(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 324 754 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
25.05.2011 Bulletin 2011/21

(21) Application number: **09822093.2**

(22) Date of filing: **23.10.2009**

(51) Int Cl.:
A61B 1/00 *(2006.01)* ***G02B 13/00*** *(2006.01)*
G02B 23/24 *(2006.01)* ***G02B 23/26*** *(2006.01)*

(86) International application number:
PCT/JP2009/068286

(87) International publication number:
WO 2010/047396 (29.04.2010 Gazette 2010/17)

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR
Designated Extension States:
AL BA RS

(30) Priority: **24.10.2008 JP 2008274486**

(71) Applicant: **Olympus Medical Systems Corp.**
Tokyo 151-0072 (JP)

(72) Inventors:
- **AONO, Susumu**
  Tokyo 192-8512 (JP)
- **KOKUBO, Mitsutaka**
  Tokyo 192-8512 (JP)

(74) Representative: **Schicker, Silvia**
Wuesthoff & Wuesthoff
Patent- und Rechtsanwälte
Schweigerstrasse 2
81541 München (DE)

(54) INSERTION SECTION OF ENDOSCOPE

(57) The present invention relates to an endoscope insertion portion using an actuator unit and a heater unit together for an imaging unit wherein a shape memory member is used in the actuator unit in order to drive a movable optical member of the imaging unit, which is configured to deform according to the temperature and a heating member is used in the heater unit, which is configured to heat a distal end optical member of the imaging unit.

An object of the present invention is to provide an endoscope insertion portion wherein an actuator unit can operate suitably.

An endoscope insertion portion is **characterized in that** the endoscope insertion portion extends in an axial direction and includes: an imaging unit (38) configured to acquire an observation image and including a distal end optical member (44) arranged at a distal end portion of the imaging unit (38), a movable optical member (51) configured to move relative to the distal end optical member (44) and having an optical axis (O); an actuator unit (56) configured to drive the movable optical member (51) and including a shape memory member (58) configured to deform according to temperature; and a heater unit (62) including a heating member (63) configured to heat the distal end optical member (44) wherein the heater unit (62) is arranged on a side opposite to a side on which the actuator unit (56) is arranged relative to the optical axis (O) of the imaging unit (38) when viewing in the axial direction of the insertion portion (21).

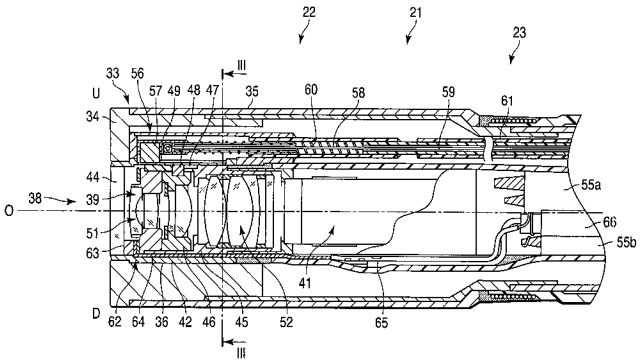

FIG. 2

EP 2 324 754 A1

Description

Technical Field

[0001] The present invention relates to an endoscope insertion portion using an actuator unit and a heater unit together for an imaging unit wherein a shape memory member is used in the actuator unit in order to drive a movable optical member of the imaging unit, which is configured to deform according to the temperature and a heating member is used in the heater unit, which is configured to heat a distal end optical member of the imaging unit.

Background Art

[0002] In Jpn. Pat. Appln. KOKAI Publication No. 2007-219155, one example of an actuator unit is disclosed. In an endoscope disclosed in Jpn. Pat. Appln. KOKAI Publication No. 2007-219155, an imaging unit is provided at the distal end portion of the endoscope. The imaging unit includes a movable lens frame with a group of objective lenses assembled therein and movable in an optical axial direction. The movable lens frame is configured to be driven by an actuator unit, and a shape memory alloy (which is referred to as SMA, hereinafter) wire is used in the actuator unit.

[0003] In Jpn. Pat. Appln. KOKAI Publication No. 11-47080, one example of a heater unit is disclosed. In an endoscope disclosed in Jpn. Pat. Appln. KOKAI Publication No. 11-47080, a heating body is provided so as to enclose the outer periphery of an objective optical system in the distal end portion of the endoscope. Heat produced in the heating body is transmited to the objective optical system, and the objective optical system rises in the temperature, and therefore, the objective optical system is prevented from being fogged.

Disclosure of Invention

[0004] When an actuator unit and a heater unit are used together, a shape memory member of the actuator unit is influenced by heat produced in a heating member of the heater unit and the actuator unit may not suitably operate.

[0005] The present invention has been made in view of the above-mentioned problem, and an object of the present invention is to provide an endoscope insertion portion wherein an actuator unit can suitably operate.

[0006] In an aspect of the present invention, an endoscope insertion portion is characterized in that the endoscope insertion portion extends in an axial direction and includes: an imaging unit configured to acquire an observation image and including a distal end optical member arranged at a distal end portion of the imaging unit and a movable optical member configured to be moved relative to the distal end optical member, and having an optical axis; an actuator unit configured to drive the movable optical member and including a shape memory member configured to deform according to temperature; and a heater unit including a heating member configured to heat the distal end optical member wherein the heater unit is arranged on a side opposite to a side on which the actuator unit is arranged relative to the optical axis of the imaging unit when viewing in the axial direction of the insertion portion.

[0007] In this aspect, the actuator unit and the heater unit are arranged as apart as possible within permissible limits for their functions when viewing in the axial direction of the insertion portion.
Therefore, the shape memory member is hardly influenced by heat produced in the heating member, and then, suitable operation of the actuator unit is ensured.

[0008] In a preferred aspect of the present invention, the endoscope insertion portion is characterized in that the imaging unit includes a cylindrical supporting member extending in the axial direction of the insertion portion, the movable optical member and the distal end optical member are arranged in an inner space of the supporting member, the actuator unit is arranged at an outer peripheral surface portion of the supporting member, the heater unit is arranged at an inner peripheral surface portion of the supporting member, and the supporting member has a heat-insulating function.

[0009] In this aspect, the supporting member having the heat-insulating function is provided between the actuator unit and the heater unit. Therefore, the shape memory member is more hardly influenced by the heat produced in the heating member.

[0010] In a preferred aspect of the present invention, the endoscope insertion portion is characterized in that the imaging unit includes two imaging substrates, and a straight line connecting the actuator unit and the heater unit with each other is substantially a perpendicular bisector of a line segment connecting the two imaging substrates with each other, when viewing in the axial direction of the insertion portion.

[0011] In this aspect, the actuator unit and the two imaging substrates, and the heater unit and the two imaging substrates are arranged as apart as possible within permissible limits for their functions, respectively, when viewing in the axial direction of the insertion portion. Therefore, the shape memory member is hardly influenced by heat produced in the two imaging substrates, and the two imaging substrates are hardly influenced by heat produced in the shape memory member and the heating member, and then, suitable operation of the actuator unit and the imaging unit is ensured.

[0012] In a preferred aspect of the present invention, the endoscope insertion portion is characterized in that the endoscope insertion portion further comprising two illumination units configured to supply illumination light to an object of observation, and a straight line connecting the two imaging substrates with each other is substantially a perpendicular bisector of a line segment connecting the two illumination units with each other, when view-

ing in the axial direction of the insertion portion.

