for bending of plural top-like angle rings **12** with displacement of 90° with respect to each other in a staggered manner. The top-like angle rings **12** are connected to one another so as to be relatively displaced by pins **13** and form a hinge structure. The coupling part **15** includes a spiral member **16**. The spiral member **16** is generally formed of stainless steel, for example. The covering material **6** is formed of an electrically insulating material of fluorine-containing rubber, for example.

[0029] The ultrasonic transducer part **1** is a convex-type multirow array, for example, and has plural ultrasonic transducers **102** provided on the upper face of a backing material **104**, and an acoustic lens **101** covering the plural ultrasonic transducers **102**, for example. One or some acoustic matching layers **103** are provided between the acoustic lens **101** and the ultrasonic transducers **102**.

[0030] The acoustic matching layer **103** is formed of Pyrex (registered trademark) glass or an epoxy resin containing metal powder, which easily propagates ultrasonic waves for providing matching of acoustic impedances between the object as a living body and the ultrasonic transducers **102**. Thereby, the ultrasonic waves transmitted from the ultrasonic transducers **102** efficiently propagate within the object.

[0031] The acoustic lens **101** is exposed from the upper surface of the exterior member **70**, and formed of silicone rubber, for example. The acoustic lens **101** focuses an ultrasonic beam transmitted from the ultrasonic transducers **102** and propagating through the acoustic matching layer **103** at a predetermined depth within the object.

[0032] The backing material **104** is formed of an elastomer such as rubber, for example, or may include mixture of a base material formed of an elastomer and a filler having higher heat conductivity than the base material. In this case, as the filler, ferrite, tungsten, alumina, or the like is used. The ultrasonic transducer part **1** is housed within the exterior member **70** with the acoustic lens **101** exposed. Since the ultrasonic waves generated by the ultrasonic transducers **102** are also applied to the backing material **104**, heat is generated from the backing material **104**.

[0033] A heat conducting member **81** is connected to the back face of the backing material **104**. The heat conducting member **81** is a plate-like member, for example, and provided along a direction intersecting the side surface of the exterior member **70**, for example, diagonally provided relative to the inner surface of the exterior member **70**. The thickness of the heat conducting member **81** is, for example, from 30 μm to 1 mm, especially preferably, from 500 μm to 700 μm. It is preferable that the heat conducting member **81** is connected to the entire surface of the back face of the backing material **104**, but may be connected to a part (e.g., more than a half of the back face) thereof. The heat conducting member **81** includes an electrically insulating material having a coefficient of thermal conductivity equal to or more than 10 W/(m·K) such as aluminumnitride (AlN), for example. A part, for example, a side surface of the heat conducting member **81** faces an opening **72** formed in the exterior member **70**. The opening **72** is formed from the rear surface of the exterior member **70** to the side lower part (e.g., the lower half part). The heat conducting member **81** and the backing material **104** are connected via an adhesive having high thermal conductivity, for example.

[0034] A heat radiating member **82** is attached to the outer surface of the side of the exterior member **70**. The heat radiating member **82** is a plate-like member along the outer surface of the exterior member **70**, and formed of a material having a coefficient of thermal conductivity equal to or more than 10 W/(m·K), for example, stainless steel (e.g., SUS 304). The heat radiating member **82** may be thin, and its thickness is from 0.1 mm to 0.2 mm, for example. The heat radiating member **82** covers the opening **72** formed on the side surface of the exterior member **70** to seal it, and a part of the heat radiating member enters the opening **72**. The part is connected to the heat conducting member **81**. The heat conducting member **81** and the heat radiating member **82** are connected to each other via an adhesive having high thermal conductivity, for example. The end face of the part entering the opening **72** of the exterior member **70** is flush with the inner surface of the exterior member **70**, for example. The heat radiating member **82** is provided from the rear surface of the exterior member **70** to the side lower part (e.g., the lower half part), for example, but may be provided on the entire surface of the side. In the former case, the area of the part where the ultrasonic transducers **102** are provided can be made larger. According to a simulation, when the coefficient of thermal conductivity of the heat conducting member **81** is 10 W/mK in the embodiment, for example, the temperature rise of the surface of the acoustic lens **101** can be reduced by 25% compared to the case without the heat conducting member **81** or the heat radiating member **82**.

