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**Shimoyama**

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(54) **BALLOON FOR ULTRASONIC ENDOSCOPE**

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This patent is subject to a terminal disclaimer.

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***A61B 1/00*** (2006.01)
***A61B 8/00*** (2006.01)

(52) **U.S. Cl.**
CPC .......... ***A61B 1/00082*** (2013.01); ***A61B 8/445*** (2013.01); ***A61B 8/4483*** (2013.01); *A61B 8/4281* (2013.01)

(58) **Field of Classification Search**
CPC .............................. A61B 8/12; A61B 1/00082
See application file for complete search history.

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(57) **ABSTRACT**

Provided is a balloon for an ultrasonic endoscope in which an ultrasound oscillator surface of an ultrasound transducer can be most swollen.

A balloon for an ultrasonic endoscope that is mounted to cover an outside surface of an ultrasound transducer provided in a distal end part body on a distal end side of an insertion part includes a bottomed tubular balloon body that has an opening portion provided at one end in a first direction corresponding to a longitudinal direction of the insertion part and attached to the distal end part body, covers an oscillator surface of the ultrasound transducer, and stores an ultrasonic wave transmission medium inside, to be swellable, and a swelling restricting part that, in a case where the ultrasonic wave transmission medium is stored inside the balloon body, makes an oscillator surface region facing the oscillator surface of the ultrasound transducer most swollen by restricting a part of the balloon body.

**8 Claims, 15 Drawing Sheets**

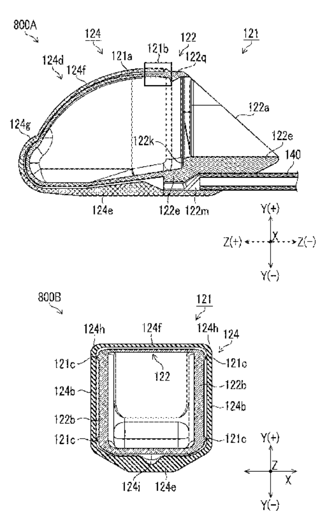

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FIG. 1

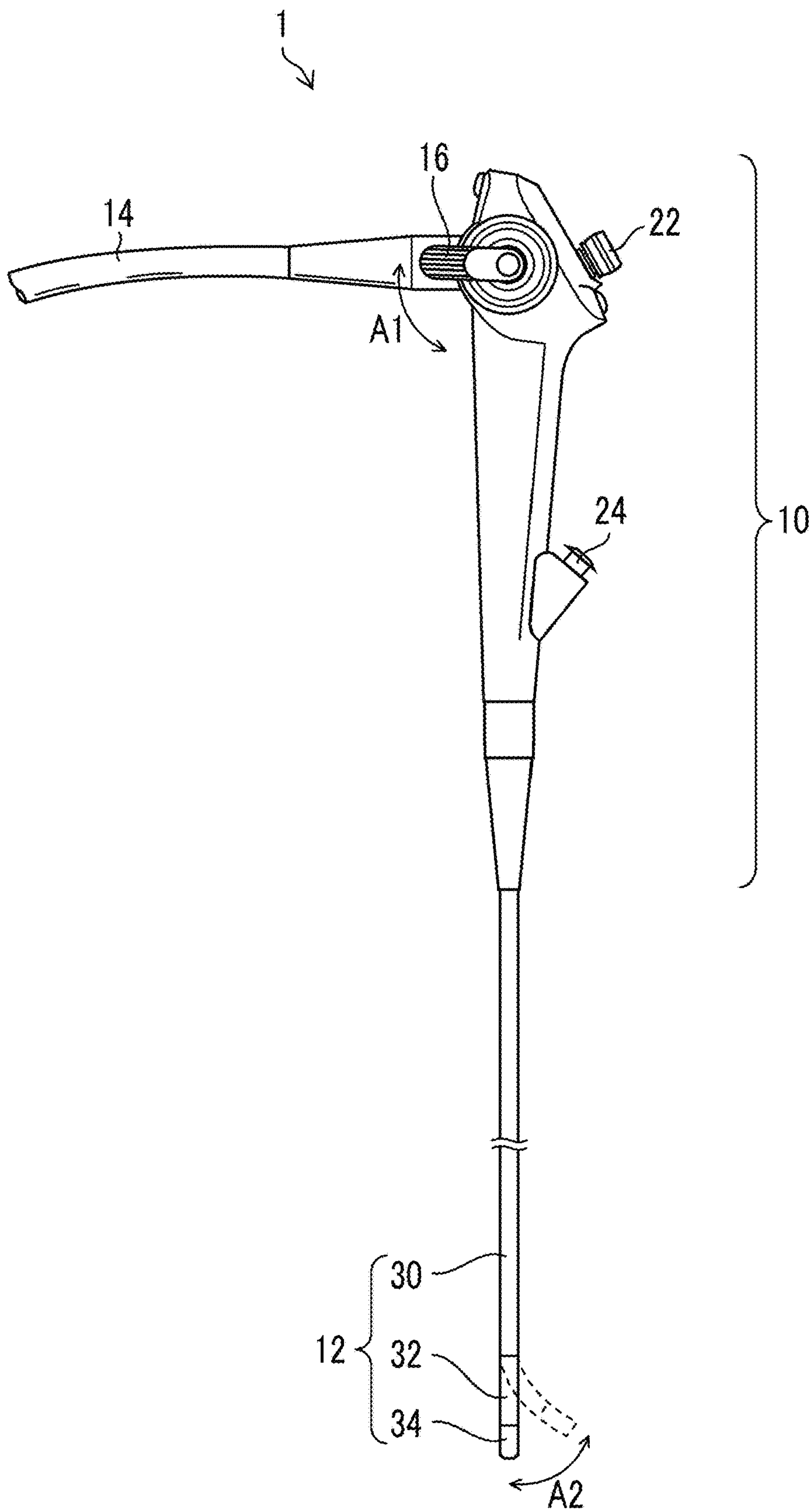
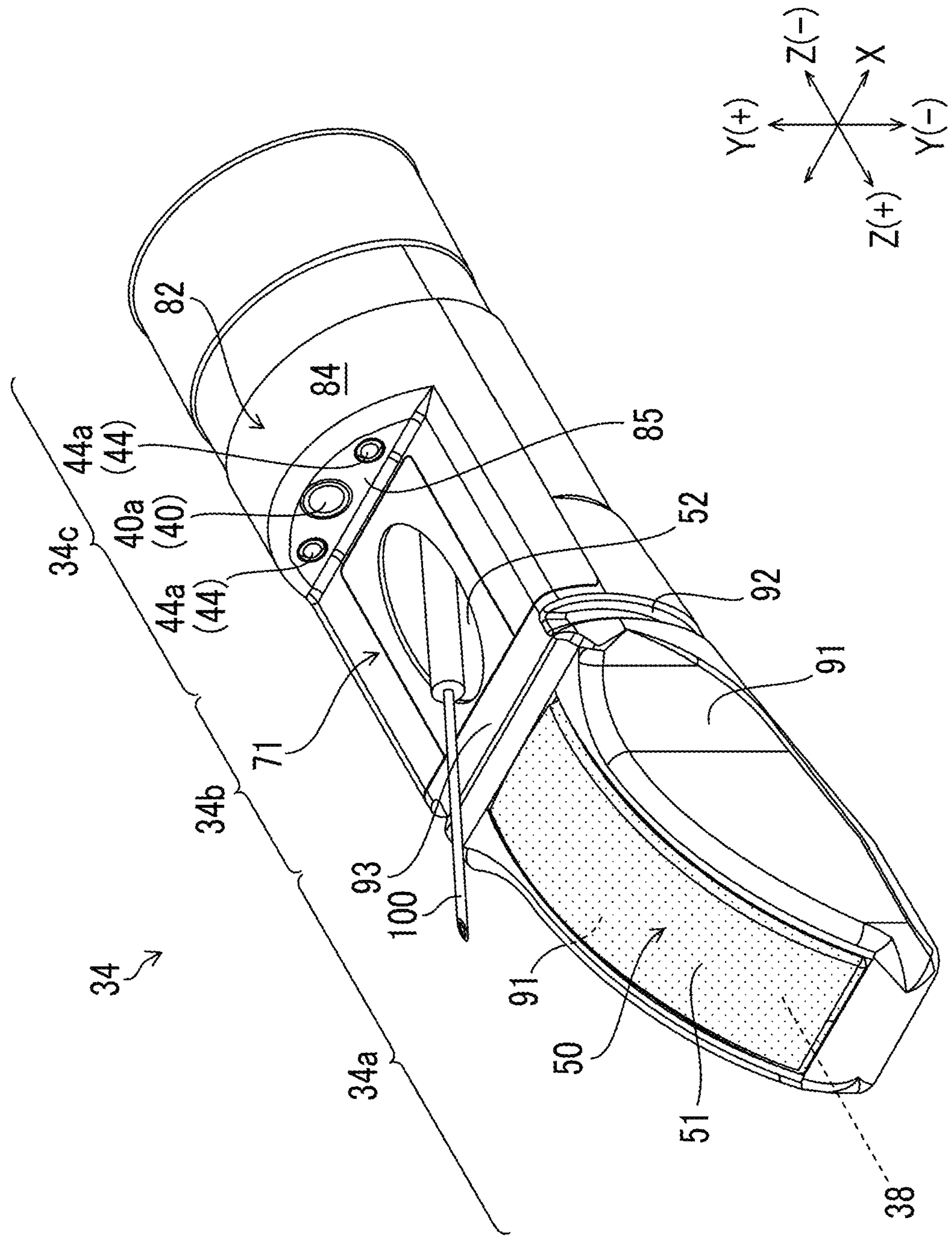


FIG. 2



34
34a
34b
34c
44a (44)
40a (40)
44a (44)
82
84
85
52
92
91
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71
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50
51
38
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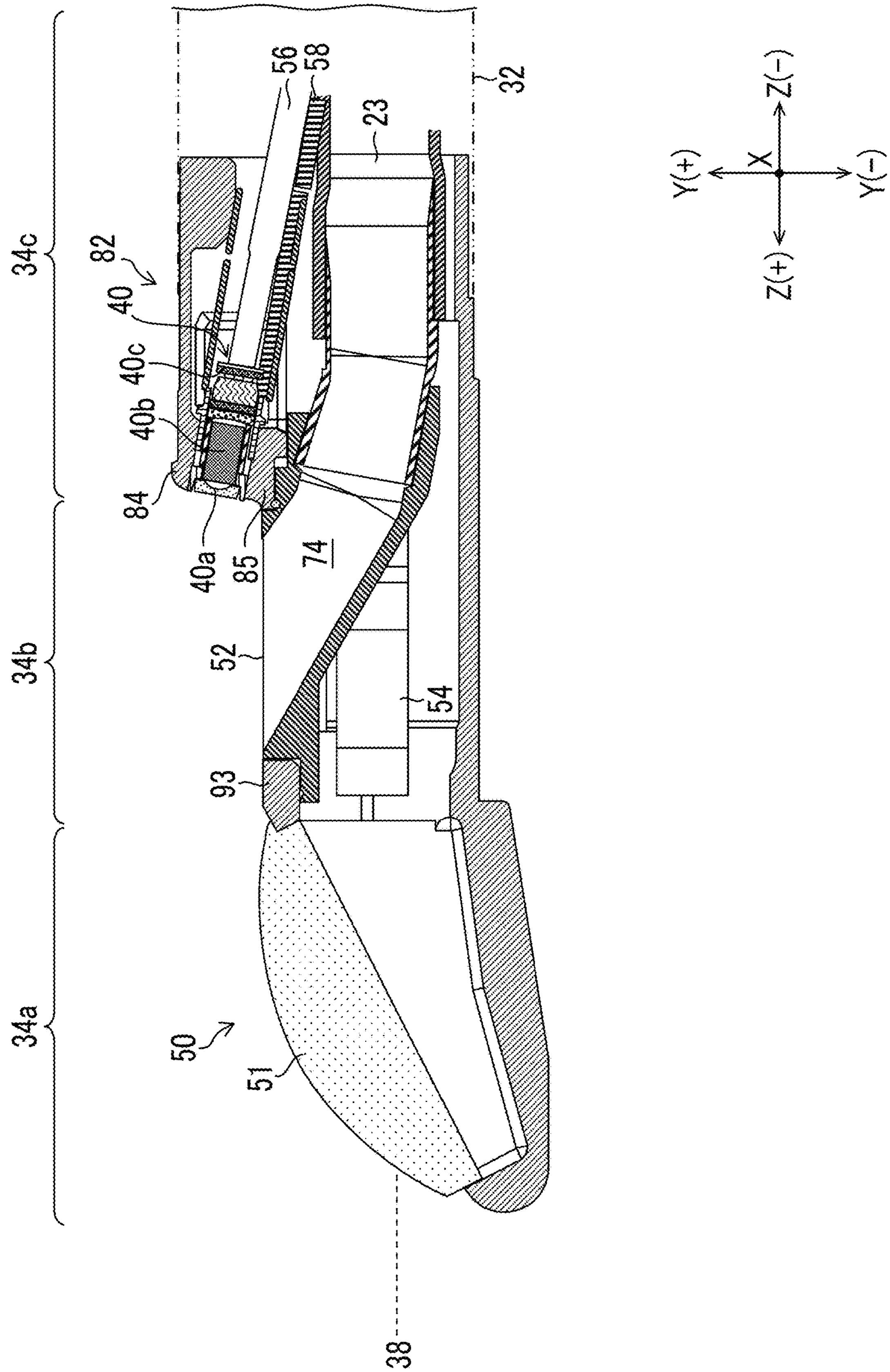
Y(−)
Z(−)
Z(+)
X