[0013] In this aspect, the actuator unit and the two illumination units, and the two imaging substrates and the two illumination units are arranged as apart as possible within permissible limits for their functions, respectively, when viewing in the axial direction of the insertion portion. The shape memory member and the two imaging substrates are hardly influenced by heat produced in the two illumination units, and then, suitable operation of the actuator unit and the imaging unit is ensured.

[0014] In a preferred aspect of the present invention, the endoscope insertion portion is characterized in that the shape memory member and the heating member are arranged in positions different from each other with respect to the axial direction of the insertion portion, respectively.

[0015] In this aspect, the shape memory member and the heating member are arranged in the positions different from each other with respect to the axial direction. Therefore, the shape memory member is hardly influenced by heat produced in the heating member, and then, suitable operation of the actuator unit is ensured certainly.

[0016] In a preferred aspect of the present invention, the endoscope insertion portion is characterized in that the imaging unit includes an imaging device and an imaging substrate, and the shape memory member, the heating member, and the imaging device and the imaging substrate are arranged in positions different from one another with respect to the axial direction of the insertion portion, respectively.

[0017] In this aspect, the shape memory member, the heating member, and the imaging device and the imaging substrate are arranged in the positions different from each other with respect to the axial direction. Therefore, the shape memory member is hardly influenced by heat produced in the imaging device and the imaging substrate, and the imaging device and the imaging substrate are hardly influenced by heat produced in the shape memory member and the heating member. Therefore, suitable operation of the actuator unit and the imaging unit is ensured more certainly.

[0018] In a preferred aspect of the present invention, the endoscope insertion portion is characterized in that the endoscope insertion portion further comprising an illumination unit configured to supply illumination light to an object of observation, the illumination unit includes: a transmitting member configured to transmit the illumination light; and an emitting member connected with an end portion of the transmitting member and configured to emit the illumination light transmitted by the transmitting member to the object of observation, and the shape memory member, the imaging device and the imaging substrate, and a connecting portion of the transmitting member and the emitting member are arranged in positions different from one another with respect to the axial direction of the insertion portion, respectively.

[0019] In this aspect, the shape memory member, the imaging device and the imaging substrate, and the connecting portion of the transmitting member and the emitting member are arranged in the positions different from each other with respect to the axial direction. Therefore, the shape memory member, and the imaging device and the imaging substrate are hardly influenced by heat produced in the illumination unit, and then, suitable operation of the actuator unit and the imaging unit is ensured more certainly.

Brief Description of Drawings

[0020]

FIG. 1 is a side view showing an endoscope according to an embodiment of the present invention;
FIG. 2 is a longitudinally cross-sectional view showing the distal end portion of an insertion portion according to the embodiment of the present invention;
FIG. 3 is a transversally cross-sectional view showing the distal end portion of the insertion portion according to the embodiment of the present invention along III-III line in FIG. 2;
FIG. 4 is a front view showing the distal end portion of the insertion portion according to the embodiment of the present invention;
FIG. 5 is a schematic view showing the distal end portion of the insertion portion according to the embodiment of the present invention when viewing in the axial direction;
FIG. 6 is a schematic longitudinally cross-sectional view showing the distal end portion of the insertion portion according to the embodiment of the present invention when viewing in the left and right direction;
FIG. 7 is a schematic longitudinally cross-sectional view showing the distal end portion of the insertion portion according to the embodiment of the present invention when viewing in the up and down direction; and
FIG. 8 is a schematic transversally cross-sectional view showing a bending portion according to the embodiment of the present invention when viewing in the axial direction.

Best Mode for Carrying Out the Invention

[0021] An embodiment of the present invention will be explained referring to the drawings.

[0022] Referring to FIG. 1, an endoscope 20 includes an insertion portion 21 configured to be inserted into a body. In the insertion portion 21, a distal end rigid portion 22 being rigid, a bending portion 23 operated to be bent, and a flexible tube portion 24 being long and flexible are provided from the distal end side to the proximal end side. An operation portion 25 is coupled to the proximal end portion of the insertion portion 21 and is configured to be held and operated by an operator. Various switches 26 and a bending operation lever 27 are provided in the op-

eration portion 25 and the bending operation lever 27 is configured to operate the bending portion 23 to be bent. A universal cable 28 extends from the operation portion 25, and a light source connector 29 is provided at the extending end portion of the universal cable 28. Moreover, an electrical cable 31 extends from the light source connector 29, and an electrical connecter 32 is provided at the extending end portion of the electrical cable 31. The light source connector 29 and the electrical connecter 32 are connected with a light source apparatus and a video processor, respectively.

[0023] Hereinafter, various units of the insertion portion 21 will be explained in detail.

[0024] Here, the insertion portion 21 extends in the axial direction, two directions which are orthogonal to the axial direction of the insertion portion 21 and each other are referred to as up and down direction, and left and right direction, respectively. In FIGS. 2 to 8, up, down, left and right are referred to as U, D, L and R, respectively.

[0025] Referring to FIGS. 2 to 4, an exterior unit 33 is provided in the distal end rigid portion 22 and forms an outer frame of the distal end rigid portion 22. The exterior unit 33 is formed by a distal end side exterior member 34 and a proximal end side exterior member 35, the distal end side exterior member 34 has a shape of a short circular column and the proximal end side exterior member 35 has a shape of a circular cylinder, and the distal end portion of the proximal end side exterior member 35 is coaxially fitted on the outside of and fixed to the proximal end side part of the distal end side exterior member 34. An imaging bore 36 and an illumination bore 37 penetrate the distal end side exterior member 34 in the axial direction.

[0026] Referring to FIGS. 2 to 7, an imaging unit 38 is provided within the exterior unit 33 and configured to acquire an observation image. The imaging unit 38 extends in the axial direction of the insertion portion 21. The central axis of the imaging unit 38 agrees with an optical axis O of the imaging unit 38 and arranged a little lower with respect to the up and down direction and on the right side with respect to the left and right direction relative to the central axis of the insertion portion 21. The imaging unit 38 is formed by an objective optical unit 39 on the distal end side and an image pick-up optical unit 41 on the proximal end side.

[0027] Referring to FIGS. 2 to 4, the objective optical unit 39 includes a circular cylindrical outer lens frame 42 as a supporting member. The outer lens frame 42 is made of a material having low thermal conductivity, for example, polyphenylsulfone, PEEK, polysulfone, polyethylene, stainless steel and has a heat-insulating function. The outer lens frame 42 is fitted on the inside of the imaging bore 36 of the distal end side exterior member 34 and fixed to the distal end side exterior member 34 with a fixing screw 43. An objective cover lens 44 as a distal end optical member is fitted on the inside of and fixed to the distal end portion of the outer lens frame 42. The distal end surface of the objective cover lens 44 is substantially coplanar with the distal end surface of the distal end side exterior member 34 and exposed outside. The distal end surface of the objective cover lens 44 may be fogged when the insertion portion 21 is inserted into the body because body temperature is generally higher than room temperature. An interior lens frame 45 is fitted on the inside of and fixed to the proximal end side part of the outer lens frame 42. A movable lens frame 46 is inserted into the distal end side part of the interior lens frame 45 so as to be movable in the axial direction relative to the interior lens frame 45. That is, a penetrating groove-shaped guide groove 47 extends in the axial direction on the upper position in the distal end side part of the interior lens frame 45, a guide pin 48 protrudes upward from the upper end portion of the outer peripheral portion of the movable lens frame 46, and the guide pin 48 of the movable lens frame 46 is inserted into the guide groove 47 of the interior lens frame 45 so as to be slidable in the axial direction. In order to drive the movable lens frame 46, the guide pin 48 is made of a magnetic material such as a metal, and a concave groove-shaped driving groove 49 extends in the axial direction on the upper position of the outer peripheral portion of the distal end side part of the outer lens frame 42. A distal end side group of objective lenses 51 as a movable optical member is fitted on the inside of and fixed to the movable lens frame 46. A proximal end side group of objective lenses 52 is fitted on the inside of and fixed to the proximal end side part of the interior lens frame 45.

