US 20030225332A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2003/0225332 A1

Okada et al. (43) Pub. Date: Dec. 4, 2003

(54) ULTRASONIC THERAPEUTIC APPARATUS

(75) Inventors: **Mitsumasa Okada**, Tokyo (JP); **Satoshi Honma**, Tokyo (JP)

Correspondence Address:
Thomas Spinelli
Scully, Scott, Murphy & Presser
400 Garden City Plaza
Garden City, NY 11530 (US)

(73) Assignee: **OLYMPUS OPTICAL CO., LTD.**, Tokyo (JP)

(21) Appl. No.: **10/445,581**

(22) Filed: **May 27, 2003**

(30) **Foreign Application Priority Data**

May 31, 2002 (JP) 2002-160557

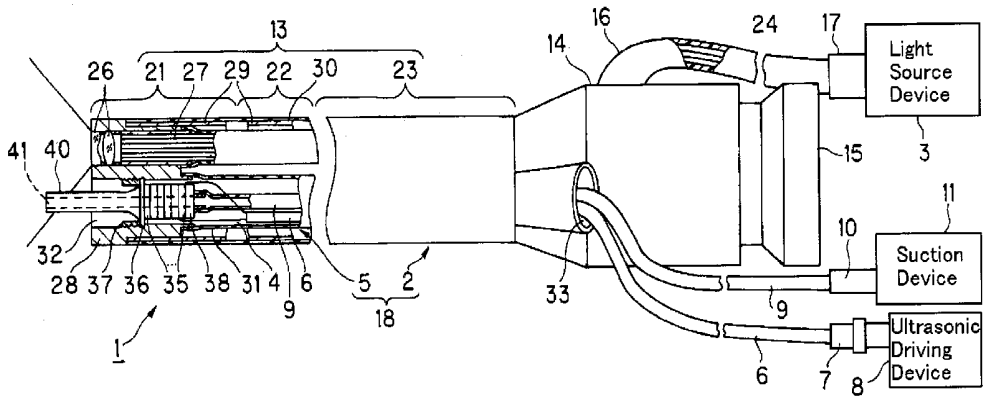
Publication Classification

(51) **Int. Cl.**[7] **A61B 8/00**

(52) **U.S. Cl.** **600/439**

(57) **ABSTRACT**

An ultrasonic therapeutic apparatus is disclosed which includes an endoscope having an inserting section to be inserted into an object, an ultrasonic vibrator for generating ultrasonic vibration, a vibration transmitting section for transmitting the ultrasonic vibration generated by the ultrasonic vibrator to the object, and a holding member for holding the ultrasonic vibrator and the vibration transmitting section in a tip portion of the inserting section of the endoscope. This construction does not need the process of positioning the ultrasonic therapeutic apparatus with respect to the endoscope. An example of the vibration transmitting section is a probe (horn).