[0035] The signal lines **2** include plural shield lines connected to the plural ultrasonic transducers **102**, respectively, for example. The signal lines **2** pass through a signal line holding part **20**. The leading end of the signal line holding part **20** is connected to the heat conducting member **81** and a part of the signal line holding part **20** is in contact with the exterior member **70**. The interior of the signal line holding part **20** is filled with a heat conducting filling material **22**. The heat conducting filling material **22** has a coefficient of thermal conductivity equal to or more than 2 W/(m·K) and an electrically insulation property such as a silicone rubber adhesive KE-3467, KE-1867, or KE-32-2152 manufactured by Shin-Etsu Chemical Co., Ltd., for example. The coefficient of thermal conductivity of the heat conducting filling material **22** is more preferably equal to or more than 10 W/(m·K).

[0036] In the above-mentioned configuration, the heat generated in the ultrasonic transducers **102** transfers to the heat conducting member **81** via the backing material **104**, and the heat generated in the backing material **104** transfers to the heat conducting member **81**. The heat that has transferred to the heat conducting member **81** transfers to the heat radiating member **82** via the part entering the opening **72** and released to the outside from the heat radiating member **82**. Therefore, the heat staying inside the exterior member **70** is suppressed, and consequently, the temperature rise at the leading end of the insertion part of the ultrasonic endoscope **40** can be suppressed. When a filler having high heat conductivity is mixed in the backing material **104**, the effect becomes especially great. Further, since the heat conducting member **81** is formed of an electrically insulating material, the insulation of the ultrasonic transducer part **1** from the heat radiating member **82** can be ensured.

[0037] Further, it is not necessary to increase the diameter of the leading end of the insertion part of the ultrasonic endoscope **40** for providing the heat conducting member **81**, and the heat radiating member **82** may be thin. Therefore, the diameter of the leading end of the insertion part of the ultrasonic endoscope **40** is not increased.

[0038] Furthermore, since the signal line holding part **20** is filled with the heat conducting filling material **22**, the heat generated in the ultrasonic transducers **102** also transfers to the heat conducting filling material **22** via the backing material **104**, and further released to the other part (e.g., the exterior member **70**) via the heat conducting filling material **22**. Therefore, the temperature rise at the leading end of the insertion part of the ultrasonic endoscope **40** can be further suppressed.

[0039] FIG. **4** is a perspective view for explanation of the configuration of the ultrasonic transducer **102**. The ultrasonic transducer **102** includes plural piezoelectric material layers **102*d*** formed of PZT or the like, a lower electrode layer **102*e***, internal electrode layers **102*f*** and **102*g*** alternately inserted between the plural piezoelectric material layers **102*d***, an upper electrode layer **102*h***, electrically insulating films **102*i***, and side electrodes **102*j*** and **102*k***.

[0040] The lower electrode layer **102*e*** is connected to the side electrode **102*k*** at the right side in the drawing and electrically insulated from the side electrode **102*j*** at the left side in the drawing. The upper electrode layer **102*h*** is connected to the side electrode **102*j*** and electrically insulated from the side electrode **102*k***. Further, the internal electrode layer **102*f*** is connected to the side electrode **102*j*** and electrically insulated from the side electrode **102*k*** by the electrically insulating film **102*i***. On the other hand, the internal electrode layer **102*g*** is connected to the side electrode **102*k*** and electrically insulated from the side electrode **102*j*** by the electrically insulating film **102*i***. The plural electrodes of the ultrasonic transducer **102** are formed in this fashion, three pairs of electrodes for applying electric fields to the three layers of piezoelectric material layers **102*d*** are connected in parallel. The number of piezoelectric material layers is not limited to three, but may be two or four or more.