[0028] An image formation of an observation image is performed by the objective cover lens 44, the distal end side group of objective lenses 51 and the proximal end side group of objective lenses 52 in the objective optical unit 39. Here, it is possible to perform focusing by moving the movable lens frame 46 in the optical axial direction to move the distal end side group of objective lenses 51 in the optical axial direction.

[0029] Referring to FIGS. 5 to 7, in the image pick-up optical unit 41 according to the present embodiment, a CCD for red and blue and a CCD for green with a large number of picture elements are used as an imaging device in order to obtain a high-definition image and improve a color reproduction quality. The one CCD 53a is arranged on the left side part of the image pick-up optical unit 41 and orthogonal to the left and right direction, and the other CCD 53b is arranged on the proximal end side of the one CCD 53a and orthogonal to the axial direction. A CCD substrate 54a, 54b as an imaging substrate is coupled to each CCD 53a, 53b. Both the CCD substrates 54a and 54b are inclined relative to the central axis of the imaging unit 38 and arranged on the left side and the right side, respectively, symmetrically with each other relative to the central axis. Regarding an opposite surface arranged on the side opposite to the central axis of the imaging unit 38, the opposite surface of the one CCD substrate 54a is directed leftward and proximally and the opposite surface of the other CCD substrate 54b is directed rightward and proximally. Here, various signal

lines extend from the CCD substrates 54a and 54b, and the various signal lines are integrated into the image pick-up cables 55a and 55b. Two image pick-up cables 55a and 55b are used for the two CCDs 53a and 53b and CCD substrates 54a and 54b, respectively.

[0030] When the electrical connecter 32 of the endoscope 20 is connected to the video processor and the CCDs 53a and 53b and the CCD substrates 54a and 54b are operated by the video processor, the CCDs 53a and 53b and the CCD substrates 54a and 54b acquire an observation image and produce an image signal. The produced image signal is output to the video processor, and an observation image is displayed on the video processor. When the imaging unit 38 is operated, the CCDs 53a and 53b and the CCD substrates 54a and 54b produce heat. On the one hand, the operation of the CCDs 53a and 53b and the CCD substrates 54a and 54b may be easily influenced by heat from the outside, and an image is degraded because of the influence of the heat from the outside. Moreover, the operation of the CCD substrates 54a and 54b may be easily influenced by electric noise from the outside, and an image is degraded because of the influence of the electrical noise.

[0031] Referring to FIGS. 2 to 4, an actuator unit 56 is provided within the exterior unit 33 and configured to drive the distal end side group of objective lenses 51 of the imaging unit 38. That is, the actuator unit 56 extends in the axial direction on the upper side of the imaging unit 38 along the imaging unit 38. The actuator unit 56 includes a driving magnet 57. The driving magnet 57 is arranged in the driving groove 49 of the outer lens frame 42 of the objective optical unit 39 so as to be slidable in the axial direction. The driving magnet 57 is magnetically coupled to the guide pin 48 of the movable lens frame 46 of the objective optical unit 39. When the driving magnet 57 is moved in the axial direction, the guide pin 48 is moved in the axial direction, and then, the movable lens frame 46 is moved in the optical axial direction. A reset spring 60 always distally urges the driving magnet 57. Moreover, the distal end portion of a SMA wire 58 as a shape memory member is coupled to the driving magnet 57. The SMA wire 58 extends in the axial direction. The distal end portion of a current line 59 is connected to the proximal end portion of the SMA wire 58, and the proximal end portion of the SMA wire 58 is held so as to be unmovable in the axial direction. Here, the current line 59 is put into an actuator cable 61, and the actuator cable 61 is inserted through the bending portion 23 and extends to the electrical connecter 32.

[0032] When an electric current flows through the SMA wire 58 via the current line 59 and the temperature of the SMA wire 58 becomes higher than the transformation temperature, the SMA wire 58 is deformed to shrink in the axial direction against the urging force of the reset spring 60 to move the driving magnet 57 proximally. On the other hand, when the electric current is stopped from flowing through the SMA wire 58 and the temperature of the SMA wire 58 become lower than the transformation temperature, the SMA wire 58 is deformed to expand in the axial direction and the driving magnet 57 is moved distally by the urging force of the reset spring 60. That is, when the actuator unit 56 is operated, the SMA wire 58 produces heat. On the other hand, the operation of the SMA wire 58 is influenced by heat from the outside, and the SMA wire 58 may not suitably operate because of the influence of the heat from the outside. In this case, the driving magnet 57 and the movable lens frame 46 are not suitably moved, and then, an obtained observation image may be out of focus.

[0033] Referring to FIGS. 2 to 4, a heater unit 62 is provided within the exterior unit 33 and configured to heat the objective cover lens 44 of the imaging unit 38. That is, the heater unit 62 extends in the axial direction along the imaging unit 38 on the lower end part of the imaging unit 38. The heater unit 62 includes a heating element 63 as a heating member. The heating element 63 is provided on the lower end part of the proximal end side of the objective cover lens 44. In the present embodiment, the heating element 63 is in contact with the proximal end surface of the objective cover lens 44 and has a shape of a belt extending along the periphery and over substantially half the circumference in the lower semicircular part of the proximal end surface. Here, the heating element 63 may not be in contact with the objective cover lens 44, and the shape of the heating element 63 may be set on any shape such as a shape of a semicircle or a crescent. The heating element 63 is connected to the one end portion of a heater substrate 64 being a flexible substrate. The heater substrate 64 is arranged between the interior lens frame 45 and the outer lens frame 42 and extends in the axial direction on the lower position of the inner peripheral portion of the outer lens frame 42. The distal end portion of a power line 65 is connected to the proximal end portion of the heater substrate 64. Here, the power line 65 is integrated into a heater cable 66, and the heater cable 66 is inserted through the bending portion 23 and extends to the electrical connecter 32.

[0034] When the heater substrate 64 and the heating element 63 are supplied with electrical power via the power line 65 and the heating element 63 is heated, the objective cover lens 44 rises in the temperature and is prevented from being fogged. When the heater unit 62 is operated, the heating element 63 produces heat, and further, the heater substrate 64 produces heat. Here, noise may be produced in an electric signal transmitted through the power line 65 because of influence of electric noise from the outside.

[0035] Referring to FIGS. 3, 4 and 7, an illumination unit 67 is provided within the insertion portion 21 and configured to illuminate an object of observation. That is, an illumination lens 68 as an emitting member is provided at the distal end portion of the illumination bore 37 of the distal end side exterior member 34. Moreover, the distal end portion of a light guide 69 as a transmitting member is inserted through and fixed to the illumination bore 37. The distal end surface of the light guide 69 is joined to

the proximal end surface of the illumination lens 68. In the present embodiment, two illumination units 67 are used, and the two illumination units 67 are arranged on the upper side with respect to the up and down direction and on the left side and the right side with respect to the left and right direction, respectively, symmetrically with each other relative to the central axis of the insertion portion 21 within the exterior unit 33. The light guide 69 extends from the distal end side exterior member 34, is inserted through the bending portion 23, and extends to the light source connecter 29.