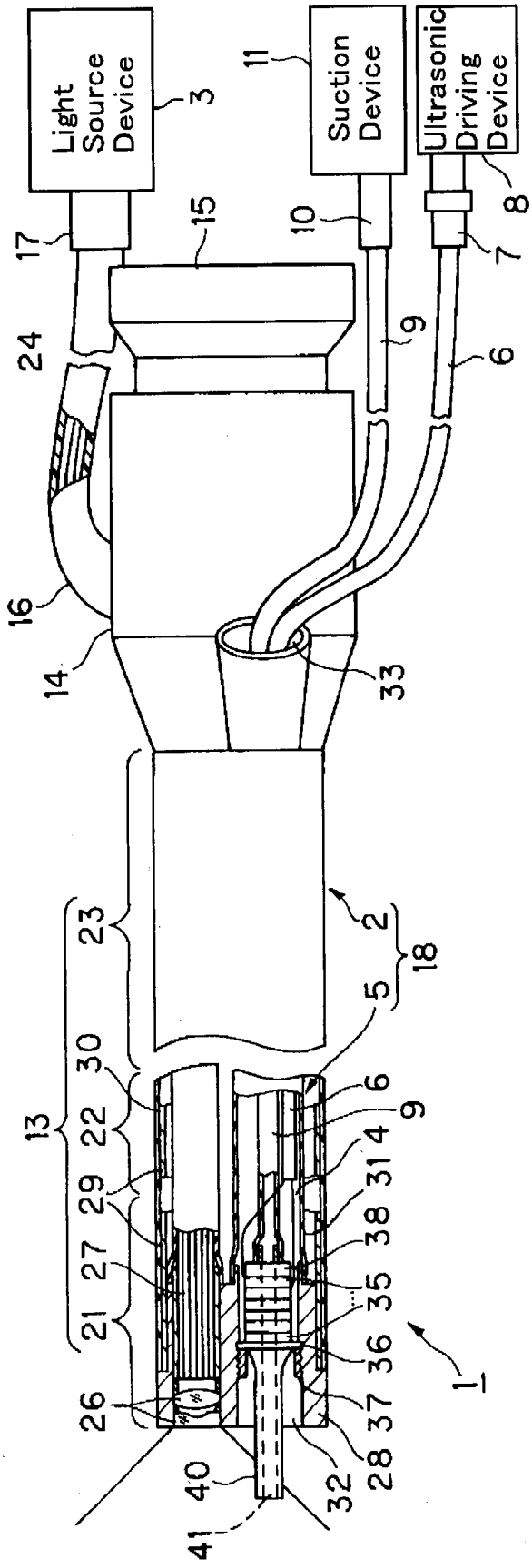

Light Source Device
3
Suction Device
11
Ultrasonic Driving Device
8
17
15
10
7
24
9
6
16
14
33
23
2
18
5
30
6
13
22
9
4
29
31
38
27
35
21
36
1
26
37
28
32
40
41