[0041] In the multilayered ultrasonic transducer **102**, the area of electrodes in contact with the piezoelectric material layers **102*d*** is larger than that of a single-layered element, and the electric impedance is lower. Therefore, the multilayered ultrasonic transducer has increased vibration output and operates more efficiently for the applied voltage than the single-layered piezoelectric vibrator having the same size. Specifically, given that the number of piezoelectric material layers **102***d* is N, the number of the piezoelectric material layers is N-times the number of the single-layered piezoelectric vibrator and the thickness of each piezoelectric material layer is 1/N of that of the single-layered piezoelectric vibrator, and the electric impedance of the ultrasonic transducer **102** is $1/N^2$-times. Therefore, the electric impedance of ultrasonic transducer **102** can be adjusted by increasing or decreasing the number of stacked piezoelectric material layers **102***d*, and thus, the electric impedance matching between a drive circuit or preamplifier and itself is easily provided, and the sensitivity can be improved.

[0042] On the other hand, the capacitance is increased due to the stacked form of the ultrasonic transducer **102**, and the amount of heat generated from the ultrasonic transducer **102** becomes larger. However, since the heat conducting member **81** and the heat radiating member **82** are provided in the embodiment, the heat generated in the ultrasonic transducers **102** is efficiently released to the outside, and consequently, the temperature rise at the leading end of the insertion part of the ultrasonic endoscope **40** can be suppressed.

[0043] As described above, according to the first embodiment of the present invention, the heat generated in the ultrasonic transducers **102** transfers to the heat conducting member **81** via the backing material **104**. The heat that has transferred to the heat conducting member **81** transfers to the heat radiating member **82** attached to the outer surface of the side of the exterior member **70** via the part entering the opening **72** and is released to the outside from the heat radiating member **82**. Thus, since the heat radiating member **82** is attached to the outer surface of the exterior member **70**, the temperature rise at the leading end of the insertion part of the ultrasonic endoscope **40** can be suppressed even when the diameter of the insertion part is small. Further, since the conducting member **81** is provided along the direction intersecting the side surface of the exterior member **70**, if the sectional area of the heat conducting member **81** is increased for raising the heat conduction efficiency of the heat conducting member **81**, the diameter of the insertion part of the ultrasonic endoscope **40** is not increased. Furthermore, the heat conducting member **81** is formed of an electrically insulating material, the insulation of the heat radiating member **82** located on the outer surface of the exterior member **70** from the ultrasonic transducer part **1** can be ensured.

[0044] FIG. **5** is a sectional view for explanation of a configuration of an ultrasonic endoscope according to the second embodiment of the present invention, and corresponds to FIG. **3** in the first embodiment. The ultrasonic endoscope according to the embodiment has the same configuration as that of the ultrasonic endoscope according to the first embodiment except that the heat conducting member **81** is formed of a conducting material (e.g., stainless steel such as SUS 304) and the heat radiating member **82** is formed of an electrically insulating material. Each of the heat conducting member **81** and the heat radiating member **82** preferably has a coefficient of thermal conductivity equal to or more than 10 W/(m·K).

[0045] Also according to the embodiment, the temperature rise at the leading end of the insertion part of the ultrasonic endoscope **40** can be suppressed as is the case of the first embodiment, and the increase in the diameter of the leading end of the ultrasonic endoscope **40** can be suppressed. Further, since the heat radiating member **82** is formed of an electrically insulating material, the insulation of the heat radiating member **82** located on the outer surface of the exterior member **70** from the ultrasonic transducer part **1** can be ensured as is the case of the first embodiment.