[0036] The light source connecter 29 of the endoscope 20 is connected to the light source apparatus, and illumination light produced in the light source apparatus is transmitted through the light guide 69, supplied to the illumination lens 68, and emitted from the illumination lens 68 to an object of observation. When the illumination light is transmitted through the illumination unit 67, a loss of an amount of light is caused and the illumination unit 67 produces heat. In particular, in the interface between the distal end surface of the light guide 69 and the proximal end surface of the illumination lens 68, a large loss of an amount of light, and then, a large amount of heat are caused. Moreover, in the present embodiment, an amount of light for the illumination light is increased because the two CCDs 53a and 53b with a large number of picture elements are used for acquiring an observation image, and then, the CCDs 53a, 53b lower in sensitivity and an image become dark. Therefore, an amount of heat in the illumination unit 67 becomes large.

[0037] As is described in detail below, in the present embodiment, the various units are arranged in the insertion portion 21 so as to minimize relative influence of heat, and therefore, suitable operation of the various units is ensured.

[0038] Referring to FIGS. 2 to 4, during operation of the heater unit 62, the heating element 63 and the heater substrate 64 produce heat, and therefore, the SMA wire 58 of the actuator unit 56 is influenced by the heat produced in the heating element 63 and the heater substrate 64 and may not suitably operate. In the present embodiment, the actuator unit 56 is arranged on the upper position and the heater unit 62 is arranged on the lower position relative to the optical axis O of the imaging unit 38, namely, the actuator unit 56 and the heater unit 62 are arranged opposite to each other relative to the optical axis O of the imaging unit 38, when viewing in the axial direction of the insertion portion 21. That is, the actuator unit 56 and the heater unit 62 are arranged as apart as possible within permissible limits for their functions when viewing in the axial direction of the insertion portion 21. Therefore, the SMA wire 58 is hardly influenced by the heat produced in the heating element 63 and the heater substrate 64. Moreover, the actuator unit 56 is arranged on the outside of the outer lens frame 42 and the heater unit 62 is arranged on the inside of the outer lens frame 42, namely, the outer lens frame 42 having the heat-insulating function is arranged between the actuator unit 56 and the heater unit 62. Therefore, the SMA wire 58 is more hardly influenced by the heat produced in the heating element 63 and the heater substrate 64, and then, suitable operation of the actuator unit 56 is ensured.

[0039] Here, the heater unit 62 is arranged on the inside of the outer lens frame 42 and the outer lens frame 42 is fitted on the inside of and fixed to the imaging bore 36 of the distal end side exterior member 34, namely, the outer lens frame 42 having the heat-insulating function is arranged between the heater unit 62 and the exterior unit 33. Therefore, during operation of the heater unit 62, the exterior unit 33 is prevented from rising in the temperature by the heat produced in the heating element 63 and the heater substrate 64.

[0040] Referring to FIG. 5, during operation of the imaging unit 38, the CCD substrates 54a and 54b produces heat, and therefore, the SMA wire 58 of the actuator unit 56 is influenced by the heat produced in the CCD substrates 54a and 54b and may not suitably operate. On the other hand, during operation of the heater unit 62 and the actuator unit 56, the heating element 63 and the heater substrate 64, and the SMA wire 58 produce heat, and therefore, the CCD substrates 54a and 54b of the imaging unit 38 is influenced by the heat produced in the heating element 63 and the heater substrate 64, and the SMA wire 58 and may not suitably operate. In the present embodiment, the two CCD substrates 54a and 54b are arranged on the left side and the right side symmetrically with each other relative to the central axis of the imaging unit 38, and the straight line L1 connecting the centers of heating of the actuator unit 56 and the heater unit 62 with each other is a perpendicular bisector of line segment L2 connecting the centers of heating of the two CCD substrates 54a and 54b, when viewing in the axial direction of the insertion portion 21. That is, the actuator unit 56 and the two CCD substrates 54a and 54b, and the heater unit 62 and the two CCD substrates 54a and 54b are arranged as apart as possible within permissible limits for their functions, when viewing in the axial direction of the insertion portion 21. Therefore, the SMA wire 58 is hardly influenced by the heat produced in the two CCD substrates 54a and 54b and the two CCD substrates 54a and 54b is hardly influenced by the heat produced in the SMA wire 58, the heating element 63 and the heater substrate 64, and therefore, suitable operation of the actuator unit 56 and the imaging unit 38 is ensured.

[0041] Here, when a high-frequency treatment instrument configured to treat a living tissue with a high-frequency current together with the endoscope, noise may be caused in an electrical signal transmitting through the power line 65 of the heater cable 66 because of the high-frequency current and influence the CCD substrates 54a and 54b, and then, an image may be degraded. As is described above, in the present embodiment, the heater unit 62 and the two CCD substrates 54a and 54b are arranged as apart as possible within permissible limits for their functions when viewing in the axial direction of the insertion portion 21, and the heater cable 66 extend-

ing from the heater unit 62 in the axial direction is also arranged as apart as possible within permissible limits for their functions relative to the two CCD substrates 54a and 54b, when viewing in the axial direction of the insertion portion 21. Therefore, the CCD substrates 54a and 54b are hardly influenced by the noise of the electric signal transmitting through the power line 65 of the heater cable 66, and suitable operation of the imaging unit 38 is ensured.

[0042] Referring to FIG. 5, during operation of the illumination units 67, the illumination units 67 produce heat, and therefore, the SMA wire 58 of the actuator unit 56 and the CCD substrates 54a and 54b of the imaging unit 38 are influenced and may not suitably operate. In the present embodiment, the two illumination units 67 are arranged on the left side with respect to the left and right direction and on the upper side and the lower side with respect to the up and down direction, respectively, symmetrically with each other relative to the central axis of the insertion portion 21 within the exterior unit 33, and the straight line L2 connecting the centers of heating of the two CCD substrates 54a and 54b is a perpendicular bisector of line segment L3 connecting the centers of heating of the two illumination units 67 when viewing in the axial direction of the insertion portion 21. That is, the actuator unit 56 and the two illumination units 67, and the two CCD substrates 54a and 54b and the two illumination units 67 are arranged as apart as possible within permissible limits for their functions, respectively, when viewing in the axial direction of the insertion portion 21. Therefore, the SMA wire 58 and the two CCD substrates 54a and 54b are hardly influenced by heat produced in the two illumination units 67, and therefore, suitable operation of the actuator unit 56 and the imaging unit 38 is ensured.

[0043] Referring to FIGS. 6 and 7, during operation of the actuator unit 56, the SMA wire 58 produces heat, during operation of the heater unit 62, in particular, the heating element 63 produces heat, during operation of the imaging unit 38, the CCDs 53a and 53b and the CCD substrates 54a and 54b produces heat, and during operation of the illumination unit 67, in particular, the interface between the illumination lens 68 and the light guide 69 produces heat. The SMA wire 58, the CCDs 53a and 53b, and the CCD substrates 54a and 54b may not suitably operate because of the influence of the heat produced in the other heating portion. In the present embodiment, the interface between the illumination lens 68 and the light guide 69, the heating element 63, the SMA wire 58, the CCDs 53a and 53b and the CCD substrates 54a and 54b are arranged in order from the distal end side to the proximal end side on the positions different from one another, respectively, with respect to the axial direction of the insertion portion 21. Therefore, the SMA wire 58, the CCDs 53a and 53b and the CCD substrates 54a and 54b are hardly influenced by the heat produced in the other heating portion, and then, suitable operation of the actuator unit 56 and the imaging unit 38 is ensured.