FIG. 3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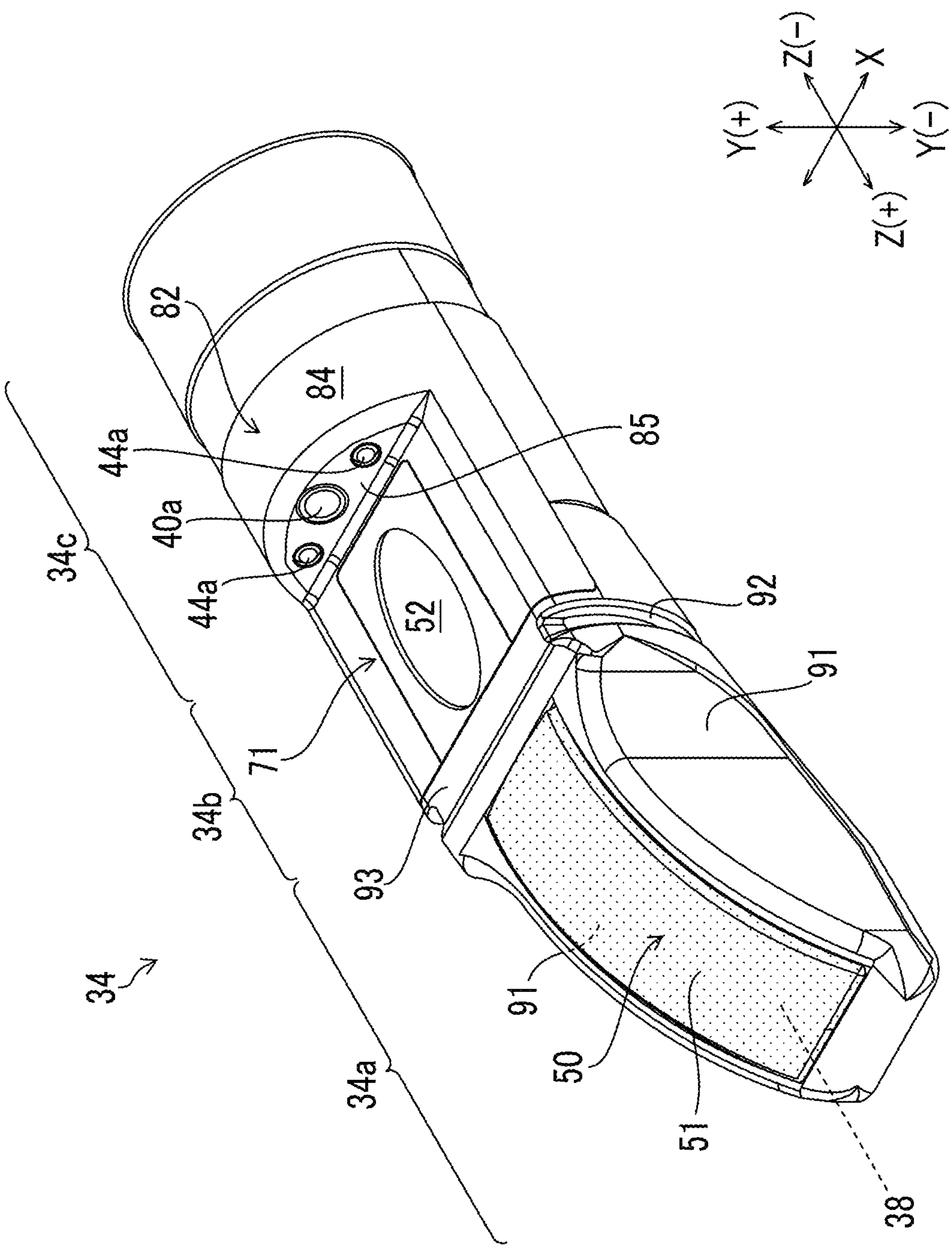
Y(−)
Z(+)

FIG. 4



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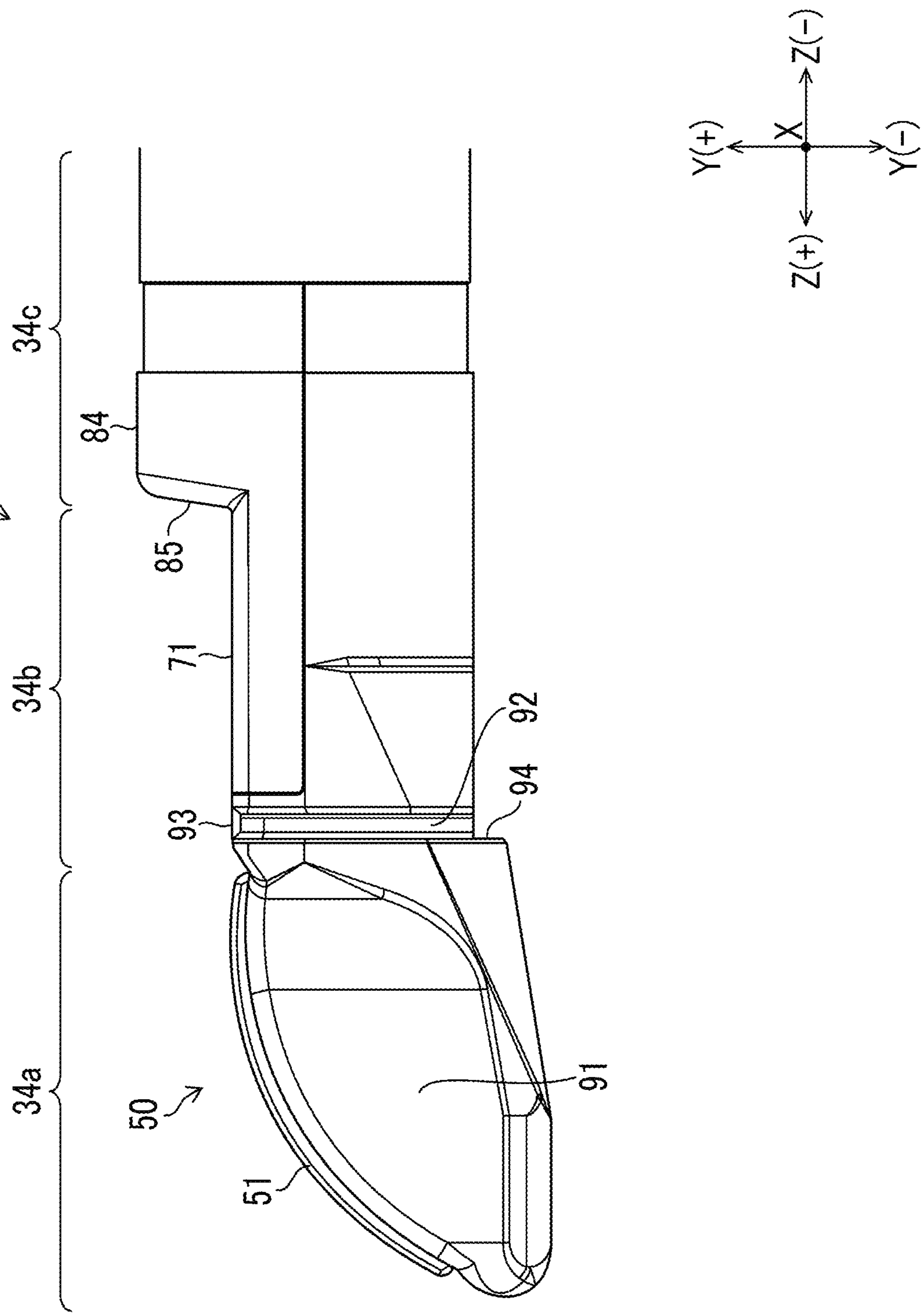

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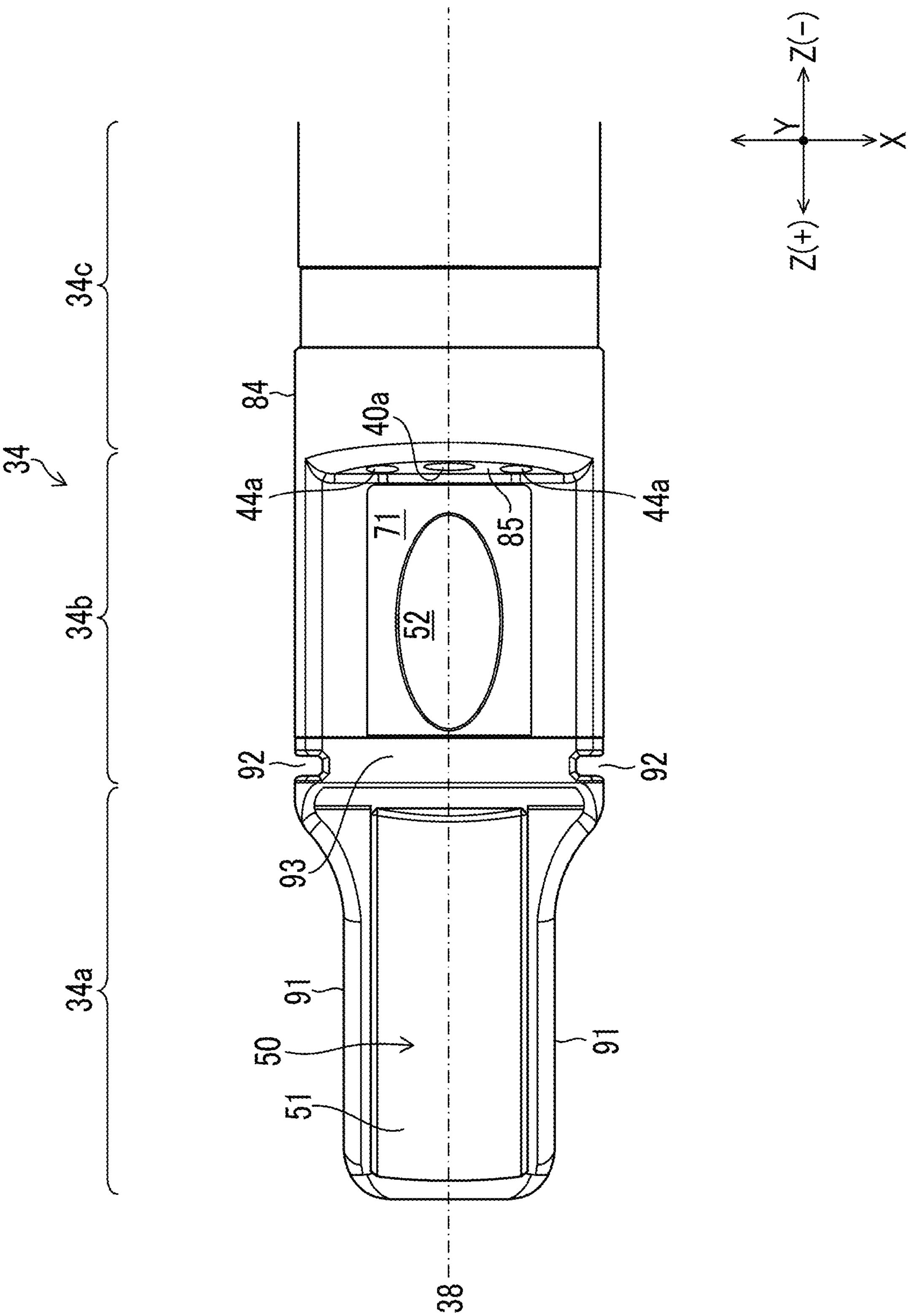

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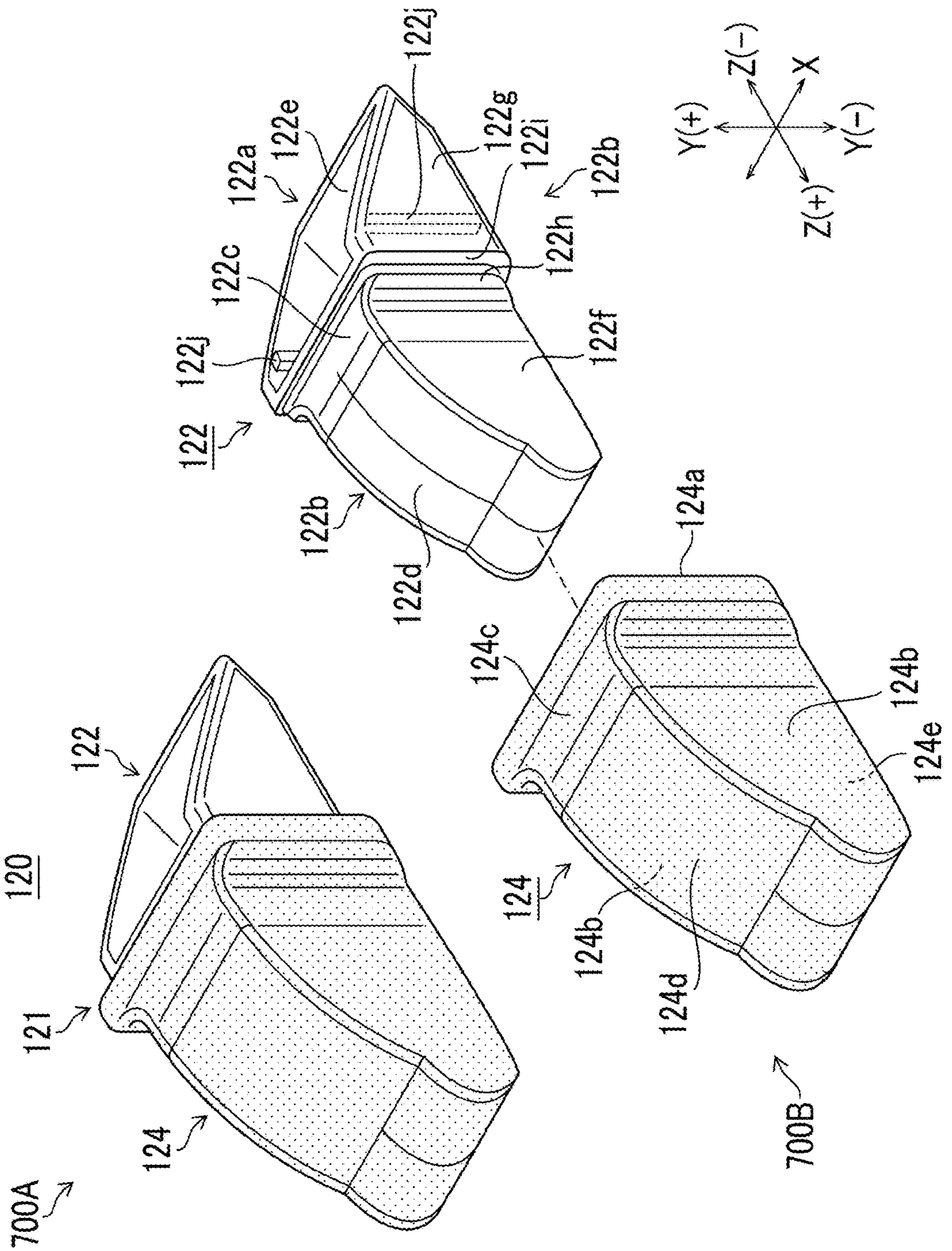
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Y(−)
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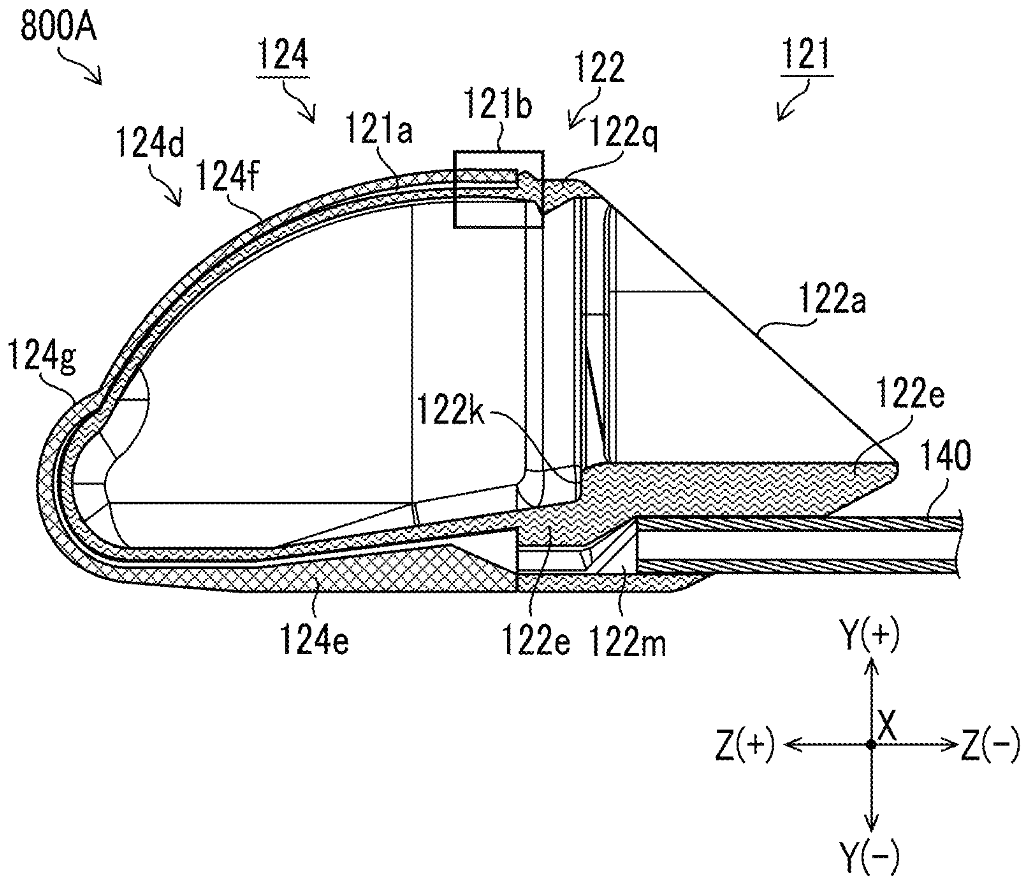
Z(−)