[0046] FIG. **6** is a sectional view for explanation of a configuration of an ultrasonic endoscope according to the third embodiment of the present invention, and corresponds to FIG. **3** in the first embodiment. The ultrasonic endoscope according to the embodiment has the same configuration as that of the ultrasonic endoscope according to the first embodiment except that the exterior member **70** is formed of a material having high heat conductivity (e.g., stainless steel such as SUS 304). In the embodiment, the exterior member **70** preferably has a coefficient of thermal conductivity equal to or more than 10 W/(m·K). According to a simulation, when the coefficient of thermal conductivity of the exterior member **70** is 10 W/mK in the embodiment, for example, the temperature rise of the surface of the acoustic lens **101** can be reduced by 15% compared to the case of the first embodiment. In FIG. **6**, the exterior member **70** is formed of a conducting material, however, a resin having high heat conductivity may be used.

[0047] Also according to the embodiment, the same effect as that of the first embodiment can be obtained. Further, the heat that has transferred via the heat conducting member **81** can be released from the exterior member **70**. Therefore, the temperature rise at the leading end of the insertion part of the ultrasonic endoscope **40** can be further suppressed.

[0048] FIG. **7** is a sectional view for explanation of a configuration of an ultrasonic endoscope according to the fourth embodiment of the present invention, and corresponds to FIG. **3** in the first embodiment. The ultrasonic endoscope according to the embodiment has the same configuration as that of the first embodiment except that the heat radiating member **82** does not enter the opening **72** and the end of the heat conducting member **81** enters the opening **72** and is connected to the heat radiating member **82**. Also according to the embodiment, the same effect as that of the first embodiment can be obtained.

[0049] In the above-mentioned respective embodiments, it is not necessary that the ultrasonic transducer **102** has a structure formed by stacking plural piezoelectric material layers, but may have a single piezoelectric material layer. Further, no imaging part **3** or light guide part **3***a* for optical observation of the object may be provided.

[0050] FIG. **8** shows an ultrasonic endoscopic apparatus including the ultrasonic endoscope and the ultrasonic endoscopic apparatus main body according to the respective embodiments of the present invention. The plural ultrasonic transducers contained in the ultrasonic transducer part **1** (FIG. **3**) are electrically connected to the ultrasonic endoscopic apparatus main body **50** by the plural shield lines via the insertion part **41**, the operation part **42**, and the connecting cord **43**. Those shield lines transmit drive signals generated in the ultrasonic endoscopic apparatus main body **50** to the respective ultrasonic transducers and transmit reception signals outputted from the respective ultrasonic transducers to the ultrasonic endoscopic apparatus main body **50**.

[0051] The ultrasonic endoscopic apparatus main body **50** includes an ultrasonic control unit **51**, a drive signal generating unit **52**, a transmission and reception switching unit **53**, a reception signal processing unit **54**, an image generating unit **55**, an ultrasonic image display unit **56**, a light source **60**, an imaging control unit **61**, an imaging device drive signal generating unit **62**, a video processing unit **63**, and an image display unit **64**.

[0052] The ultrasonic control unit **51** controls imaging operation using the ultrasonic transducer part **1**. The drive signal generating unit **52** includes plural drive circuits (pulsers or the like), for example, and generates drive signals to be used for respectively driving the plural ultrasonic transducers. The transmission and reception switching unit **53** switches between the output of the drive signals to the ultrasonic transducer part **1** and the input of the reception signals from the ultrasonic transducer part **1**.

[0053] The reception signal processing unit **54** includes plural preamplifiers, plural A/D converters, a digital signal processing circuit or CPU, for example, and performs predetermined signal processing such as amplification, phase matching and addition, and envelope detection on the reception signals to be outputted from the plural ultrasonic transducers. The image generating unit **55** generates image data representing ultrasonic images based on the reception signals on which the predetermined signal processing has been performed. The ultrasonic image display unit **56** displays ultrasonic images based on the image data generated in this manner.

[0054] The light source **60** emits light to be used for illumination of the object. The light outputted from the light source **60** illuminates the object via the optical fiber **31** (FIG. **3**) of the universal cord **44** through the illumination window **32** (FIG. **3**) of the insertion part **41**. The illuminated object is imaged by the imaging part **3** through the observation window **3***d* (FIG. **2**) of the insertion part **41**, and video signals outputted from the imaging part **3** are inputted to the video processing unit **63** of the ultrasonic endoscopic apparatus main body **50** via the connecting cord **43**.