[0044] Here, the SMA wire 58, the CCDs 53a and 53b and the CCD substrates 54a and 54b, the heating element 63 and the heater substrate 64, and the illumination units 67 may be increased in an amount of heat because of the influence of the other heating portion and, as a result, the whole distal end rigid portion 22 and then the exterior unit 33 may rise in the temperature. In the present embodiment, as is described above, the SMA wire 58, the CCDs 53a and 53b and the CCD substrates 54a and 54b, the heating element 63 and the heater substrate 64, and the illumination units 67 are arranged so as to be influenced by the heat produced in the other heating portion as less as possible, and therefore, the exterior unit 33 is prevented from rising in the temperature.

[0045] As is mentioned above, in the present embodiment, the various units are arranged so as to minimize the relative influence of the heating. As a result, as is shown in FIG. 5, the two light guides 69, and the actuator unit 56 and the heater unit 62 are arranged side by side in the left and right direction, respectively, and the straight line L3 connecting the centers of the two light guides 69 with each other and the straight line L1 connecting the centers of the actuator unit 56 and the heater unit 62 with each other are parallel to each other, when viewing in the axial direction of the insertion portion 21. Therefore, the space within the exterior unit 33 is made maximally efficient use of. Moreover, during bending operation in the up and down direction, the actuator unit 56 and the heater unit 62 are prevented from applying unnecessary load to the light guide 69. Furthermore, as is shown in FIG. 8, the light guide 69 of the illumination unit 67 and the various cables 55a, 55b, 61 and 66 extending from the various units 38, 56 and 62 are arranged evenly on the upper side, the lower side, the left side and the right side relative to the central axis of the bending portion 23 within the bending portion 23. Therefore, during bending operation of the bending portion 23, it is prevented that the bending portion 23 meanders because of unevenness of the built-in members.

[0046] In the above embodiment, although the actuator unit 56 and the heater unit 62 are arranged opposite to each other relative to the optical axis O of the imaging unit 38, the actuator unit and the heater unit may be arranged simply on the sides opposite to each other, respectively, relative to the central axis of the imaging unit 38, when viewing in the axial direction of the insertion portion 21. Furthermore, one or more actuator unit 56 and one or more heater unit 62 may be arranged on the sides opposite to each other, respectively, relative to the optical axis O of the imaging unit 38 when viewing in the axial direction of the insertion portion 21.

Claims

1. An endoscope insertion portion **characterized in that**
   the endoscope insertion portion extends in an axial

direction and comprises:

an imaging unit (38) configured to acquire an observation image and including a distal end optical member (44) arranged at a distal end portion of the imaging unit (38) and a movable optical member (51) configured to be moved relative to the distal end optical member (44), and having an optical axis (O);
an actuator unit (56) configured to drive the movable optical member (51) and including a shape memory member (58) configured to deform according to temperature; and
a heater unit (62) including a heating member (63) configured to heat the distal end optical member (44) wherein the heater unit (62) is arranged on a side opposite to a side on which the actuator unit (56) is arranged relative to the optical axis (O) of the imaging unit (38) when viewing in the axial direction of the insertion portion (21).

2. The endoscope insertion portion according to claim 1, **characterized in that**
the imaging unit (38) includes a cylindrical supporting member (42) extending in the axial direction of the insertion portion (21),
the movable optical member (51) and the distal end optical member (44) are arranged in an inner space of the supporting member (42),
the actuator unit (56) is arranged at an outer peripheral surface portion of the supporting member (42),
the heater unit (62) is arranged at an inner peripheral surface portion of the supporting member (42), and
the supporting member (42) has a heat-insulating function.

3. The endoscope insertion portion according to claim 1, **characterized in that**
the imaging unit (38) includes two imaging substrates (54a, 54b), and
a straight line (L1) connecting the actuator unit (56) and the heater unit (62) with each other is substantially a perpendicular bisector of a line segment (L2) connecting the two imaging substrates (54a, 54b) with each other, when viewing in the axial direction of the insertion portion (21).

4. The endoscope insertion portion according to claim 3, **characterized in that**
the endoscope insertion portion further comprising two illumination units (67) configured to supply illumination light to an object of observation, and
a straight line (L2) connecting the two imaging substrates (54a, 54b) with each other is substantially a perpendicular bisector of a line segment (L3) connecting the two illumination units (67) with each other, when viewing in the axial direction of the insertion portion (21).

5. The endoscope insertion portion according to claim 1, **characterized in that**
the shape memory member (58) and the heating member (63) are arranged in positions different from each other with respect to the axial direction of the insertion portion (21), respectively.

6. The endoscope insertion portion according to claim 5, **characterized in that**
the imaging unit (38) includes an imaging device (53a, 53b) and an imaging substrate (54a, 54b), and the shape memory member (58), the heating member (63), and the imaging device (53a, 53b) and the imaging substrate (54a, 54b) are arranged in positions different from one another with respect to the axial direction of the insertion portion (21), respectively.

7. The endoscope insertion portion according to claim 6, **characterized in that**
the endoscope insertion portion further comprising an illumination unit (67) configured to supply illumination light to an object of observation,
the illumination unit (67) includes: a transmitting member (69) configured to transmit the illumination light; and an emitting member (68) connected with an end portion of the transmitting member (69) and configured to emit the illumination light transmitted by the transmitting member (69) to the object of observation, and
the shape memory member (58), the imaging device (53a, 53b) and the imaging substrate (54a, 54b), and a connecting portion of the transmitting member (69) and the emitting member (68) are arranged in positions different from one another with respect to the axial direction of the insertion portion (21), respectively.