FIG. 8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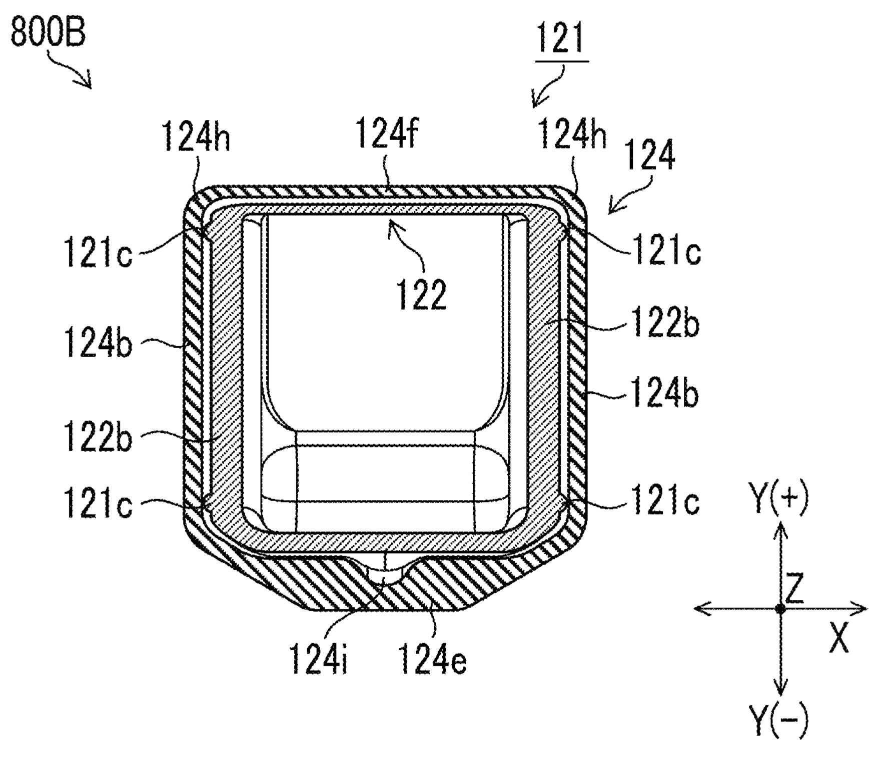
Y(-)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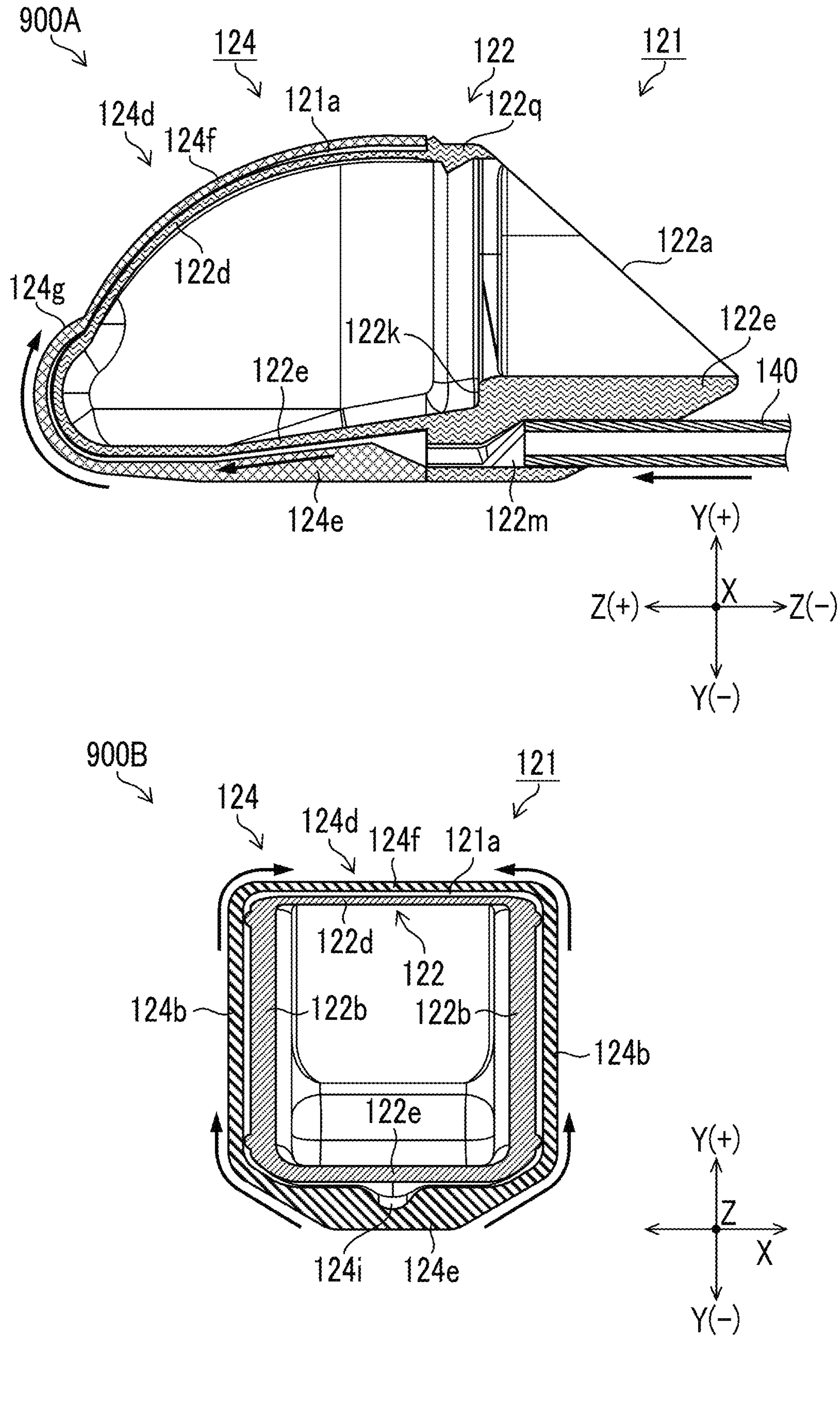
Y(-)

FIG. 9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Y(−)

FIG. 10

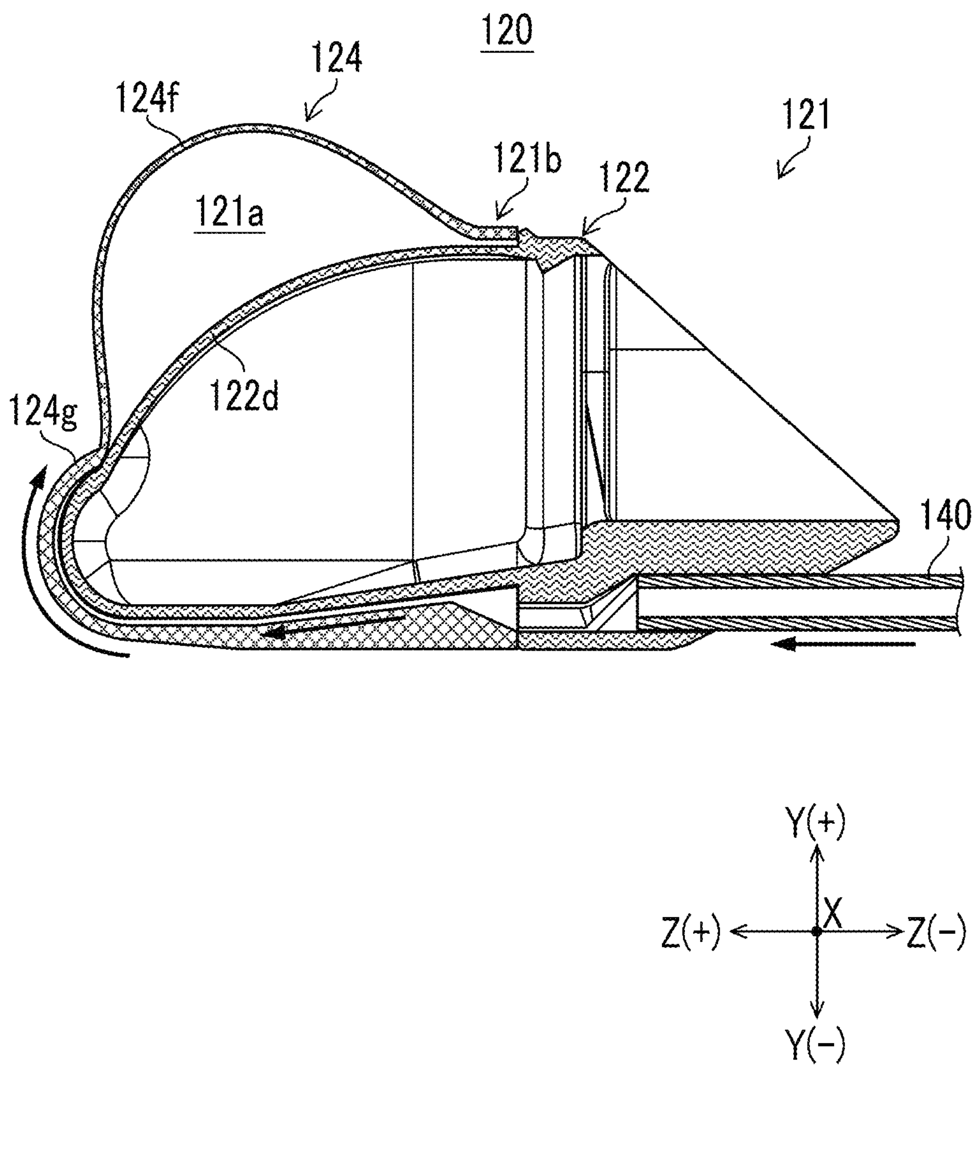
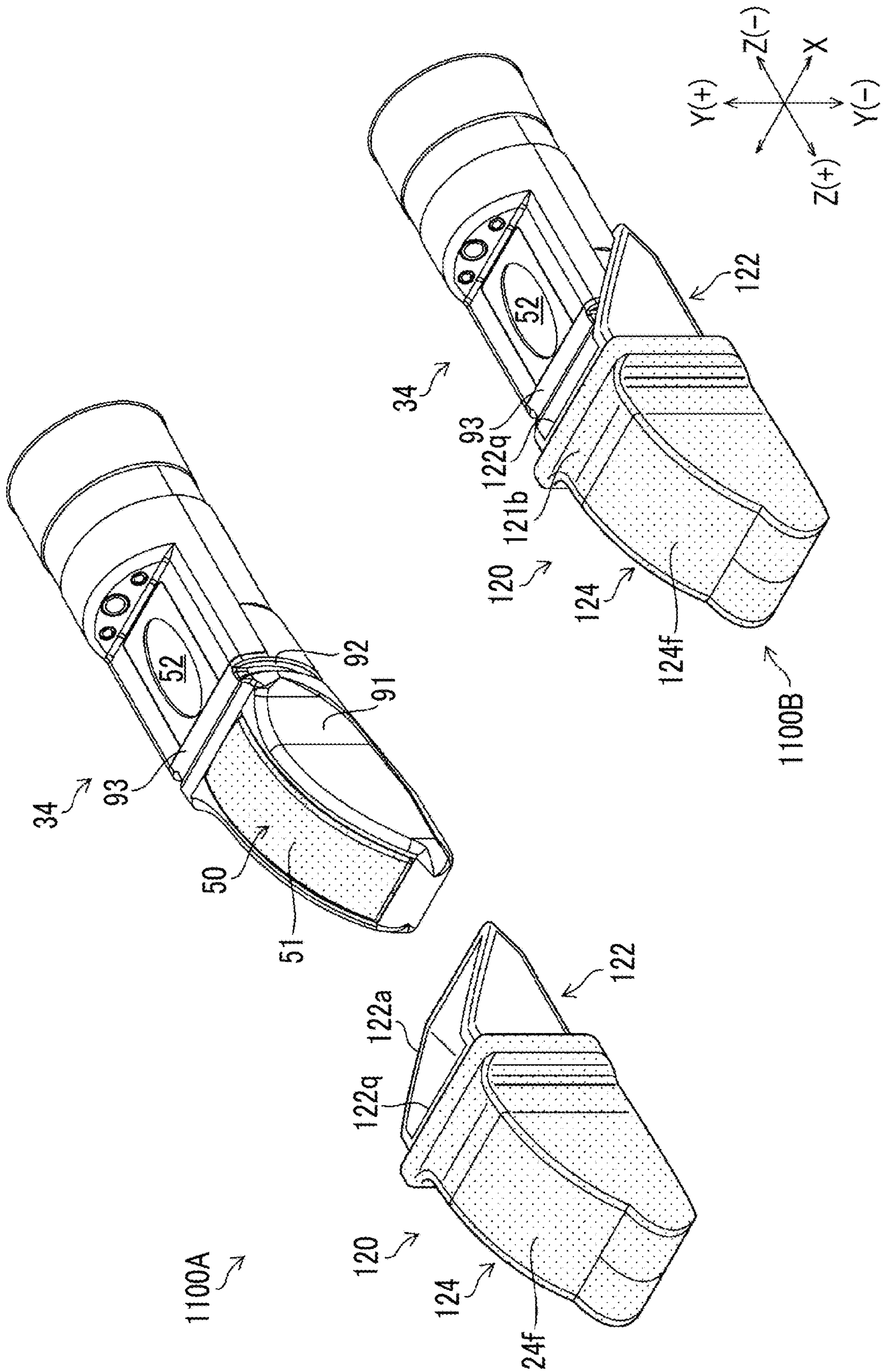