FIG. 1

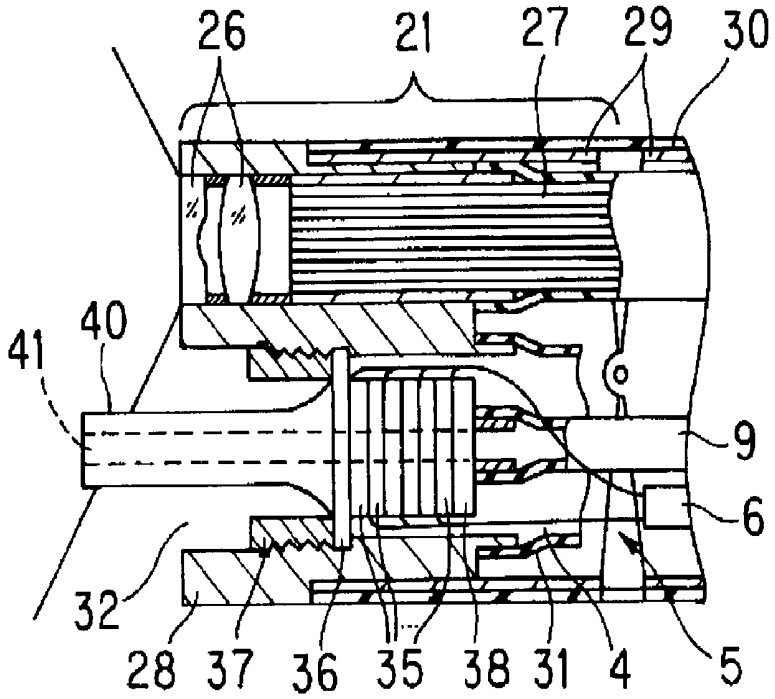


FIG. 2A

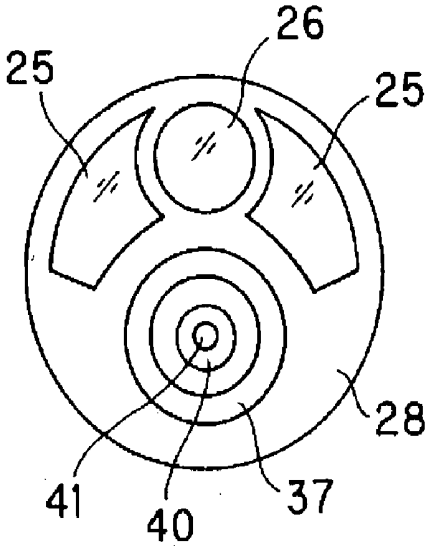


FIG. 2B

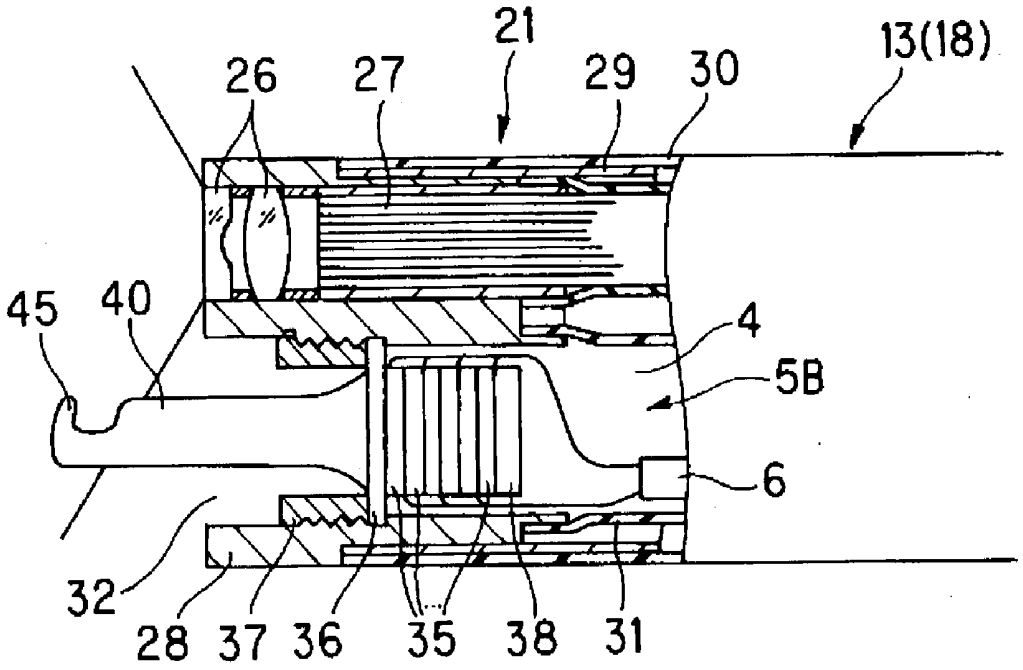

21
13(18)
26
27
29
30
45
40
4
5B
6
32
28
37
36
35
38
31

FIG. 3

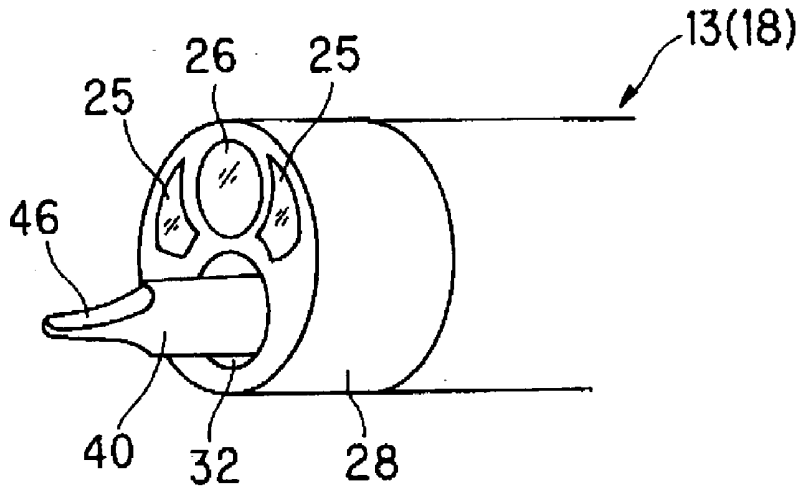

13(18)
26
25
25
46
40
32
28

FIG. 4

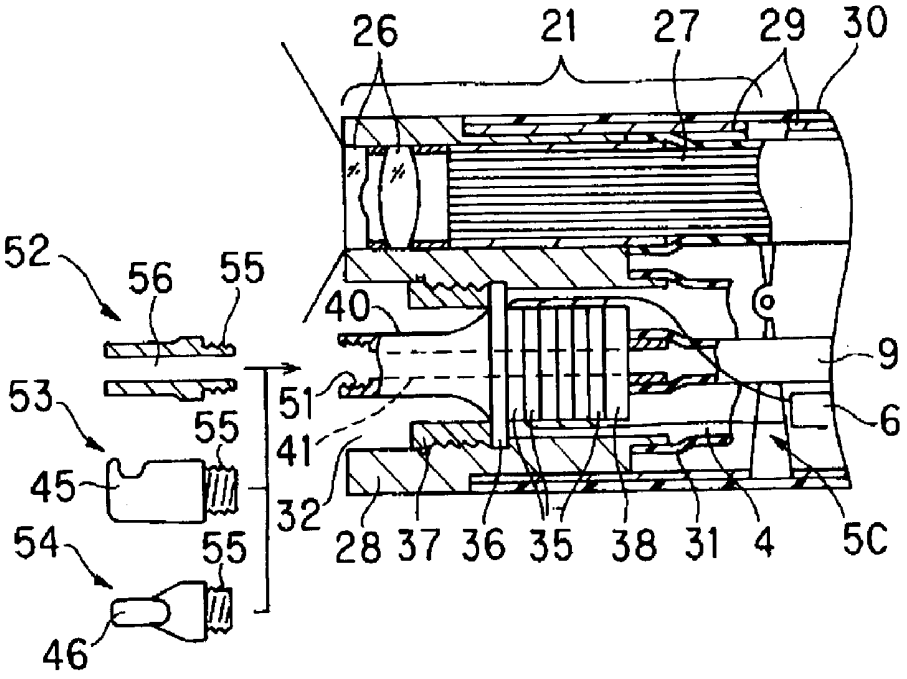

26
21
27
29
30
52
56
55
40
9
53
55
51
41
6
45
32
28 37 36 35 38 31 4 5C
54
55
46

FIG. 5

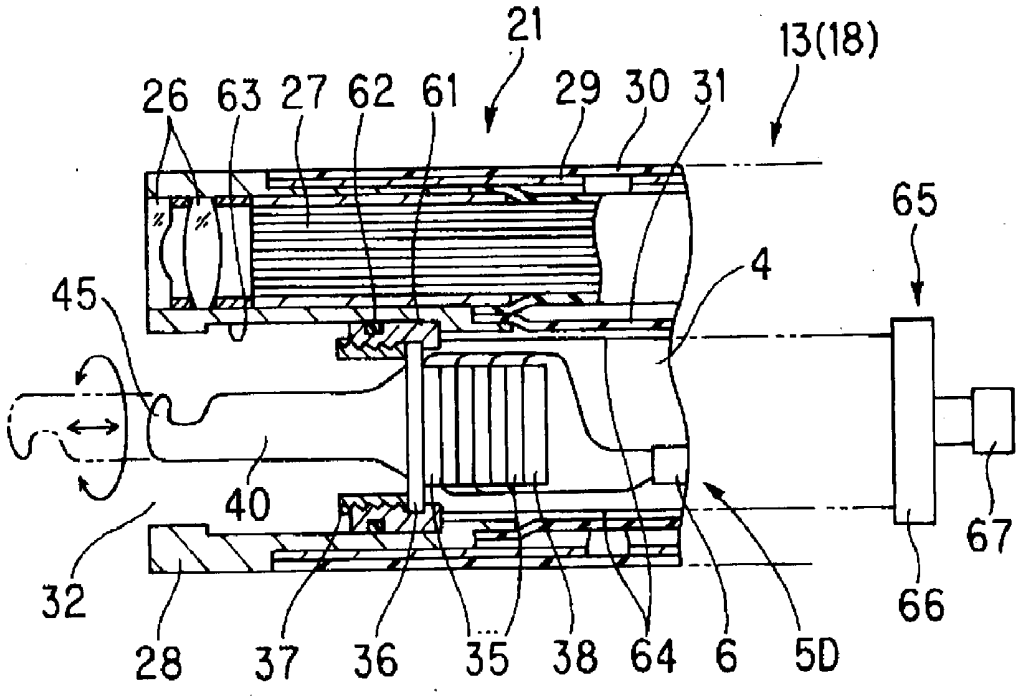

21
13(18)
26 63 27 62 61
29 30 31
65
4
45
40
67
32
66
28 37 36 35 38 64 6 5D

FIG. 6

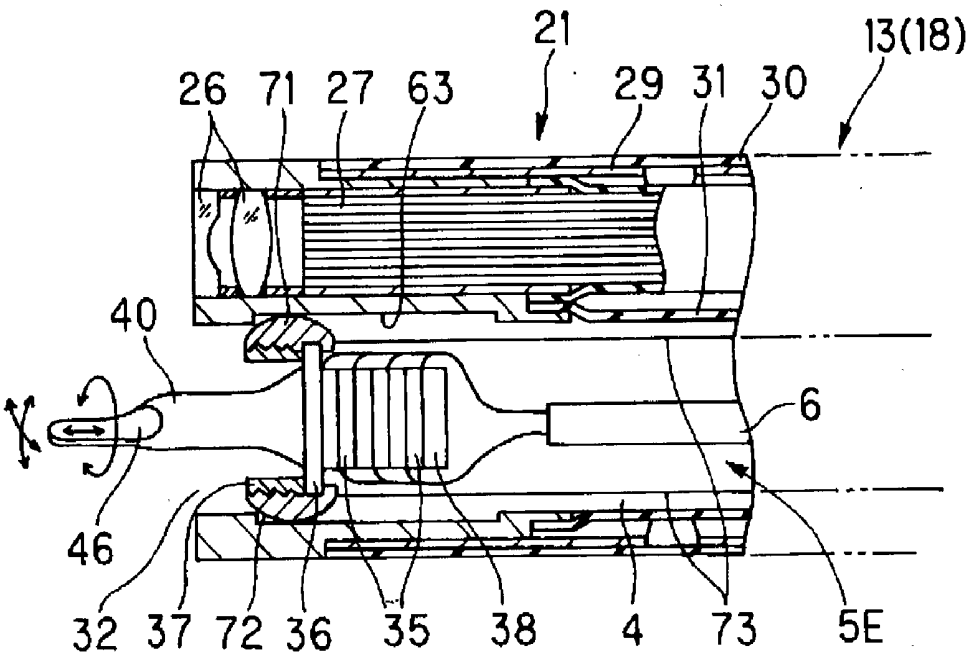

21
13(18)
26
71
27
63
29
31
30
40
6
46
32
37
72
36
35
38
4
73
5E

FIG. 7

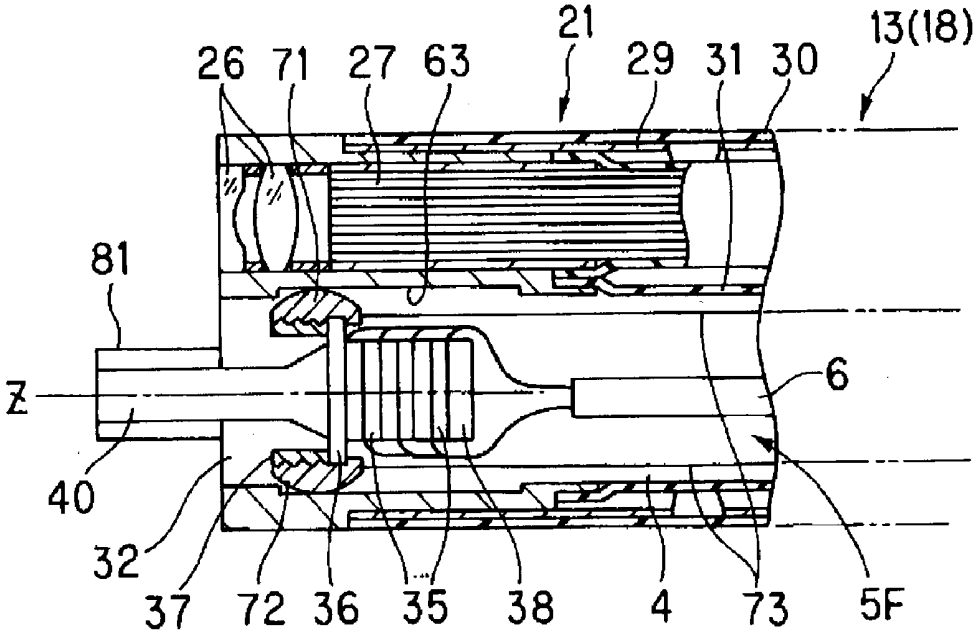

21
13(18)
26
71
27
63
29
31
30
81
Z
6
40
32
37
72
36
35
38
4
73
5F

FIG. 8

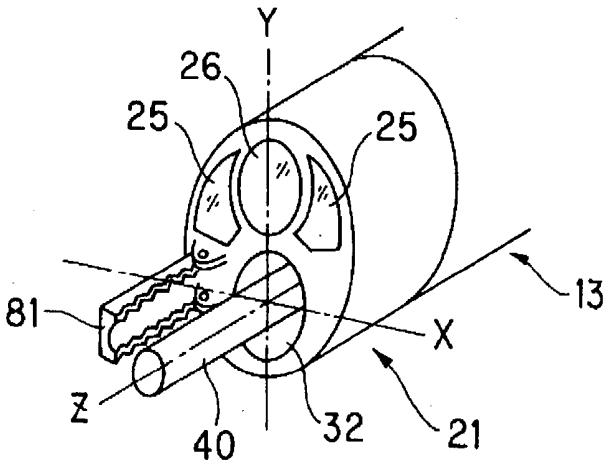


FIG. 9

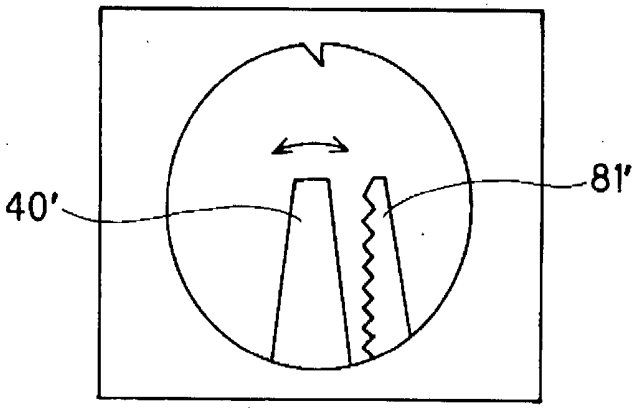


FIG. 10

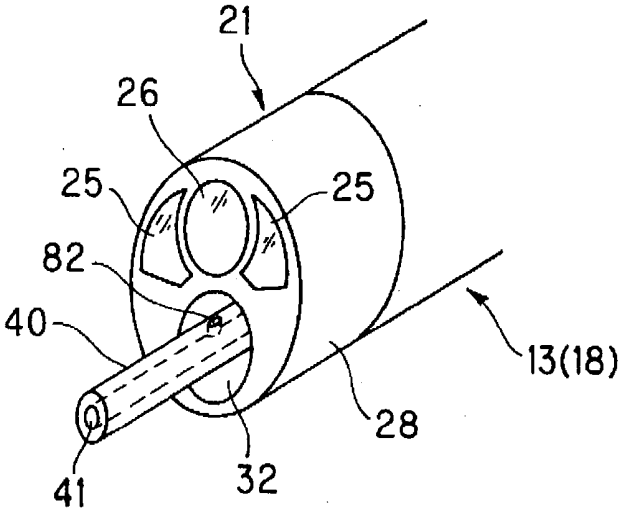


FIG. 11

ULTRASONIC THERAPEUTIC APPARATUS