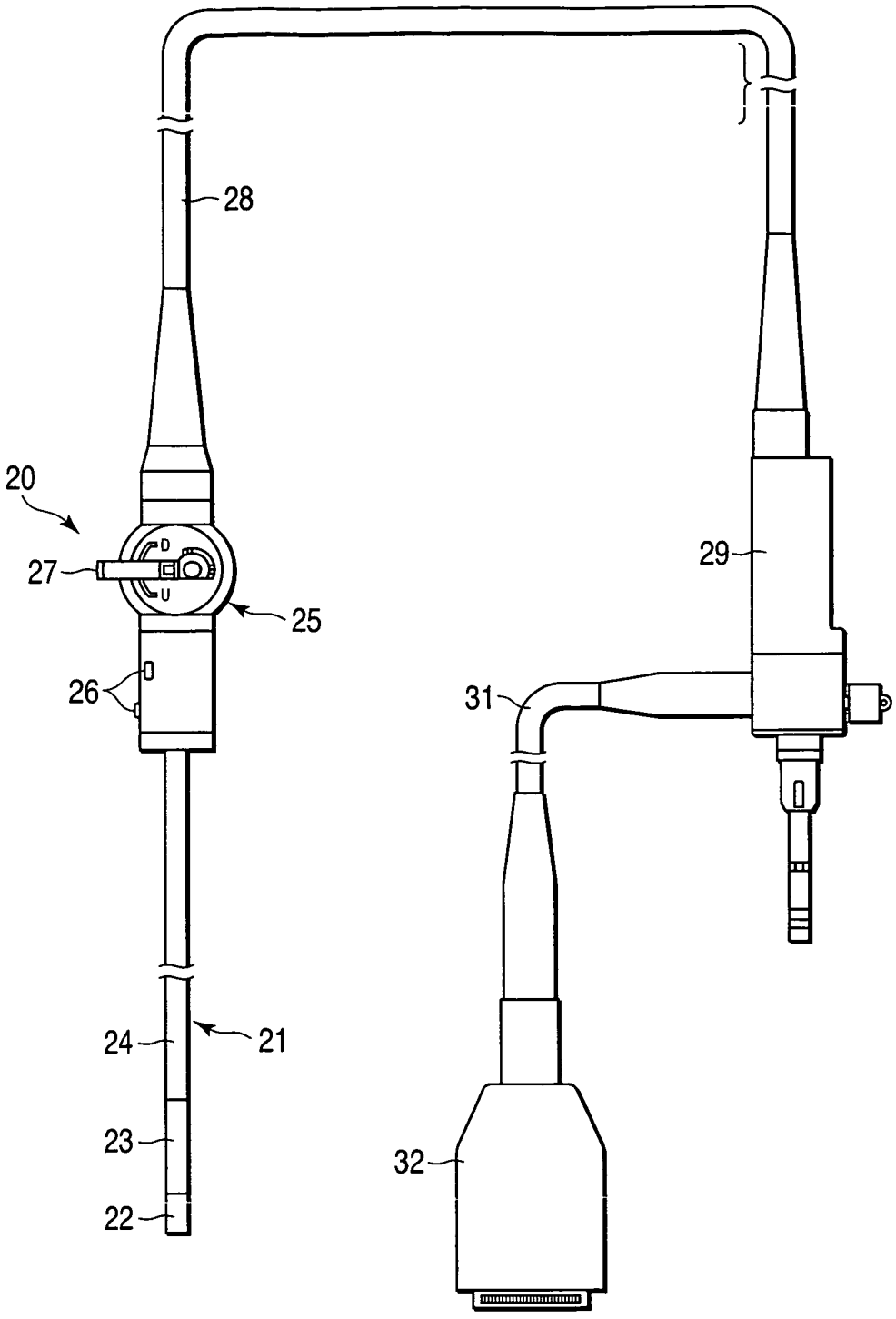

FIG. 1

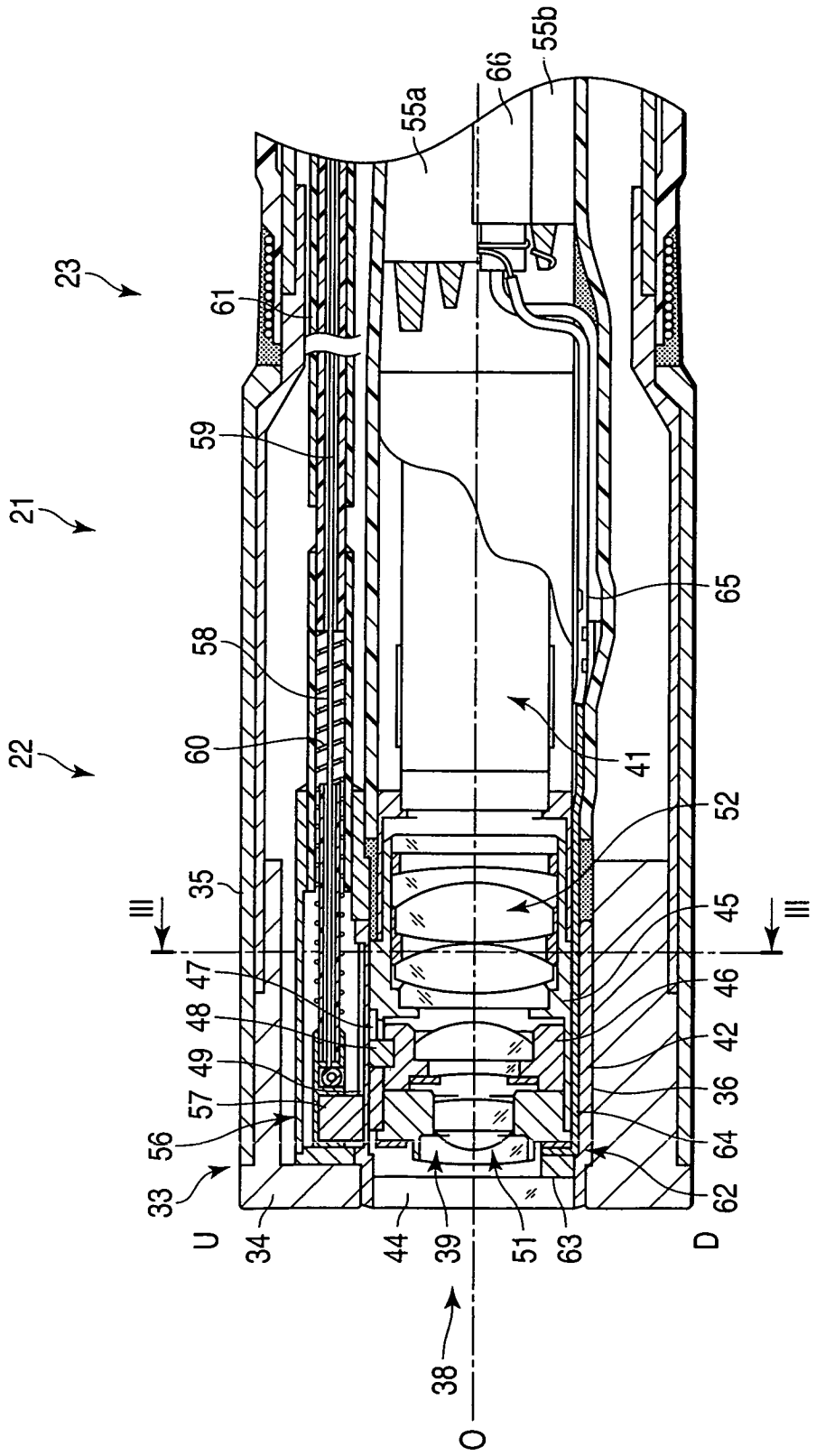
23
21
22
61
59
58
60
55a
66
55b
65
41
52
35
45
III
III
47
48
49
57
56
33
46
42
36
64
62
U
D
34
44
39
51
63
38
O

FIG. 2

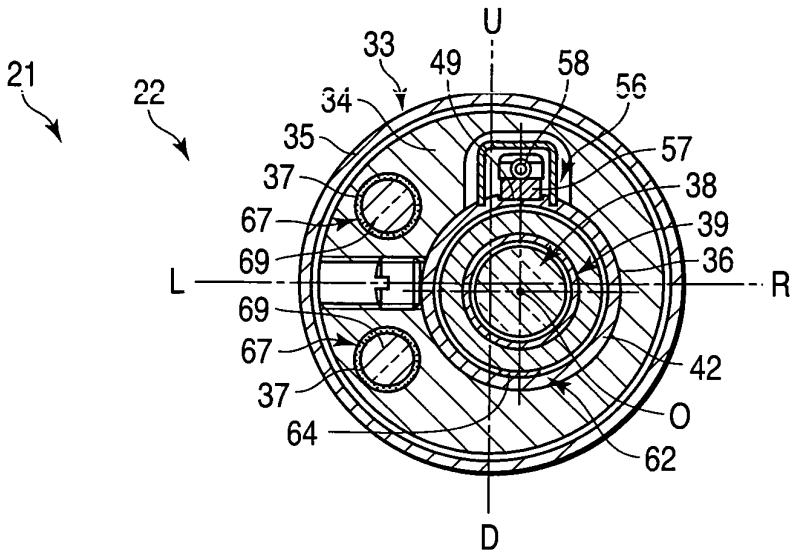
21
22
U
33
49
58
56
34
35
57
37
38
67
39
69
36
L
R
69
67
42
37
O
64
62
D