[0055] The imaging control unit **61** controls imaging operation using the imaging part **3**. The imaging device drive signal generating unit **62** generates drive signals to be supplied to the imaging part **3**. The video processing unit **63** generates image data based on the video signals received from the imaging part **3**. The image display unit **64** receives the image data from the video processing unit **63** and displays images of the object.

1. An ultrasonic endoscope comprising:

an ultrasonic transducer part having plural ultrasonic transducers;

an exterior member for holding said ultrasonic transducer part;

an opening formed in said exterior member;

a heat conducting member arranged inside of said exterior member and connected to said ultrasonic transducer part; and

a heat radiating member provided on an outer surface of said exterior member and connected to said heat conducting member via said opening.

2. The ultrasonic endoscope according to claim **1**, wherein a part of said heat radiating member is located within said opening and connected to said heat conducting member.

3. The ultrasonic endoscope according to claim **1**, wherein a part of said heat radiating member is located within said opening and connected to said exterior member.

4. The ultrasonic endoscope according to claim **1**, wherein said heat radiating member is electrically insulated from said ultrasonic transducer part.

5. The ultrasonic endoscope according to claim **4**, wherein at least one of said heat conducting member and said heat radiating member has an electrical insulation property.

6. The ultrasonic endoscope according to claim **1**, wherein each of said heat conducting member and said heat radiating member has a coefficient of thermal conductivity not less than 10 W/(m·K).

7. The ultrasonic endoscope according to claim **6**, wherein said heat radiating member is formed of stainless steel.

8. The ultrasonic endoscope according to claim **1**, wherein:

said ultrasonic transducer part has a backing material;

said heat conducting member is connected to said backing material; and

said backing material is formed of a material including mixture of an electrically insulating base material and a filler having higher heat conductivity than the base material.

9. The ultrasonic endoscope according to claim **1**, wherein said ultrasonic transducer has plural piezoelectric material layers stacked via electrode layers.

10. The ultrasonic endoscope according to claim **1**, wherein said exterior member has a coefficient of thermal conductivity not less than 10 W/(m·K).

11. The ultrasonic endoscope according to claim **10**, wherein said exterior member is formed of stainless steel.

12. The ultrasonic endoscope according to claim **1**, further comprising:

signal lines connected to said ultrasonic transducer part for transmitting drive signals for said ultrasonic transducers;

a signal line holding part provided within said exterior member for holding said signal lines and having an end connected to said heat conducting member; and

a heat conducting filler filling inside of said signal line holding part.

13. The ultrasonic endoscope according to claim **12**, wherein said heat conducting filler has a coefficient of thermal conductivity not less than 2 W/(m·K).

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专利名称(译)	超声波内窥镜		
公开(公告)号	US20090088647A1	公开(公告)日	2009-04-02
申请号	US12/201538	申请日	2008-08-29
[标]申请(专利权)人(译)	富士胶片株式会社		
申请(专利权)人(译)	富士胶片株式会社		
当前申请(专利权)人(译)	富士胶片株式会社		
[标]发明人	NAGANO KAZUHIKO HYUGA HIROAKI		
发明人	NAGANO, KAZUHIKO HYUGA, HIROAKI		
IPC分类号	A61B8/14		
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外部链接	Espacenet USPTO		

摘要(译)

一种超声波内窥镜，能够在不增加直径的情况下抑制插入部的温度上升。超声波内窥镜包括：超声波换能器部分，具有多个超声波换能器;用于保持超声波换能器部分的外部构件;形成在外部构件中的开口;导热构件，设置在外部构件的内部并连接到超声波换能器部分;散热构件设置在外部构件的外表面上并通过开口连接到导热构件。例如，散热构件的一部分位于开口内，并且该部分连接到导热构件。散热构件与超声换能器部分电绝缘。