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is based upon and claims the benefit of priority from prior Japanese Patent Application No.2002-160557, filed May 31, 2002, the entire contents of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to an ultrasonic therapeutic apparatus and, more particularly, to an ultrasonic therapeutic apparatus used under endoscopic observation.

[0004] 2. Description of the Related Art

[0005] An ultrasonic therapeutic apparatus which is used under endoscopic observation has heretofore been known.

[0006] Each of JP-A-1987-299251 and JP-A-2001-37768 discloses an ultrasonic therapeutic apparatus including an ultrasonic therapeutic probe fitted in a hand piece containing an ultrasonic vibrator. Specifically, in either of the disclosed arts, the hand piece of the ultrasonic therapeutic apparatus is fitted to an operating section of an endoscope, and the ultrasonic therapeutic probe is inserted into a channel of the endoscope to perform ultrasonic treatment under endoscopic observation. JP-A-1987-299251 discloses a combination of an ultrasonic therapeutic apparatus and a flexible endoscope, while JP-A-2001-37768 discloses a combination of an ultrasonic therapeutic apparatus and a rigid endoscope.

[0007] In these related arts, the process of inserting an elongated ultrasonic probe into a channel of an endoscope takes place before or during an operation. However, accurate and reliable insertion of the ultrasonic probe into the endoscope is a difficult process. It is preferable to dispose the ultrasonic probe at a position where part of the ultrasonic probe becomes visible in the field of view of the endoscope so that treatments can be performed reliably and safely, but users often feel stress from the process of accurately disposing the ultrasonic probe at such a position.

BRIEF SUMMARY OF THE INVENTION

[0008] An ultrasonic therapeutic apparatus according to the invention includes an endoscope having an inserting section to be inserted into an object, an