FIG. 3

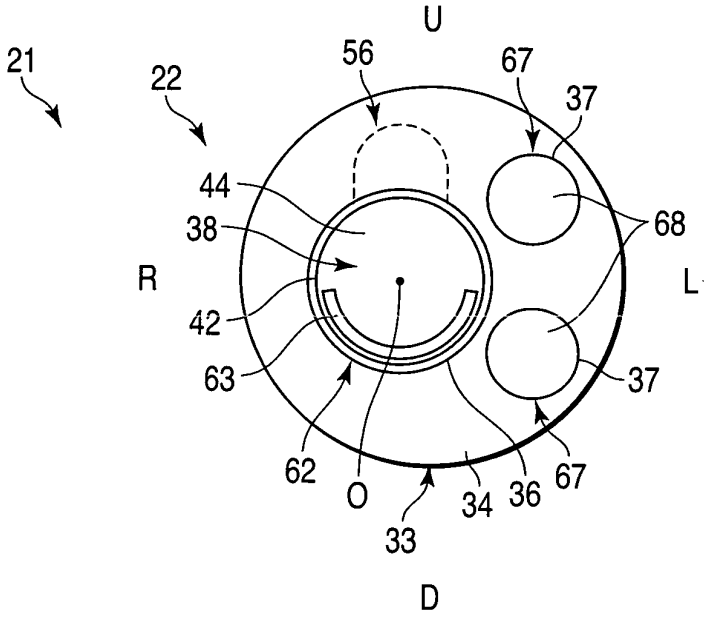
21
22
U
56
67
37
44
38
68
R
L
42
63
37
62
O
34
36
67
33
D

FIG. 4

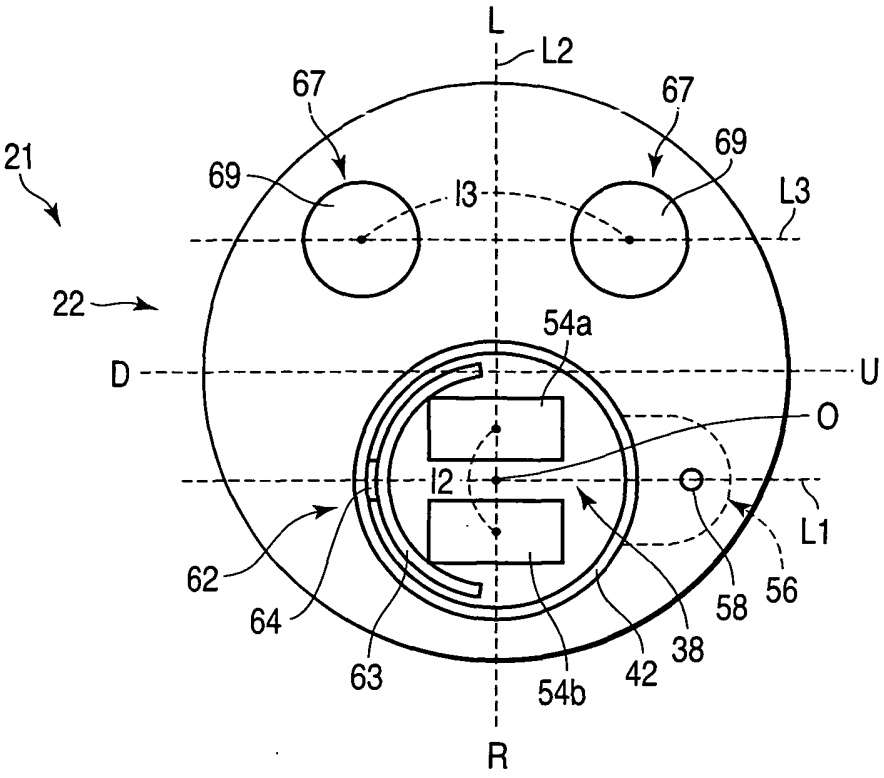
L
L2
67
67
69
69
21
I3
L3
22
54a
D
U
O
I2
L1
62
64
63
54b
42
38
58
56
R

FIG. 5

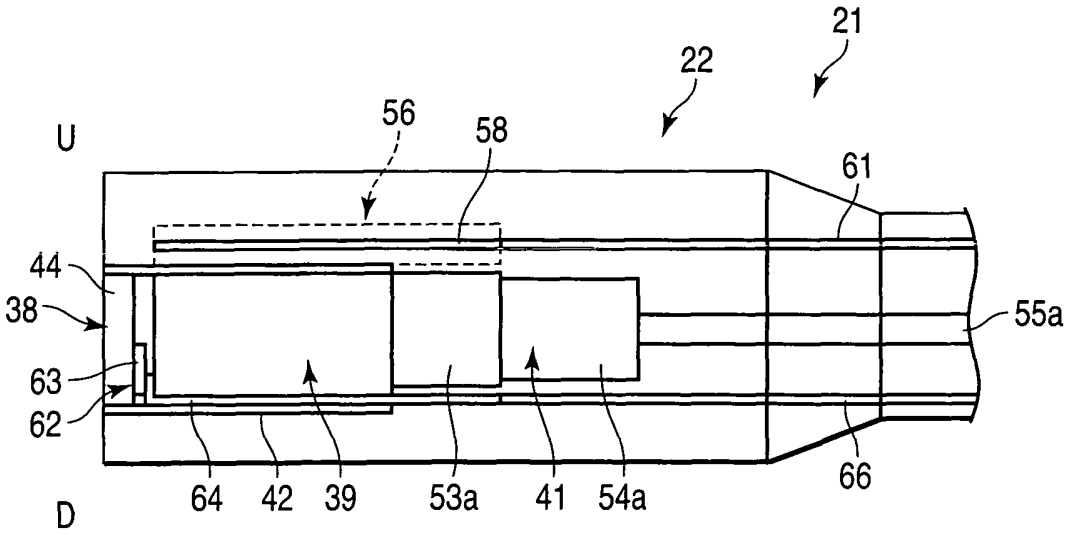
21
22
U
56
58
61
44
38
55a
63
62
64
42
39
53a
41
54a
66
D