FIG. 11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Y(−)
Z(+)
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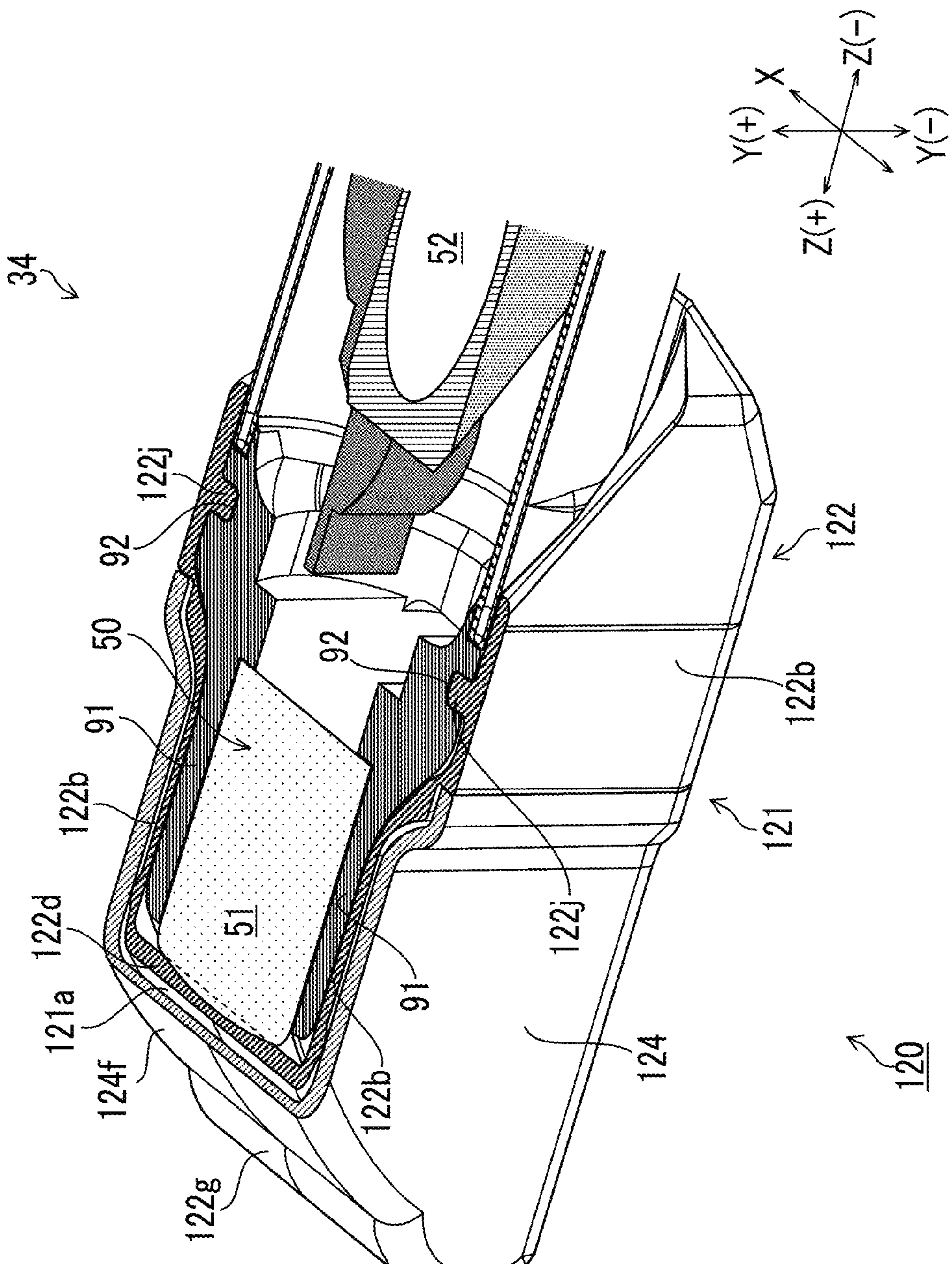
34
93
50
51
122
122a
122q
120
124
124f
1100A

FIG. 12



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122d
121a
124f
122g
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91
122b
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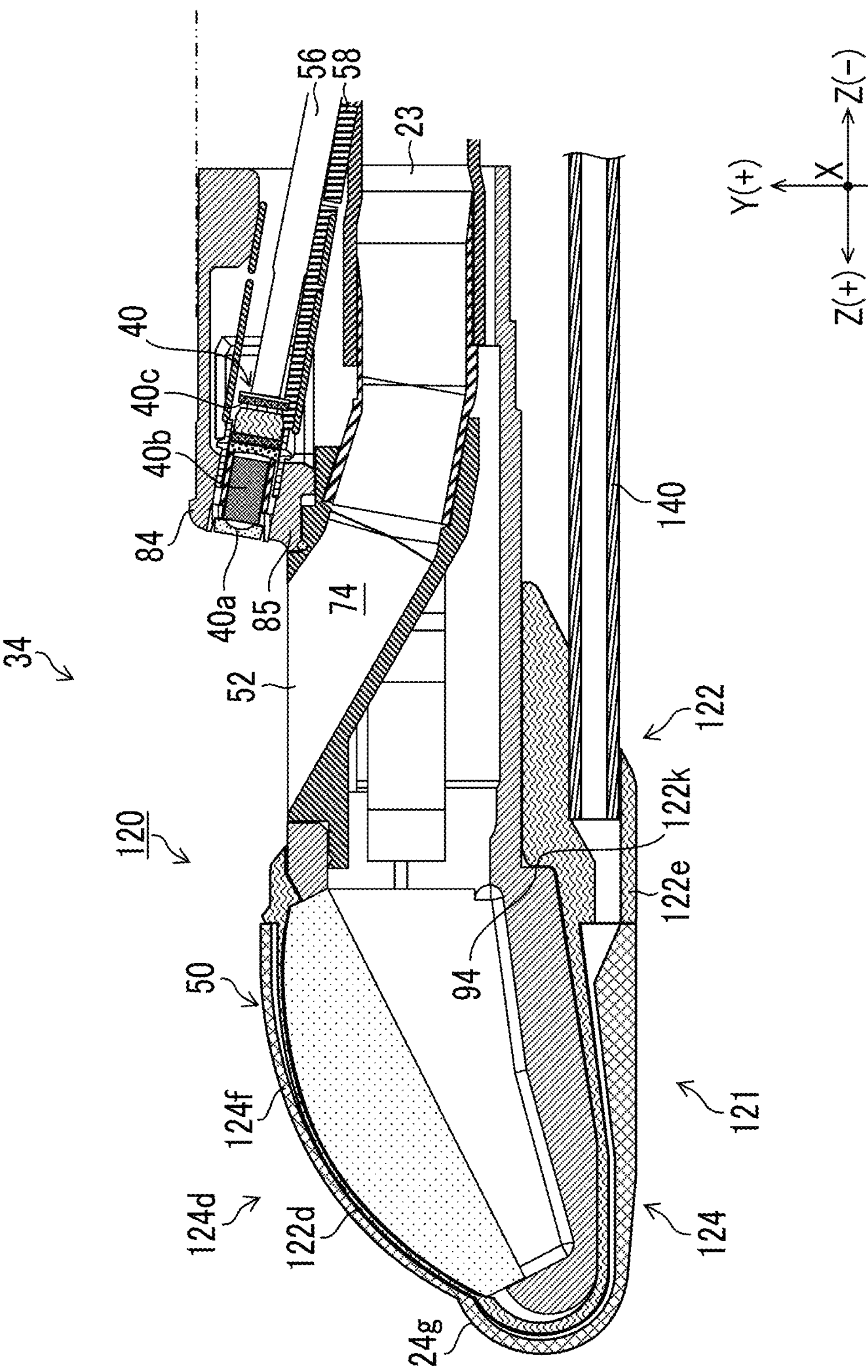
122j
122b
121
122
124
120
X
Z(−)
Y(+)
Y(−)
Z(+)

FIG. 13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122
122k
122e
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50
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124d
122d
124g
124
121
X
Y(+)
Y(−)
Z(+)
Z(−)

FIG. 14

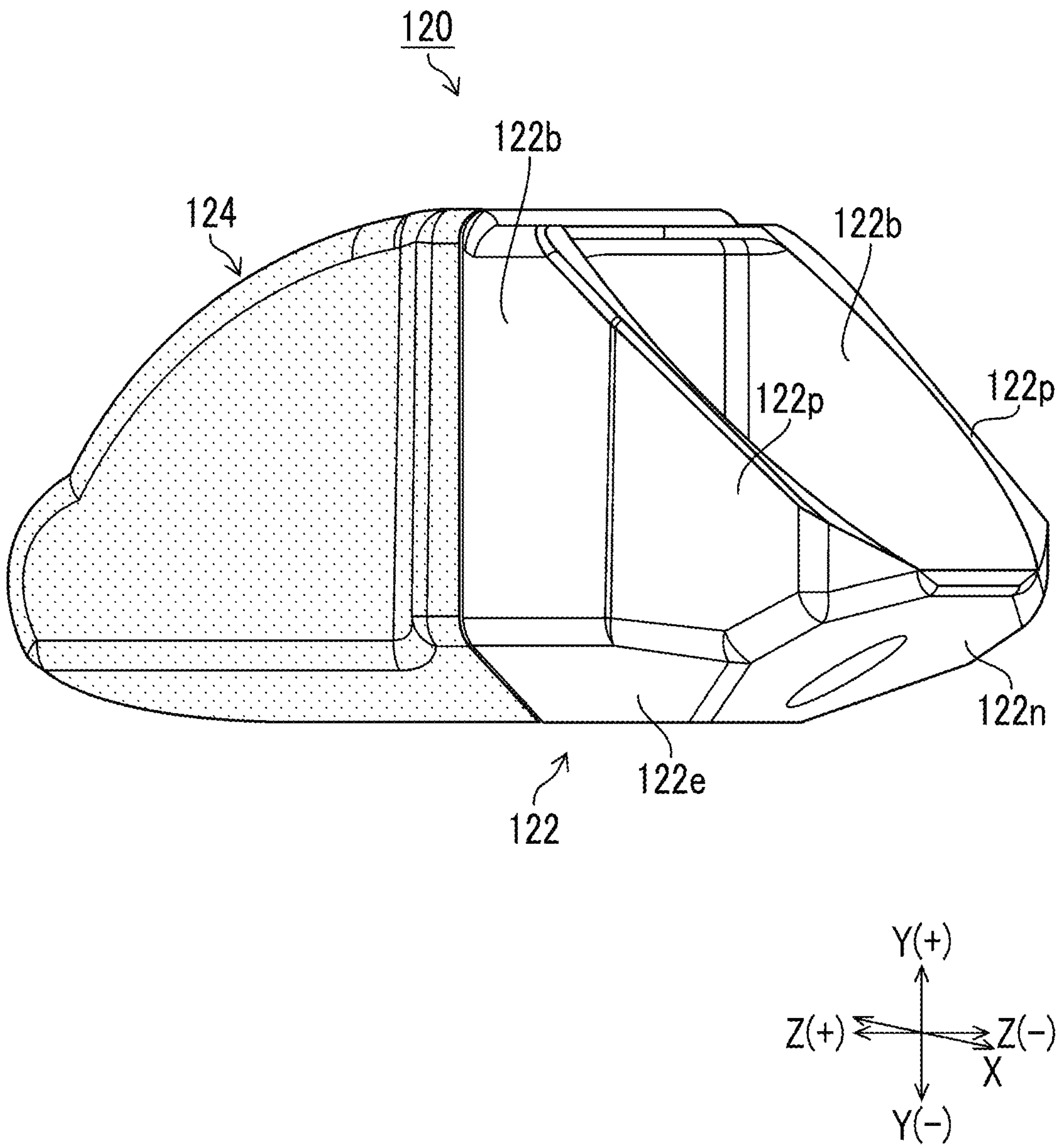
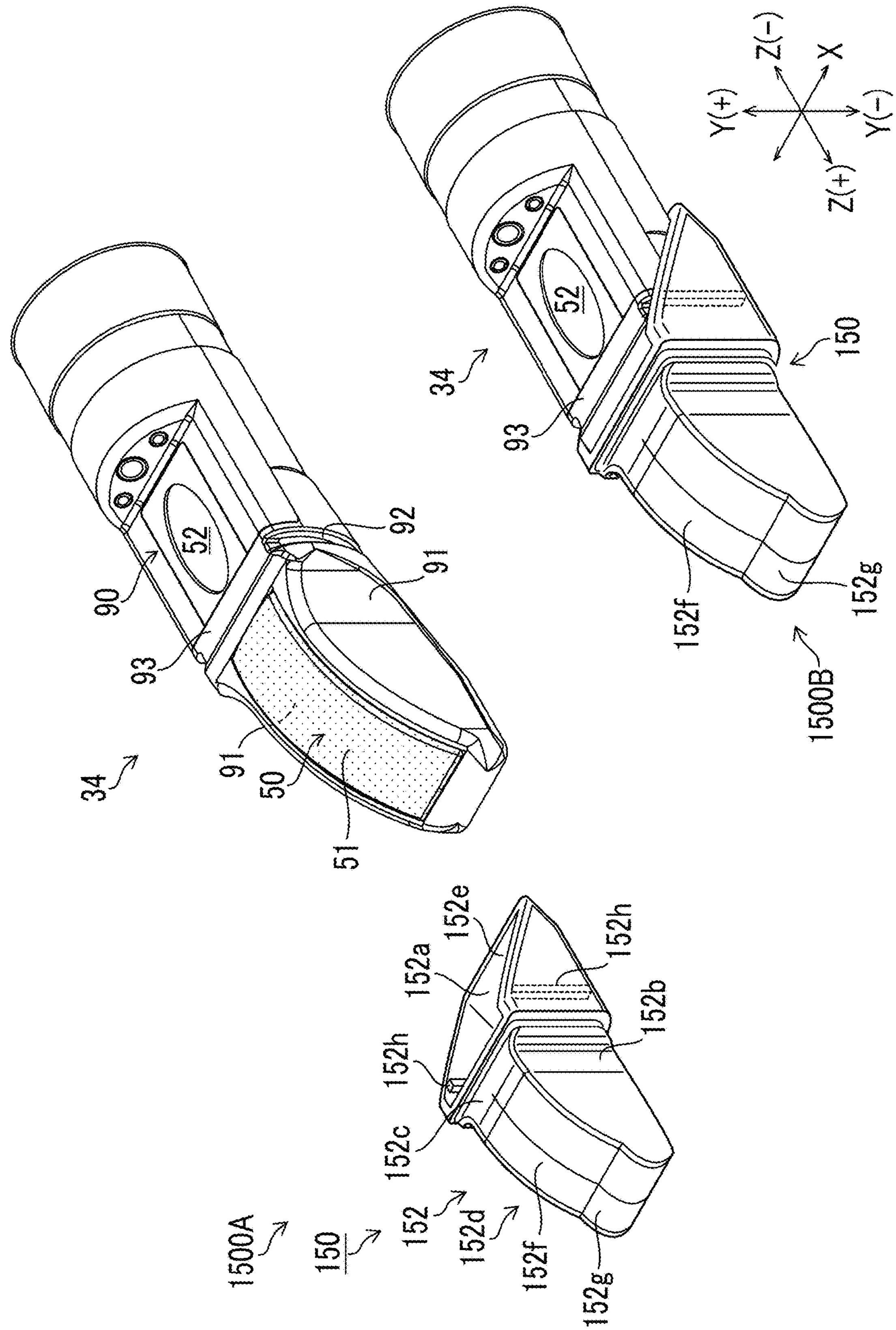


FIG. 15



Z(−)
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Y(+)
Y(−)
Z(+)
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152
152d
152c
152h
152a
152e
152b

# BALLOON FOR ULTRASONIC ENDOSCOPE

## CROSS-REFERENCE TO RELATED APPLICATION

The present application claims priority under 35 U.S.C § 119(a) to Japanese Patent Application No. 2021-156431 filed on Sep. 27, 2021, which is hereby expressly incorporated by reference, in its entirety, into the present application.