FIG. 6

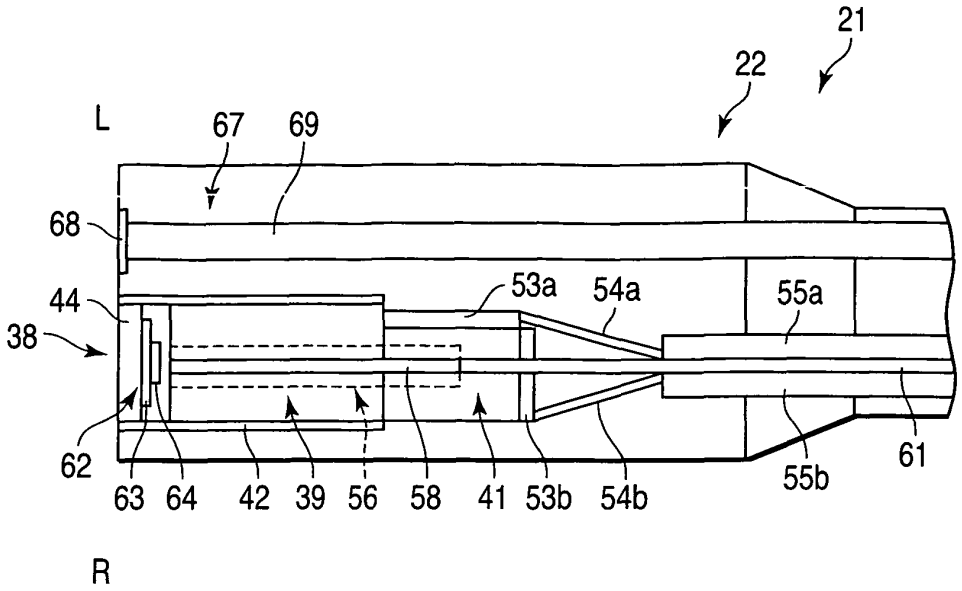
21
22
L
67
69
68
44
38
53a
54a
55a
62
63
64
42
39
56
58
41
53b
54b
55b
61
R

FIG. 7

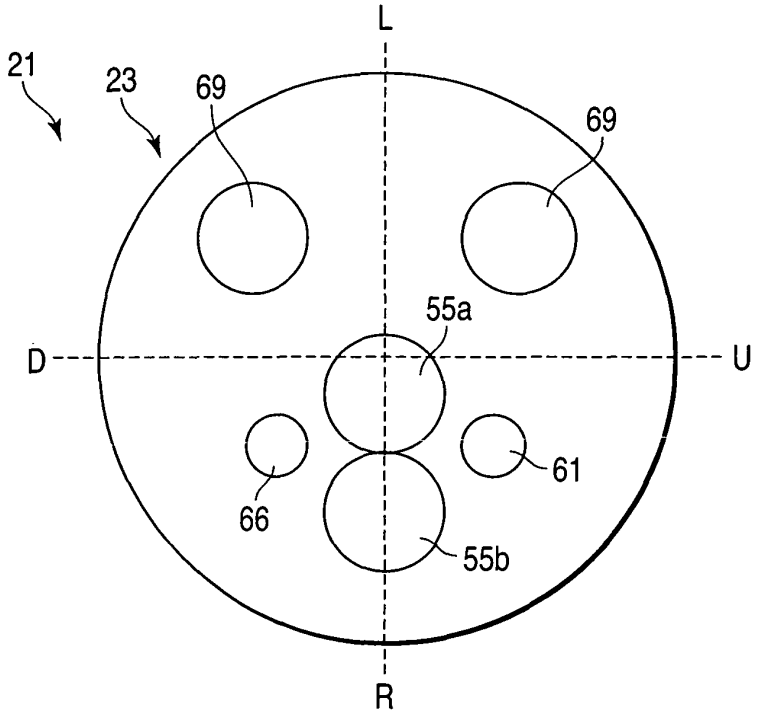
L
21
23
69
69
55a
D
U
61
66
55b
R

FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/068286

A. CLASSIFICATION OF SUBJECT MATTER
A61B1/00(2006.01)i, *G02B13/00*(2006.01)i, *G02B23/24*(2006.01)i, *G02B23/26*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61B1/00, G02B13/00, G02B23/24, G02B23/26

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2010
Kokai Jitsuyo Shinan Koho	1971-2010	Toroku Jitsuyo Shinan Koho	1994-2010

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2008-23275 A (Olympus Corp.), 07 February 2008 (07.02.2008), entire text; all drawings & US 2007/0100209 A1	1-7
Y	JP 2-257926 A (Olympus Optical Co., Ltd.), 18 October 1990 (18.10.1990), entire text; all drawings (Family: none)	1,3-7
Y	JP 5-337078 A (Olympus Optical Co., Ltd.), 21 December 1993 (21.12.1993), paragraphs [0064], [0067]; fig. 19, 21 & US 5609561 A	2

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search 08 January, 2010 (08.01.10)	Date of mailing of the international search report 26 January, 2010 (26.01.10)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/068286

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2008-79823 A (Olympus Medical Systems Corp.), 10 April 2008 (10.04.2008), entire text; all drawings (Family: none)	3,4

Form PCT/ISA/210 (continuation of second sheet) (April 2007)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2007219155 A **[0002]**
- JP 11047080 A **[0003]**

专利名称(译)	内窥镜的插入部分		
公开(公告)号	EP2324754A1	公开(公告)日	2011-05-25
申请号	EP2009822093	申请日	2009-10-23
[标]申请(专利权)人(译)	奥林巴斯医疗株式会社		
申请(专利权)人(译)	奥林巴斯医疗系统股份有限公司.		
当前申请(专利权)人(译)	奥林巴斯医疗系统股份有限公司.		
[标]发明人	AONO SUSUMU KOKUBO MITSUTAKA		
发明人	AONO, SUSUMU KOKUBO, MITSUTAKA		
IPC分类号	A61B1/00 G02B13/00 G02B23/24 G02B23/26 A61B1/002 A61B1/12		
CPC分类号	G02B23/2476 A61B1/0008 A61B1/00096 A61B1/002 A61B1/0058 A61B1/05 A61B1/127 A61B1/128 G02B23/2453		
代理机构(译)	SCHICKER，SILVIA		
优先权	2008274486 2008-10-24 JP		
其他公开文献	EP2324754B1 EP2324754A4		
外部链接	Espacenet		

摘要(译)

内窥镜的插入部分，其构造方式使得致动器单元和加热器单元与成像单元结合使用，其中致动器单元使用可根据温度变形的形状记忆构件，以便驱动成像单元的可移动光学构件，并且其中加热器单元使用加热构件以加热成像单元的尖端光学构件。该配置允许内窥镜的插入部分的致动器单元被适当地操作。内窥镜的轴向延伸的插入部分设置有：用于捕获观察图像的成像单元（38），具有光轴（O）的成像单元（38）并且设置有安装到其上的尖端光学构件（44）。成像单元（38）的尖端并且还具有可相对于尖端光学构件（44）移动的可移动光学构件（51）;用于驱动可移动光学构件（51）的致动器单元（56），致动器单元（56）具有根据温度可变形的形状记忆构件（58）;加热器单元（62）具有用于加热尖端光学构件（44）的加热构件（63），当沿插入部分（21）的轴向观察时，加热器单元（62）位于致动器的对面单元（56）横跨成像单元（38）的光轴（O）。

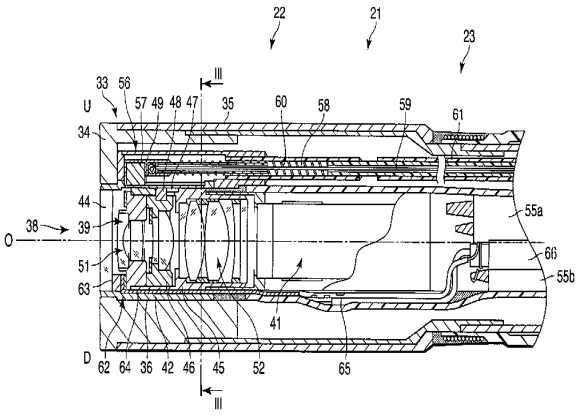

FIG.2