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

The present invention relates to a balloon for an ultrasonic endoscope, and in particular, to a balloon that is mounted on a distal end part of an insertion part of an ultrasonic endoscope.

### 2. Description of the Related Art

In the medical field, an ultrasonic endoscope is used. The ultrasonic endoscope is an endoscope that disposes an imaging element and an ultrasound transducer integrally in a distal end part of an insertion part that is inserted into a body cavity of a subject. The ultrasound transducer emits an ultrasonic wave toward a site to be observed in the body cavity and receives an echo signal reflected from the site to be observed, and an electric signal depending on the received echo signal is output to an ultrasonic observation device. Then, the electric signal is subjected to various kinds of signal processing in the ultrasonic observation device, and is then displayed as an ultrasound tomographic image on a monitor or the like.

The ultrasonic wave and the echo signal are considerably attenuated in the air. For this reason, there is a need to interpose an ultrasonic wave transmission medium, such as water or oil, between the ultrasound transducer and the site to be observed. Accordingly, an expandable balloon is mounted on a distal end part of an ultrasonic endoscope, and the ultrasonic wave transmission medium is injected into the balloon to expand the balloon to be brought into contact with the site to be observed. As a result, air is eliminated from a region between the ultrasound transducer and the site to be observed, and the attenuation of the ultrasonic wave and of the echo signal is restrained.

Various balloons that are mounted on the distal end part of the insertion part of the ultrasonic endoscope have been suggested.

JP2004-254942A discloses a technique in which a groove that surrounds an oscillator is provided at an insertion part distal end, and a balloon is mounted in the groove. JP1996-131442A (JP-H08-131442A) discloses a technique in which a restricting unit that restricts expansion of a balloon in a scanning axis direction on an ultrasound transducer is provided. JP1978-107190A (JP-S53-107190A) discloses an ultrasound diagnostic apparatus having a flexible film body attached to a probe body to form a sealed space in front of an ultrasonic wave transmission and reception surface, and a fluid with which the sealed space is filled.

## SUMMARY OF THE INVENTION

In a case where the balloon is mounted at a position covering an outside surface of the ultrasound transducer, for example, in diagnosis or treatment of a narrow path, such as a bronchus in a body cavity, by an ultrasonic bronchial endoscope, in a case where a balloon including a distal end part in which the ultrasound transducer is disposed is swollen in a spherical shape, an outer diameter of the balloon increases, and a contact position of an oscillator surface may not be stable.

The present invention has been accomplished in view of such a situation, and an object of the present invention is to provide a balloon for an ultrasonic endoscope in which an ultrasound oscillator surface of an ultrasound transducer can be most swollen.

A first aspect of the present invention provides a balloon for an ultrasonic endoscope that is mounted to cover an outside surface of an ultrasound transducer provided in a distal end part body on a distal end side of an insertion part, the balloon comprising a bottomed tubular balloon body that has an opening portion provided at one end in a first direction corresponding to a longitudinal direction of the insertion part and attached to the distal end part body, covers an oscillator surface of the ultrasound transducer, and stores an ultrasonic wave transmission medium inside, to be swellable, and a swelling restricting part that, in a case where the ultrasonic wave transmission medium is stored inside the balloon body, makes an oscillator surface region facing the oscillator surface of the ultrasound transducer most swollen by restricting a part of the balloon body.

A second aspect of the present invention is the balloon for an ultrasonic endoscope, in which the balloon body has at least a two-layer structure including an inner part that has the opening portion at one end and an outer part that covers the inner part and that is bonded on an opening portion side, a storage portion that stores the ultrasonic wave transmission medium is provided between the inner part and the outer part, and the outer part has an oscillator surface region.

A third aspect of the present invention is the balloon for an ultrasonic endoscope, in which an adhesion portion for bonding the inner part and the outer part is provided, and the adhesion portion functions as the swelling restricting part.

A fourth aspect of the present invention is the balloon for an ultrasonic endoscope, in which the outer part includes a thick portion that is formed to have a thickness greater than a thickness of the oscillator surface region, on the other end side opposite to the one end in the first direction, and the thick portion functions as the swelling restricting part.

A fifth aspect of the present invention is the balloon for an ultrasonic endoscope, in which the outer part includes thick portions that are formed to have a thickness greater than a thickness of the oscillator surface region, on both sides in a second direction perpendicular to the first direction of the oscillator surface region, and transition portions that are formed between the thick portions and the oscillator surface region, and the transition portions function as the swelling restricting part.

A sixth aspect of the present invention is the balloon for an ultrasonic endoscope, in which adhesion regions of the inner part and of the outer part are provided on both sides in a second direction perpendicular to the first direction of the oscillator surface region, and the adhesion regions function as the swelling restricting part.

A seventh aspect of the present invention is the balloon for an ultrasonic endoscope, in which the balloon body has a region smaller than a distance between standing wall portions provided on both sides of the ultrasound transducer before the distal end part body is mounted.

An eighth aspect of the present invention is the balloon for an ultrasonic endoscope, in which the balloon body includes a protrusion portion that protrudes to a distal end part body side and that is fitted into a groove portion of the distal end part body formed on a proximal end side of the ultrasound transducer.

A ninth aspect of the present invention is the balloon for an ultrasonic endoscope, in which the balloon body includes a locking portion that is locked to a stepped portion formed on a surface of the distal end part body on an opposite side of the ultrasound transducer.

With the balloon for an ultrasonic endoscope of the present invention, the ultrasound oscillator surface of the ultrasound transducer can be most swollen.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a general view of an ultrasonic endoscope (endoscope).

FIG. **2** is a perspective view of a distal end part body.

FIG. **3** is a sectional view of the distal end part body.

FIG. **4** is a perspective view of the distal end part body.

FIG. **5** is a side view of the distal end part body.

FIG. **6** is a plan view of the distal end part body.

FIG. **7** is an exploded assembly diagram of a balloon for an ultrasonic endoscope in which a tube is omitted.

FIG. **8** is a sectional view of the balloon for an ultrasonic endoscope.

FIG. **9** is a sectional view illustrating a flow of an ultrasonic wave transmission medium that is supplied to the balloon for an ultrasonic endoscope.

FIG. **10** is a sectional view showing a state in which an oscillator surface region of the balloon for an ultrasonic endoscope is swollen.

FIG. **11** is a perspective view illustrating mounting of the balloon for an ultrasonic endoscope with the tube omitted, on the distal end part body.

FIG. **12** is a perspective view of a distal end part body on which the balloon for an ultrasonic endoscope with the tube omitted is mounted, taken along an XZ plane.

FIG. **13** is a sectional view of the distal end part body on which the balloon for an ultrasonic endoscope is mounted, taken along a YZ plane.

FIG. **14** is a perspective view as the balloon for an ultrasonic endoscope with the tube omitted is viewed from a proximal end side.

FIG. **15** is a perspective view illustrating mounting of a balloon for an ultrasonic endoscope with a tube omitted of another embodiment on the distal end part body.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, an ultrasonic endoscope on which a balloon for an ultrasonic endoscope according to the present invention is mounted will be described with reference to the accompanying drawings.

### Overall Configuration of Ultrasonic Endoscope

FIG. **1** is a general view of the ultrasonic endoscope **1**. As shown in FIG. **1**, the ultrasonic endoscope **1** (hereinafter, simply referred to as an "endoscope **1**") is used for collection or the like of a cellular tissue of a lesion part (an observation part, a test part, or an examination part can be used). In the present embodiment, description will be provided in connection with a lymph node as an example of a lesion part.

The endoscope **1** is configured with an operating part **10** that is gripped by a practitioner and that is used for various operations, an insertion part **12** that is inserted into a body of a patient, and a universal cord **14**. The endoscope **1** is connected to system constituent devices that configure an endoscope system, such as a processor device, a light source device, and an ultrasonic observation device (not shown), through the universal cord **14**.

The operating part **10** is provided with various operation members that are operated by the practitioner. For example, an angle lever **16**, a suction button **22**, and the like are provided.

The operating part **10** is provided with a treatment tool inlet port **24** through which a treatment tool is inserted into a treatment tool insertion channel **23** (see FIG. **3**) that is inserted into the insertion part **12**.

The insertion part **12** extends from a distal end of the operating part **10** and is formed in a small-diameter elongated shape as a whole. The insertion part **12** is configured with, in order from a proximal end side toward a distal end side, a soft part **30**, a bendable part **32**, and a distal end part body **34** as a distal end part.

The soft part **30** occupies most of the insertion part **12** from the proximal end side and has enough flexibility to be bent in any direction. In a case where the insertion part **12** is inserted into a body cavity, the soft part **30** is bent along an insertion path into the body cavity.

The bendable part **32** is bent in an up-down direction (A2 direction) by rotating the angle lever **16** of the operating part **10** in an A1 direction. With the bending operation of the bendable part **32**, the distal end part body **34** can be directed in a desired direction.

Though details will be described with reference to FIGS. **2** and **3** described below, the distal end part body **34** comprises an observation optical system **40** and illumination optical systems **44** that are provided to capture an observation image in a body, an ultrasound transducer **50** that acquires an ultrasound image, and a treatment tool outlet port **52** (hereinafter, referred to as an outlet port **52**) from which the treatment tool inserted from the treatment tool inlet port **24** is led out.

The universal cord **14** includes a signal cable **54**, a signal cable **56**, and light guides **58** shown in FIG. **3** described below in detail. A connector is provided in an end portion (not shown) of the universal cord **14**. The connector is connected to predetermined system constituent devices that configure the endoscope system, such as a processor device, a light source device, and an ultrasonic observation device. As a result, power, control signals, illumination light, and the like necessary for the operation of the endoscope **1** are supplied from the system constituent devices to the endoscope **1**. A signal of the observation image acquired by the observation optical system **40** and a signal of the ultrasound image acquired by the ultrasound transducer **50** are transmitted from the endoscope **1** to the system constituent devices. The signals transmitted to the system constituent devices are subjected to image processing, the observation image and the ultrasound image are displayed on a monitor, and the practitioner or the like can observe the images.

The configuration of the operating part **10** is not limited to the aspect shown in FIG. **1**. A pair of angle knobs may be provided instead of the angle lever **16**, and the bendable part **32** may be bent in the up-down direction and in a right-left direction by rotating a pair of angle knobs. An air/water supply button may be provided in the operating part **10**, and gas, such as air, a liquid for cleaning, or the like may be supplied to the distal end part body **34** by operating the air/water supply button.

### Configuration of Distal End Part Body

FIG. **2** is a perspective view of the distal end part body **34** from which a puncture needle is led out. FIG. **3** is a sectional view of the distal end part body **34**.

Hereinafter, in describing the configuration of each part, a three-dimensional rectangular coordinate system of an X axis, a Y axis, and a Z axis is used. A Z direction in the drawings is a direction parallel to a longitudinal axis **38** of the distal end part body **34** (insertion part **12**). A Z(+) direction side of the Z direction in the drawings is a distal end side of the distal end part body **34**, and a Z(−) direction side is a proximal end side of the distal end part body **34**. The Z direction in the drawings corresponds to a first direction of the present invention. A Y direction in the drawings is perpendicular to the Z direction and is an up-down direction in each drawing in the present embodiment. A Y(+) direction side as one direction side of the Y direction is an up direction, and a Y(−) direction side as the other direction side opposite to the one direction side of the Y direction is a down direction. An X direction in the drawings is a direction perpendicular to both the Z direction and the Y direction and corresponds to a second direction of the present invention.

As shown in FIGS. **2** and **3**, the distal end part body **34** comprises, from the distal end side toward the proximal end side of the distal end part body **34**, an ultrasonic attachment part **34***a*, an outlet port forming portion **34***b*, and a body part **34***c* (see FIGS. **2** and **3**).

The ultrasound transducer **50** is attached to the ultrasonic attachment part **34***a* in a posture tilted forward (inclined) to the Y(−) direction side with respect to the longitudinal axis **38** in a case where the distal end part body **34** is viewed from the X direction side. The ultrasound transducer **50** is a convex type that has an oscillator surface **51** on which ultrasound oscillators that transmit and receive ultrasonic waves are arranged in an arc shape along a direction of the longitudinal axis **38** (first direction). The ultrasound transducer **50** transmits ultrasonic waves from the oscillator surface **51** toward a living body and receives an ultrasound echo reflected by a living body tissue on the oscillator surface **51**. A signal that generates an ultrasound image of a lymph node is acquired by the ultrasound transducer **50**. The number of ultrasound oscillators that configure the ultrasound transducer **50** is not limited.

The outlet port forming portion **34***b* has an outlet port **52** for a treatment tool that is opened on the Y(+) direction side, and a substantially rectangular opening forming surface **71** parallel to an XZ plane in which the outlet port **52** is opened and along the Z direction (including the longitudinal axis **38**; the same applies hereinafter). The opening forming surface **71** is a surface parallel to the XZ plane and along the Z direction, and configures a part of an outer peripheral surface of the distal end part body **34**. In the present embodiment, although the outlet port **52** is opened in the planar opening forming surface **71**, the outlet port **52** may be opened in surfaces of various shapes, such as a curved surface, an inclined surface, or an uneven surface. In the present embodiment, description will be provided in connection with a puncture needle **100** that is used in tissue collection, such as a lymph node, as an example of the treatment tool.

A pipe line **74** is formed inside the outlet port forming portion **34***b* and the body part **34***c*. A distal end side of the pipe line **74** is connected to the outlet port **52**, and a proximal end side of the pipe line **74** is connected to the treatment tool insertion channel **23** inserted into the insertion part **12**. As a result, a distal end of the puncture needle **100** inserted from the treatment tool inlet port **24** is guided to the outlet port **52** by way of the treatment tool insertion channel **23** and the pipe line **74**, and is led out from the outlet port **52** to the outside.

The body part **34***c* comprises an optical system storage portion **82** in which the observation optical system **40** and the illumination optical systems **44** are disposed. The optical system storage portion **82** has a substantially semi-cylindrical shape, and has a convex surface **84** and a stepped surface **85**. The convex surface **84** configures a part of the outer peripheral surface of the distal end part body **34** (optical system storage portion **82**). The convex surface **84** is positioned on the Y(+) direction side with respect to the opening forming surface **71** and has a shape along the Z direction. The convex surface **84** may be formed in various shapes, such as a curved surface, an inclined surface, or an uneven surface.

The stepped surface **85** is an inclined surface that connects a proximal end side of the opening forming surface **71** and a distal end side of the convex surface **84**, and configures a part of the outer peripheral surface of the distal end part body **34**. The inclined surface used herein includes a vertical surface having an inclined angle of 90° with respect to the Z direction.

The stepped surface **85** is provided with an observation window **40***a* of the observation optical system **40** and illumination windows **44***a* of a pair of illumination optical systems **44**.

The observation optical system **40** includes the observation window **40***a* provided in the stepped surface **85**, and a lens system **40***b* and an imaging element **40***c* provided in the optical system storage portion **82**. The imaging element **40***c* is a charge coupled device (CCD) type or a complementary metal oxide semiconductor (CMOS) type image sensor and captures an observation image taken from the observation window **40***a* through the lens system **40***b*. Then, the imaging element **40***c* outputs an imaging signal of the observation image to the system constituent devices through the signal cable **56** inserted into the insertion part **12**.

The illumination optical systems **44** are provided on both sides of the observation optical system **40** in the X direction, and each of the illumination optical systems **44** includes the illumination window **44***a* provided in the stepped surface **85**, and the light guide **58** inserted into the insertion part **12**. An emission end of the light guide **58** is disposed behind each illumination window **44***a*. As a result, illumination light supplied from the light source device to each light guide **58** is emitted from each illumination window **44***a*.

As described above, in the distal end part body **34**, the ultrasound transducer **50**, the outlet port **52**, and the stepped surface **85** (observation window **40***a*) are disposed in order from the distal end side toward the proximal end side. That is, the outlet port **52** is disposed between the ultrasound transducer **50** and the observation window **40***a*. For this reason, a puncture place toward a lymph node in a bronchial wall surface by the puncture needle **100** can be observed with the observation optical system **40**.

Ultrasonic Endoscope System

Next, an ultrasonic endoscope system of the embodiment will be described. The ultrasonic endoscope system has the above-described endoscope **1** comprising the distal end part body **34** provided on the distal end side of the insertion part **12** and the ultrasound transducer **50** provided in the distal end part body **34**, and a balloon **120** for an ultrasonic endoscope (see FIG. **7**, hereinafter, referred to as a "balloon") that covers an outside surface of the ultrasound transducer **50**.

The configuration of the distal end part body **34** on which the balloon **120** is mounted will be described. FIG. **4** is a perspective view of the distal end part body **34**. FIG. **5** is a side view of the distal end part body **34**. FIG. **6** is a plan view of the distal end part body **34**.

The distal end part body **34** has standing wall portions **91** on both side surfaces of the ultrasound transducer **50** in a width direction (X direction) that is a direction perpendicular to the first direction (Z direction) and is a direction parallel to a plane direction of the oscillator surface **51** of the ultrasound transducer **50**. The two standing wall portions **91** are configured with surfaces parallel to a YZ plane. The standing wall portions **91** do not need to be parallel to the YZ plane over the entire surface, and parallel can mean substantially parallel. A distance between the two standing wall portions **91** in the width direction, that is, a width of the ultrasonic attachment part **34***a*, is shorter than other portions (the outlet port forming portion **34***b* and the body part **34***c*) of the distal end part body **34** in a case of being viewed from the Y direction (see FIG. **6**).

Fixing portions of the balloon **120** described below are in close contact with and fixed to the standing wall portions **91**, whereby the balloon is fixed to the distal end part body **34**.

The distal end part body **34** has a plane portion **93** between the ultrasound transducer **50** and the outlet port **52**. The plane portion **93** is a plane substantially parallel to the XZ plane and has a length in the X direction longer than a length in the Z direction. The plane portion **93** is connected on the distal end side of the above-described opening forming surface **71**, and the plane portion **93** and the opening forming surface **71** configure an integrated plane.

The distal end part body **34** has groove portions **92** on both side surfaces of the distal end part body **34** in the X direction between the ultrasound transducer **50** and the outlet port **52**. In other words, as shown in FIG. **6**, in a case where the distal end part body **34** is viewed from the Y(+) direction side, the groove portions **92** are disposed between the ultrasound transducer **50** and the outlet port **52**. The groove portions **92** extend from both end portions (Y(−) direction side) of the plane portion **93** in parallel to the Y direction (see FIG. **5**) and are disposed on both sides of the plane portion **93** (see FIG. **6**). That is, the groove portions **92** are disposed on a proximal end side (Z(−) direction side) of the ultrasound transducer **50** and are disposed on both sides of the ultrasound transducer **50** in a case where the distal end part body **34** is viewed from the Z(+) direction side. In FIGS. **4** to **6**, although the groove portions **92** are provided on the proximal end side of the ultrasound transducer **50**, positions where the groove portions **92** are formed are not limited to the proximal end side of the ultrasound transducer **50**, and may be provided in the standing wall portions **91**.

As described below, in regard to the groove portions **92**, protrusion portions **122***j* that are provided in a fixing portion of the balloon **120** are fitted into the groove portions **92**. The groove portions **92** and the protrusion portions **122***j* are fitted, whereby it can be made difficult for the balloon **120** to fall off from the distal end part body **34**.

The distal end part body **34** has a stepped portion **94** on a surface on an opposite side to the oscillator surface **51** on the proximal end side (Z(−) direction side) of the ultrasound transducer **50** (see FIG. **5**). The stepped portion **94** is a plane substantially parallel to the XY plane and protrudes in the Y(−) direction as viewed from the Z(−) direction.

As described below, the stepped portion **94** is locked to a locking portion **122***k* that is provided in the fixing portion of the balloon **120**, whereby it is possible to restrain the balloon **120** from falling off from the distal end part body **34**.

Configuration of Balloon

Next, the balloon of the embodiment will be described. In the drawings, similarly to FIGS. **2** to **6**, description will be provided using the three-dimensional rectangular coordinate system of the X axis, the Y axis, and the Z axis. The X axis, the Y axis, and the Z axis coincide with the X direction, the Y direction, and the Z direction in a case where the balloon **120** is mounted on the distal end part body **34**. A Z(+) direction side is a distal end side, and a Z(−) direction side is a proximal end side. The Z direction in the drawings corresponds to a first direction of the present invention and corresponds to a longitudinal direction of the insertion part. A Y direction in the drawings is perpendicular to the Z direction and is an up-down direction in each drawing in the present embodiment. A Y(+) direction side as one direction side of the Y direction is an up direction, and a Y(−) direction side as the other direction side opposite to the one direction side of the Y direction is a down direction. An X direction in the drawings is a direction perpendicular to both the Z direction and the Y direction and corresponds to a second direction of the present invention.

FIG. **7** is an assembly diagram of the balloon **120** in which a tube is omitted, **700**A of FIG. **7** is a perspective view after assembly, and **700**B of FIG. **7** is a perspective view before assembly. As shown in FIG. **7**, the balloon **120** is configured with a balloon body **121** of a two-layer structure including an inner part **122** and an outer part **124**.

Inner Part

The inner part **122** has an opening portion **122***a* at one end in the first direction (Z direction), and comprises two side surface portions **122***b* disposed to face each other, a top surface portion **122***c*, an inclined surface portion **122***d*, and a bottom surface portion **122***e*. The inner part **122** is configured in a bottomed tubular shape having the opening portion **122***a*, and portions other than the opening portion **122***a* are closed by the two side surface portions **122***b*, the top surface portion **122***c*, the inclined surface portion **122***d*, and the bottom surface portion **122***e*.

Each side of the two side surface portions **122***b*, the top surface portion **122***c*, and the bottom surface portion **122***e* that define the opening portion **122***a* is linear, and a shape of the opening portion **122***a* is a substantially rectangular shape.

The opening portion **122***a* is inclined from a downside (Y(−) side) to an upside (Y(+) side) from the proximal end side (Z(−) side) toward the distal end side (Z(+) side).

Each of the side surface portions **122***b* extends along the first direction (Z direction) and is configured with surfaces substantially parallel to the YZ plane. Each of the side surface portions **122***b* comprises a first side surface portion **122***f* that is positioned on a top surface portion **122***c* side and on an inclined surface portion **122***d* side, and a second side surface portion **122***g* that is positioned on an opening portion **122***a* side. A distance between the first side surface portions **122***f* facing each other is smaller than a distance between the second side surface portions **122***g* facing each other. A stepped portion **122***h* is formed between the first side surface portion **122***f* and the second side surface portion **122***g*.

The inner part **122** comprises a flange portion **122***i* that surrounds an outer periphery of the inner part **122**. The flange portion **122***i* is provided on a proximal end side of the top surface portion **122***c* and on a proximal end side of the first side surface portion **122***f* and is also provided in the bottom surface portion **122***e* (not shown). The flange portion **122***i* is configured with four connected linear portions and is provided to surround the outer periphery of the inner part **122**.

The inclined surface portion **122***d* has a shape following the oscillator surface **51** of the ultrasound transducer **50** described above and is inclined in an arc shape from an upside (Y(+) side) to a downside (Y(−) side) from the proximal end side (Z(−) side) toward the distal end side (Z(+) side).

The side surface portions **122***b* have the two protrusion portions **122***j* facing each other on inner surfaces of the second side surface portions **122***g*. The two protrusion portions **122***j* extend in parallel in the Y direction and protrude in a direction approaching each other.

Outer Part

The outer part **124** has an opening portion **124***a* at one end in the first direction (Z direction), and comprises two side surface portions **124***b* disposed to face each other, a top surface portion **124***c*, an inclined surface portion **124***d*, and a bottom surface portion **124***e*. The outer part **124** is configured in a bottomed tubular shape having the opening portion **124***a*, and portions other than the opening portion **124***a* are closed by the two side surface portions **124***b*, the top surface portion **124***c*, the inclined surface portion **124***d*, and the bottom surface portion **124***e*.

Each side of the two side surface portions **122***b*, the top surface portion **122***c*, and the bottom surface portion **122***e* that define the opening portion **124***a* is linear, and a shape of the opening portion **124***a* is a substantially rectangular shape.

Each of the side surface portions **124***b* extends along the first direction (Z direction) and is configured with surfaces substantially parallel to the YZ plane. The opening portion **124***a* of the outer part **124** is widened to a side surface portion **124***b* side (X direction) to house the stepped portion **122***h* of the inner part **122**.

The inclined surface portion **124***d* has a shape following the oscillator surface **51** of the ultrasound transducer **50** described above and is inclined in a curved shape from the upside (Y(+) side) to the downside (Y(−) side) from the proximal end side (Z(−) side) toward the distal end side (Z(+) side).

Balloon Body

As shown in **700**A, the inner part **122** is housed in the outer part **124** through the opening portion **124***a* of the outer part **124**, and the outer part **124** covers the inner part **122**. Note that the outer part **124** does not need to cover the entire inner part **122**. The outer part **124** covers the two first side surface portions **122***f*, the top surface portion **122***c*, the inclined surface portion **122***d*, and a part (distal end side) of the bottom surface portion **122***e* of the inner part **122**. On the other hand, the outer part **124** does not cover the second side surface portions **122***g* and a part (proximal end side) of the bottom surface portion **122***e* of the inner part **122**.

As shown in **700**A, the two side surface portions **122***b* and the two side surface portions **124***b* that configure the inner part **122** and the outer part **124** are disposed to face each other, respectively, the top surface portion **122***c* and the top surface portion **124***c* are disposed to face each other, the inclined surface portion **122***d* and the inclined surface portion **124***d* are disposed to face each other, and the bottom surface portion **122***e* and the bottom surface portion **124***e* are disposed to face each other.

A peripheral edge portion of the opening portion **124***a* of the outer part **124** comes into contact with the flange portion **122***i* of the inner part **122**. With the flange portion **122***i*, a relative position of the outer part **124** with respect to the inner part **122** is determined.

The outer part **124** is bonded on the opening portion **122***a* side of the inner part **122**, and the balloon body **121** having the two-layer structure is configured. The balloon body **121** is configured in a bottomed tubular shape that has the opening portion **122***a* provided at one end in the first direction (Z direction) of the insertion part **12** and attached to the distal end part body **34**.

As a material for the balloon body **121**, to make a configuration in which it is difficult for the inner part **122** and the outer part **124** to stick to each other, it is preferable that the inner part **122** and the outer part **124** are formed of different materials. Note that, as described below, a clearance is provided between the inner part **122** and the outer part **124**, whereby it is possible to restrain the inner part **122** and the outer part **124** from being stuck to each other. Accordingly, the inner part **122** and the outer part **124** may be formed of the same material. As the materials for the inner part **122** and the outer part **124**, silicon rubber, natural rubber, or the like can be used.

In a case where the balloon **120** is mounted on the distal end part body **34**, the first side surface portions **122***f* of the inner part **122** and the standing wall portions **91** are disposed to face each other, and the inclined surface portion **122***d* and the ultrasound transducer **50** are disposed to face each other. The side surface portions **124***b* of the outer part **124** and the standing wall portions **91** are disposed to face each other with the first side surface portions **122***f* interposed therebetween, and the inclined surface portion **124***d* and the ultrasound transducer **50** are disposed to face each other with the inclined surface portion **122***d* interposed therebetween.

The opening portion **122***a* provided in the inner part **122** is an insertion port into which the above-described distal end part body **34** is inserted. An internal space of the inner part **122** is a similar shape to the shape of the distal end part body **34**, and is formed in a shape smaller than an outer shape of the distal end part body **34**. A width (a length in the X direction) of the two side surface portions **122***b* of the balloon **120** before being mounted on the distal end part body **34** is smaller than a distance between the two standing wall portions **91** in the width direction. As a result, in a case of being inserted into the distal end part body **34** from the opening portion **122***a* of the inner part **122**, the two side surface portions **122***b* of the inner part **122** expand in the X direction, and the side surface portions **122***b* are in close contact with and fixed to the standing wall portions **91** by contractile force to return. The two side surface portions **122***b* of the inner part **122** function as a fixing portion that is in close contact with and fixed to the distal end part body **34**.

The two protrusion portions **122***j* provided on the second side surface portions **122***g* that configure the side surface portions **122***b* of the inner part **122** are fitted into the groove portions **92** of the distal end part body **34** described above in a case where the balloon **120** is mounted on the distal end part body **34**. The two protrusion portions **122***j* that are fitted into the groove portions **92** of the distal end part body **34** are provided in the side surface portions **122***b* that function as the fixing portion. In a case where the groove portions **92** are provided in the standing wall portions **91**, the two protrusion portions **122***j* are provided in the first side surface portions **122***f* that configure the side surface portion **122***b*.

The inside of the inner part **122** is formed in a similar shape to the distal end part body **34** and in a shape smaller than the outer shape of the distal end part body **34**, whereby the inner part **122** can be in contact and fixed from the oscillator surface **51** and the surface on the opposite side to the oscillator surface **51**. As a result, the inner part **122** can also be in close contact with and fixed to the oscillator surface **51** and to the surface on the opposite side to the oscillator surface **51** of the distal end part body **34**, and the balloon **120** can be firmly fixed to the distal end part body **34**. The inclined surface portion **122***d* and the bottom surface portion **122***e* of the inner part **122** function as a fixing portion that is in close contact with and fixed to the distal end part body **34**.

It is preferable that the balloon body **121** has a shape following the outer shape of the oscillator surface of the ultrasound transducer **50** described above. With the balloon body **121** having such a configuration, it is possible to stabilize an orientation in a case where the balloon **120** is mounted on the distal end part body **34**.

FIG. **8** is a sectional view of the balloon **120**. **800**A is a sectional view of the balloon **120** taken along the YZ plane, and **800**B is a sectional view of the balloon **120** taken along the XY plane. As shown in FIG. **8**, the outer part **124** covers the inner part **122**, and the outer part **124** and the inner part **122** are bonded, whereby the balloon body **121** is configured.

As shown in **800**A, the inner part **122** and the outer part **124** are bonded, and a closed space can be formed between the inner part **122** and the outer part **124**. This space is a storage portion **121***a* that stores an ultrasonic wave transmission medium. The ultrasonic wave transmission medium is stored in the storage portion **121***a*, whereby an oscillator surface region **124***f* that configures the inclined surface portion **124***d* of the outer part **124** can be swollen. The oscillator surface region **124***f* functions as a swelling portion. The oscillator surface region **124***f* is a region facing the oscillator surface **51** of the ultrasound transducer **50**.

As described above, since the storage portion **121***a* of the balloon **120** is configured with the closed space between the inner part **122** and the outer part **124**, it is possible to secure fluid-tightness in the balloon **120** itself. Accordingly, unlike the related art in which fluid-tightness is secured between the distal end part body and the balloon, it is not essential that the balloon **120** has an annular groove shape in locking the distal end part body and the balloon. With the balloon **120**, it is possible to avoid an increase in diameter and an increase in size of the distal end part body **34** due to the annular groove shape. The balloon **120** gives a degree of freedom for design to the shape of the distal end part body **34**. As shown in FIG. **7**, the opening portion **122***a* of the balloon **120** can have a rectangular shape, instead of an annular shape.

It is preferable that the inner part **122** and the outer part **124** are not in close contact, and that a clearance is provided therebetween. The inner part **122** and the outer part **124** are not in close contact, whereby it is possible to prevent it from being difficult for the ultrasonic wave transmission medium to be supplied in a case of supplying the ultrasonic wave transmission medium to the storage portion **121***a* since an outer surface of the inner part **122** and an inner surface of the outer part **124** stick to each other. As described below, in a case of adhering and assembling the inner part **122** and the outer part **124**, it can be made difficult for the inner part **122** and the outer part **124** to stick to each other. The clearance means a state in which the outer surface of the inner part **122** and the inner surface of the outer part **124** are separated from each other by a given distance.

As shown in **800**A, in a region surrounded by a quadrangle, the inner part **122** and the outer part **124** are bonded by an adhesive or the like. A clearance is not present in an adhesion portion **121***b* of the inner part **122** and of the outer part **124** bonded by the adhesive. The clearance may not be provided in the entire region between the inner part **122** and the outer part **124**.

The adhesion portion **121***b* may be, for example, at a position corresponding to the top surface portion **122***c* (not shown) of the inner part **122** and to the top surface portion **124***c* (not shown) of the outer part **124**.

The adhesion portion **121***b* does not expand even though the ultrasonic wave transmission medium is supplied into the balloon **120**. Thus, even though the puncture needle **100** is led out from the outlet port **52**, the proximal end side (Z(−) side) of the balloon **120** does not expand. Therefore, it is possible to restrain the puncture needle **100** led out from the outlet port **52** from being brought into contact with the swollen balloon **120**. The adhesion portion **121***b* functions as a swelling restricting part capable of suppressing swelling except in the oscillator surface region **124***f* described below. The adhesion portion **121***b* suppresses swelling of a proximal end side (Z(−) side) of the oscillator surface region **124***f*.

The inclined surface portion **124***d* of the outer part **124** includes the oscillator surface region **124***f* and a thick portion **124***g*. The thick portion **124***g* is disposed on the other end side (Z(+) side) opposite to one end side (Z(−) side) in the first direction (Z direction) and is formed to have a thickness greater than a thickness of the oscillator surface region **124***f*. The thick portion **124***g* suppresses swelling of a distal end side (Z(+) side) of the oscillator surface region **124***f* of the outer part **124** in a case where the ultrasonic wave transmission medium is supplied to the storage portion **121***a*. The thick portion **124***g* functions as a swelling restricting part and can make the oscillator surface region **124***f* more effectively swollen.

Since the oscillator surface region **124***f* is formed to have a film thickness thinner than other regions of the outer part **124** including the thick portion **124***g*, the oscillator surface region **124***f* can be easily swollen compared to other regions.

The bottom surface portion **122***e* of the inner part **122** that functions as a fixing portion of the balloon **120** has the locking portion **122***k* inside. The locking portion **122***k* is configured with a plane substantially parallel to the XY plane and stands in the Y(+) direction as viewed from the distal end side (Z(+) side). The locking portion **122***k* is locked to the stepped portion **94** of the distal end part body **34** described above in a case where the balloon **120** is mounted on the distal end part body **34**.

The inner part **122** of the balloon body **121** has a communication path **122***m* that communicates with the storage portion **121***a*, in the bottom surface portion **122***e* on an opposite side to the oscillator surface region **124***f*. The communication path **122***m* has an opening in the Z(−) direction, and the storage portion **121***a* communicates with the outside through the communication path **122***m*.

A tube **140** is inserted into the communication path **122***m* of the bottom surface portion **122***e* of the inner part **122** that functions as a fixing portion of the balloon **120**, whereby it is possible to attach the tube **140** to the balloon **120**. The attachment of the tube **140** to the balloon **120** may be attachable and detachable or may be inseparable. The tube **140** is a tubular member that has a space to be a flow channel inside. The ultrasonic wave transmission medium can be supplied from the flow channel of the tube **140** to the storage portion **121***a* in the balloon **120** through the communication path **122***m*. As a result, it is possible to expand the oscillator surface region **124***f* that configures the outer part **124** of the balloon **120**. The tube **140** is attached to the balloon **120**, whereby a supply pipe line for supplying the ultrasonic wave transmission medium to the balloon **120** does not need to be provided in the insertion part **12** of the endoscope **1**. Thus, it is possible to achieve a reduction in diameter of the insertion part **12**. The balloon **120** (and the tube **140**) is disposable, whereby there is no need to perform cleaning and sterilization of the tube **140**. In recent years, a minimum pipe line diameter to be sterilized by a sterilization device has been defined, and there has been an increasing demand for cleaning, disinfection, and sterilization. By making the tube **140** disposable, it is possible to omit work of cleaning and sterilization of a supply pipe line.

The tube **140** is configured to more difficultly expand than the balloon body **121** (inner part **122** and outer part **124**). That is, the balloon body **121** is configured to more easily expand than the tube **140**. A configuration in which the balloon body **121** more easily expands than the tube **140** can be realized, for example, by making a film thickness of the balloon body smaller than a film thickness of the tube or by using a material having an expansion coefficient greater than the material for the tube **140**, as the material for the balloon body **121**.

As shown in **800**B, the outer part **124** has the side surface portions **124***b* (that is, thick portions) that are formed to have a thickness greater than the thickness of the oscillator surface region **124***f*, on both sides in the second direction (X direction) perpendicular to the first direction (Z direction) of the oscillator surface region **124***f* The outer part **124** has transition portions **124***h* that connect the oscillator surface region **124***f* and the side surface portions **122***b*. The transition portions **124***h* increase in thickness from the oscillator surface region **124***f* toward the side surface portions **124***b*. The transition portions **124***h* can suppress swelling of the oscillator surface region **124***f* in the X direction in a case where the ultrasonic wave transmission medium is supplied to the storage portion **121***a*, and function as a swelling restricting part. The transition portions **124***h* can be configured with a part on the Y(+) side of the side surface portions **124***b*.

As shown in **800**B, in the balloon body **121**, the side surface portions **122***b* of the inner part **122** and the side surface portions **124***b* of the outer part **124** are disposed to face each other on both sides in the second direction (X direction) perpendicular to the first direction (Z(+) direction) of the oscillator surface region **124***f* The balloon body **121** has adhesion regions **121***c* where the inner part **122** and the outer part **124** are adhered by an adhesive or the like, between the side surface portions **122***b* and the side surface portion **124***b* facing each other. The adhesion regions **121***c* suppress swelling of the oscillator surface region **124***f* in the X direction in a case where the ultrasonic wave transmission medium is supplied to the storage portion **121***a*, and function as a swelling restricting part. The adhesion regions **121***c* may be partial regions between the side surface portions **122***b* and the side surface portion **124***b* as shown in **800**B or may be the entire regions between the side surface portions **122***b* and the side surface portion **124***b* facing each other.

As shown in **800**B, the bottom surface portion **124***e* of the outer part **124** has a recess portion **124***i* that has a semi-spherical shape a in sectional view and that extends in the Z direction, at substantially a center in the width direction (X direction). The recess portion **124***i* is a portion that configures a part of the clearance and that communicates with the communication path **122***m* of the inner part **122**. It is possible to easily supply the ultrasonic wave transmission medium to the storage portion **121***a* with the recess portion **124***i*.

FIG. **9** is a sectional view of the balloon **120** illustrating a flow of the ultrasonic wave transmission medium supplied to the balloon **120**. **900**A is a sectional view of the balloon **120** taken along the YZ plane, and **900**B is a sectional view of the balloon **120** taken along the XY plane.

A flow channel through which the ultrasonic wave transmission medium is supplied to the storage portion **121***a* will be described with reference to FIG. **9**. As shown in **900**A, the tube **140** is attached to the communication path **122***m* of the outer part **124** for supplying the ultrasonic wave transmission medium to the storage portion **121***a*. Since the tube **140** is disposed on an opposite side (Y(−) side) to the oscillator surface region **124***f*, swelling of the oscillator surface region **124***f* is not obstructed. The acquisition of the observation image with the observation optical system **40** is not obstructed.

The ultrasonic wave transmission medium is supplied to the balloon **120** through the tube **140**. The ultrasonic wave transmission medium is supplied to a region having the clearance between the inner part **122** and the outer part **124** through the communication path **122***m* of the inner part **122**. A region between the bottom surface portion **122***e* of the inner part **122** and the bottom surface portion **124***e* of the outer part **124** is filled with the ultrasonic wave transmission medium, and a region between the inclined surface portion **122***d* of the inner part **122** and the inclined surface portion **124***d* of the outer part **124** is filled with the ultrasonic wave transmission medium. The ultrasonic wave transmission medium is finally stored in the storage portion **121***a* that is mainly configured with the oscillator surface region **124***f* and the inclined surface portion **122***d*.

As shown in **900**B, a region between the bottom surface portion **122***e* of the inner part **122** and the bottom surface portion **124***e* of the outer part **124** is filled with the ultrasonic wave transmission medium, and a region between the side surface portion **122***b* of the inner part **122** and the side surface portion **124***b* of the outer part **124** is filled with the ultrasonic wave transmission medium. The ultrasonic wave transmission medium is finally stored in the storage portion **121***a* that is mainly configured with the oscillator surface region **124***f* and the inclined surface portion **122***d*.

FIG. **10** is a sectional view showing a state in which the oscillator surface region of the balloon for an ultrasonic endoscope is swollen, and is a sectional view of the balloon **120** taken along the YZ plane. As shown in FIG. **10**, in a case where the ultrasonic wave transmission medium is stored in the storage portion **121***a*, the oscillator surface region **124***f* is most swollen.

As described above, the oscillator surface region **124***f* has a film thickness thinner than other regions of the outer part **124** including the thick portion **124***g*. As a result, the oscillator surface region **124***f* is more easily swollen than other regions.

In regions other than the oscillator surface region **124***f*, for example, the thick portion **124***g*, the adhesion portion **121***b*, the transition portions **124***h* (not shown), and the adhesion regions **121***c* (not shown) that function as a swelling restricting part are provided. With the thick portion **124***g* and the adhesion portion **121***b*, swelling of regions (regions in the Z(+) direction and the Z(−) direction with respect to the oscillator surface region **124***f*) other than the oscillator surface region **124***f* is suppressed. With the transition portions **124***h* and the adhesion regions **121***c*, swelling of regions (regions in the X direction with respect to the oscillator surface region **124***f*) other than the oscillator surface region **124***f* is suppressed.

In the balloon **120**, the oscillator surface region **124***f* is made most swollen, whereby it is possible to suppress swelling of a bottom surface side and side surface sides of the balloon **120**, and to insert the distal end part body **34** to a periphery in a case of inserting the distal end part body **34** with the balloon **120** mounted thereon into the body cavity.

The tube **140** is a member that does not expand compared to the balloon **120**. Accordingly, in a case where the ultrasonic wave transmission medium is supplied to the balloon **120** through the tube **140**, since expansion of the tube **140** is suppressed, it is possible to effectively supply the ultrasonic wave transmission medium to the balloon **120**.

Next, mounting of the balloon **120** on the distal end part body **34** will be described. FIG. **11** is a perspective view illustrating mounting of the balloon **120** with the tube omitted, on the distal end part body **34**. **1100**A shows a state before the balloon **120** is mounted on the distal end part body **34**. The opening portion **122***a* of the balloon **120** and the distal end side of the distal end part body **34** are aligned. **1100**B shows a state after the balloon **120** is mounted on the distal end part body **34**. The opening portion **122***a* of the balloon **120** is attached to the distal end part body **34**, and the balloon **120** is mounted on the distal end part body **34**. The inner part **122** covers the ultrasound transducer **50** of the ultrasonic attachment part **34***a* and further covers a part of the outer peripheral surface of the outlet port forming portion **34***b* other than the opening forming surface **71**. The outer part **124** is disposed at a position covering the ultrasound transducer **50** of the ultrasonic attachment part **34***a*.

As described above, at least the side surface portions **122***b* are in close contact with and fixed to the standing wall portions **91** by contractile force of the side surface portion **122***b* (not shown) as a fixing portion of the inner part **122**.

A flat portion **122***q* of the inner part **122** that functions as a fixing portion is provided on the proximal end side of the oscillator surface region **124***f* of the balloon **120** that functions as a swelling portion. The plane portion **93** between the ultrasound transducer **50** and the outlet port **52** is in close contact with and fixed to the flat portion **122***q* of the balloon **120**. The flat portion **122***q* is provided, whereby it is possible to extend a distance between the oscillator surface region **124***f* and the outlet port **52**. Therefore, it is possible to restrain the puncture needle **100** led out from the outlet port **52** from being brought into contact with the swollen balloon **120**. The flat portion **122***q* may be at a position of the adhesion portion **121***b* described above.

Since the balloon **120** has a shape in which the ultrasound transducer **50** is offset, as a whole, it is possible to allow a worker to easily recognize an orientation in which the balloon **120** is mounted on the distal end part body **34**.

With the balloon **120** of the present embodiment, the inner part **122** and the outer part **124** are bonded to form a sealed space, and the sealed space is used as the storage portion **121***a* that stores the ultrasonic wave transmission medium. Accordingly, the outer shape of the distal end part body **34** is not limited to a shape for securing fluid-tightness and can be designed in consideration of a reduction in diameter of the distal end part body **34** and a lead-out route of the puncture needle **100**.

In a case where the tube **140** is attached to the balloon **120** and the ultrasonic wave transmission medium is supplied to the storage portion **121***a* through the tube **140**, as shown in FIG. **11**, there is no need to provide a supply pipe line in the distal end part body **34** of the endoscope **1**.

FIG. **12** is a diagram of the distal end part body **34** on which the balloon **120** with the tube omitted is mounted, taken along the XZ plane. As shown in FIG. **12**, the side surface portion **122***b* as a fixing portion of the inner part **122** that configures the balloon **120** has the protrusion portions **122***j*. The groove portions **92** are provided between the ultrasound transducer **50** and the outlet port **52**. The protrusion portions **122***j* and the groove portions **92** are fitted. The groove portions **92** and the protrusion portions **122***j* are fitted, whereby movement in a direction in which the balloon **120** and the distal end part body **34** are separated from each other is regulated, and it can be made difficult for the balloon **120** to fall off from the distal end part body **34**.

In a case where the standing wall portions **91** have groove portions (not shown), protrusion portions (not shown) are provided in the side surface portions **122***b* of the balloon **120** facing the ultrasound transducer **50**. The protrusion portions and the groove portions are fitted, whereby it can be made difficult for the balloon **120** to fall off from the distal end part body **34**.

The balloon **120** has the storage portion **121***a* between the oscillator surface region **124***f* facing the oscillator surface **51** and the inclined surface portion **122***d*.

FIG. **13** shows a cross section of the distal end part body **34** on which the balloon **120** is mounted, taken along the YZ plane. As shown in FIG. **13**, the distal end part body **34** has the stepped portion **94** in a surface on the opposite side to the oscillator surface **51** on the proximal end side (Z(−) direction side) of the ultrasound transducer **50**. The bottom surface portion **122***e* as a fixing portion of the inner part **122** that configures the balloon **120** has the locking portion **122***k*. The stepped portion **94** and the locking portion **122***k* are locked, whereby it is possible to restrain the balloon **120** from falling off from the distal end part body **34**. It is possible to restrain falling off of the balloon **120** in a case where the insertion part **12** of the endoscope **1** on which the balloon **120** is mounted is pulled out from the body cavity in the Z(−) direction. The tube **140** is attached in parallel with the insertion part **12** and is connected to a supply and exhaust unit of the ultrasonic wave transmission medium, such as a syringe, near the operating part **10**.

FIG. **14** is a perspective view of the balloon **120** with the tube omitted as viewed from the Z(−) direction to the Z(+) direction. The bottom surface portion **122***e* of the inner part **122** has a tapered portion **122***n* on the proximal end side (Z(−) side). The tapered portion **122***n* is inclined in the Y(+) direction while extending in the Z(−) direction. The two side surface portions **122***b* of the inner part **122** have tapered portions **122***p* on the proximal end side (Z(−) side), respectively. The two tapered portions **122***p* are inclined in an orientation approaching each other while extending in the Z(−) direction.

The tapered portions **122***n* are provided, whereby force in the first direction (Z direction) can be released in the Y direction. The tapered portion **122***p* is provided, whereby force in the first direction (Z direction) can be released in the X direction. As a result, in a case where the distal end part is inserted into and pulled out from the body cavity, force applied due to contact with a tissue in the body can be released in the Y direction and in the X direction. Therefore, it is possible to restrain the balloon **120** from falling off from the distal end part body **34**.

Although a case where the balloon **120** has the tapered portions **122***n* and the tapered portion **122***p* has been described, any one of the tapered portions **122***n* or the tapered portion **122***p* may be provided.

The balloon **120** of the embodiment can make the oscillator surface region **124***f* of the outer part **124** facing the oscillator surface **51** of the ultrasound transducer **50** most swollen by restricting a part of the balloon body **121** with the swelling restricting part in a case where the ultrasonic wave transmission medium is stored inside the storage portion **121***a* of the balloon body **121**. As a result, in a case where the balloon **120** is swollen, it is possible to achieve a reduction in outer diameter of the balloon **120**, and since the balloon **120** is not swollen on an opposite side of the oscillator surface **51**, it is possible to stably bring the oscillator surface **51** into contact with a site to be observed in a body cavity through the balloon **120**.

In the above-described embodiment, although an example where the balloon **120** has the balloon body **121** having the two-layer structure composed of the inner part **122** and the outer part **124** has been described, the present invention is not limited to the balloon body **121** having the two-layer structure. For example, in addition to the inner part **122** and the outer part **124**, a separate member may be laminated to form a balloon body having a structure of three layers or more.

Next, a balloon of another embodiment will be described. FIG. **15** is a perspective view illustrating mounting of a balloon **150** of another embodiment on the distal end part body **34**. The Z direction in the drawing corresponds to a first direction of the present invention and corresponds to a longitudinal direction of the insertion part.

**1500**A shows a state before the balloon **150** is mounted on the distal end part body **34**. **1500**B shows a state after the balloon **150** is mounted on the distal end part body **34**. Unlike the balloon **120**, the balloon **150** is a balloon that is configured with one layer.

The structure of the balloon **150** will be described. The balloon **150** comprises a balloon body **152**, has an opening portion **152***a* at one end in the first direction (Z direction), and comprises two side surface portions **152***b* disposed to face each other, a top surface portion **152***c*, an inclined surface portion **152***d*, and a bottom surface portion **152***e*. The balloon body **152** is configured in a bottomed tubular shape having the opening portion **152***a* to be attached to the distal end part body **34**, and portions other than the opening portion **152***a* are closed by the two side surface portions **152***b*, the top surface portion **152***c*, the inclined surface portion **152***d*, and the bottom surface portion **152***e*. Since the balloon body **152** is configured in a bottomed tubular shape, the balloon body **152** can store the ultrasonic wave transmission medium inside.

The inclined surface portion **152***d* has an oscillator surface region **152***f* facing the oscillator surface **51** of the ultrasound transducer **50**. Since the oscillator surface region **152***f* is configured to have a film thickness thinner than other portions of the balloon body **152**, the oscillator surface region **152***f* is configured to be more easily swollen than other regions.

Two protrusion portions **152***h* facing each other are provided on the proximal end side (Z(−) side) of the side surface portions **152***b*. The two protrusion portions **152***h* are in parallel in the Y direction and protrude in a direction approaching each other.

As shown in **1500**A, the opening portion **152***a* of the balloon **150** and a distal end side of the distal end part body **34** are aligned, and as shown in **1500**B, the opening portion **152***a* of the balloon **150** is attached to the distal end part body **34**, and the balloon **150** is mounted on the distal end part body **34**.

The protrusion portions **152***h* of the balloon **150** and the groove portions **92** of the distal end part body **34** are fitted, whereby it can be made difficult for the balloon **150** to fall off from the distal end part body **34**.

The ultrasonic wave transmission medium is stored in a space configured with the balloon **150** and with the distal end part body **34**, whereby the oscillator surface region **152***f* of the balloon body **152** is swollen.

In this case, a swelling restricting part is provided in the balloon body **152**, whereby the oscillator surface region **124***f* can be more effectively swollen. For example, the swelling restricting part is a thick portion **152***g* that is disposed on the other end side (Z(+) side) opposite to one end (Z(−) side) of the inclined surface portion **152***d* in the first direction (Z direction). In a case where the ultrasonic wave transmission medium is supplied inside the balloon body **152**, the thick portion **152***g* suppresses swelling of a distal end side (Z(+) side) of the oscillator surface region **152***f*.

As another swelling restricting part, the two side surface portions **152***b* are in close contact with and fixed to the standing wall portions **91**. The side surface portions **152***b* in close contact with and fixed to the standing wall portions **91** suppress swelling of the oscillator surface region **152***f* in the width direction (X direction) in a case where the ultrasonic wave transmission medium is supplied inside the balloon body **152**. A width (a length in the X direction) of the two side surface portions **152***b* of the balloon **150** before being mounted on the distal end part body **34** is made smaller than a distance (a length in the X direction) between the two standing wall portions **91** in the width direction, whereby the two side surface portions **152***b* can be in close contact with and fixed to the standing wall portions **91**.

As another swelling restricting part, the top surface portion **152***c* and the plane portion **93** of the distal end part body **34** are in close contact and fixed. The top surface portion **152***c* in close contact with and fixed to the plane portion **93** suppresses swelling of the proximal end side (Z(−) side) of the oscillator surface region **152***f* in a case where the ultrasonic wave transmission medium is supplied inside the balloon body **152**. A distance (a length in the Y direction) between the top surface portion **152***c* and the bottom surface portion **152***e* of the balloon **150** before being mounted on the distal end part body **34** is made smaller than a height (a length in the Y direction) of the distal end part body **34** to be portions to which the top surface portion **152***c* and the bottom surface portion **152***e* are in close contact with and fixed, whereby the top surface portion **152***c* can be in close contact with and fixed to the plane portion **93**.

The balloon **150** of another embodiment can make the oscillator surface region **152***f* of the balloon body **152** facing the oscillator surface **51** of the ultrasound transducer **50** most swollen by restricting a part of the balloon body **152** with the swelling restricting part in a case where the ultrasonic wave transmission medium is stored inside the balloon body **152**. As a result, in a case where the balloon **150** is swollen, it is possible to achieve a reduction in outer diameter of the balloon **150**, and since the balloon **150** is not swollen on an opposite side of the oscillator surface **51**, it is possible to stably bring the oscillator surface **51** into contact with a site to be observed in a body cavity through the balloon **150**.

EXPLANATION OF REFERENCES

**1**: ultrasonic endoscope
**10**: operating part
**12**: insertion part
**14**: universal cord
**16**: angle lever
**22**: suction button
**23**: treatment tool insertion channel
**24**: treatment tool inlet port
**30**: soft part
**32**: bending part
**34**: distal end part body
**34***a*: ultrasonic attachment part
**34***b*: outlet port forming portion
**34***c*: body part
**38**: longitudinal axis

**40**: observation optical system
**40***a*: observation window
**40***b*: lens system
**40***c*: imaging element
**44**: illumination optical system
**44***a*: illumination window
**50**: ultrasound transducer
**51**: oscillator surface
**52**: treatment tool outlet port
**54**: signal cable
**56**: signal cable
**58**: light guide
**71**: opening forming surface
**74**: pipe line
**82**: optical system storage portion
**84**: convex surface
**85**: stepped surface
**91**: standing wall portion
**92**: groove portion
**93**: plane portion
**94**: stepped portion
**100**: puncture needle
**120**: balloon for ultrasonic endoscope
**121**: balloon body
**121***a*: storage portion
**121***b*: adhesion portion
**121***c*: adhesion region
**122**: inner part
**122***a*: opening portion
**122***b*: side surface portion
**122***c*: top surface portion
**122***d*: inclined surface portion
**122***e*: bottom surface portion
**122***f*: first side surface portion
**122***g*: second side surface portion
**122***h*: stepped portion
**122***i*: flange portion
**122***j*: protrusion portion
**122***k*: locking portion
**122***m*: communication path
**122***n*: tapered portion
**122***p*: tapered portion
**122***q*: flat portion
**124**: outer part
**124***a*: opening portion
**124***b*: side surface portion
**124***c*: top surface portion
**124***d*: inclined surface portion
**124***e*: bottom surface portion
**124***f*: oscillator surface region
**124***g*: thick portion
**124***h*: transition portion
**124***i*: recess portion
**140**: tube
**150**: balloon
**152**: balloon body
**152***a*: opening portion
**152***b*: side surface portion
**152***c*: top surface portion
**152***d*: inclined surface portion
**152***e*: bottom surface portion
**152***f*: oscillator surface region
**152***g*: thick portion
**152***h*: protrusion portion

What is claimed is:

**1**. A balloon for an ultrasonic endoscope that is mounted to cover an outside surface of an ultrasound transducer provided in a distal end part body on a distal end side of an insertion part, the balloon comprising:

a bottomed tubular balloon body that has an opening portion provided at one end in a first direction corresponding to a longitudinal direction of the insertion part and attached to the distal end part body, covers an oscillator surface of the ultrasound transducer, and stores an ultrasonic wave transmission medium inside, to be swellable; and

a swelling restricting part that, in a case where the ultrasonic wave transmission medium is stored inside the balloon body, makes an oscillator surface region facing the oscillator surface of the ultrasound transducer most swollen by restricting a part of the balloon body,

wherein the balloon body has at least a two-layer structure including an inner part that has the opening portion at one end and an outer part that covers the inner part and that is bonded on an opening portion side,

wherein the outer part includes thick portions that are formed to have a thickness greater than a thickness of the oscillator surface region, on both sides of the oscillator surface region in a second direction perpendicular to the first direction, and transition portions that are formed between the thick portions and the oscillator surface region, and the swelling restricting part comprises the transition portions.

**2**. The balloon for an ultrasonic endoscope according to claim **1**,

wherein a storage portion that stores the ultrasonic wave transmission medium is provided between the inner part and the outer part, and

the outer part has the oscillator surface region.

**3**. The balloon for an ultrasonic endoscope according to claim **2**,

wherein an adhesion portion for bonding the inner part and the outer part is provided, and the swelling restricting part comprises the adhesion portion.

**4**. The balloon for an ultrasonic endoscope according to claim **2**,

wherein the outer part includes a thick portion that is formed to have a thickness greater than a thickness of the oscillator surface region, on the other end side opposite to the one end in the first direction, and the swelling restricting part comprises the thick portion.

**5**. The balloon for an ultrasonic endoscope according to claim **2**,

wherein adhesion regions of the inner part and of the outer part are provided on both sides of the oscillator surface region in the second direction perpendicular to the first direction, and the swelling restricting part comprises the adhesion regions.

**6**. The balloon for an ultrasonic endoscope according to claim **1**,

wherein the balloon body has a region smaller than a distance between standing wall portions provided on both sides of the ultrasound transducer before mounting on the distal end part body.

**7**. The balloon for an ultrasonic endoscope according to claim **1**,

wherein the balloon body includes a protrusion portion that protrudes to a distal end part body side and that is fitted into a groove portion of the distal end part body formed on a proximal end side of the ultrasound transducer.

**8**. The balloon for an ultrasonic endoscope according to claim **1**, wherein the balloon body includes a locking portion that is locked to a stepped portion formed on a surface of the distal end part body on an opposite side of the ultrasound transducer.

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