ultrasonic vibrator for generating ultrasonic vibration, a vibration transmitting section for transmitting the ultrasonic vibration generated by the ultrasonic vibrator to the object, and a holding member for holding the ultrasonic vibrator and the vibration transmitting section in a distal tip portion of the inserting section of the endoscope.

[0009] Accordingly, since the ultrasonic vibrator and the vibration transmitting section are held in the distal tip portion of the inserting section of the endoscope, there is no need for the process of inserting the ultrasonic therapeutic apparatus into the endoscope and positioning the ultrasonic therapeutic apparatus with respect to the endoscope before and during an operation.

[0010] An example of the vibration transmitting section is a probe (horn). For good operability, a suction passage may be provided in the probe. Preferably, the probe and the ultrasonic vibrator are removably disposed so that an appropriate probe can be selected according to the contents of an operation to be applied. In this case, the shape of the probe may be a cylinder, a cone, a hook, a spatula or the like.

[0011] For good operability, the distal tip portion of the probe may be positioned in the field of view of the endoscope. The probe may be constructed to be movable back and forth, rotatable and tiltable so that the probe can be easily positioned at an appropriate location.

[0012] In the case of a tiltable probe, a jaw may be provided in the distal tip portion of the endoscope so that an object can be clamped between the probe and the jaw.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0013] These and other features, aspects, and advantages of the apparatus and methods of the present invention will become better understood with regard to the following description, appended claims, and accompanying drawings where:

[0014] **FIG. 1** is a view showing an ultrasonic therapeutic apparatus according to a first embodiment of the invention;

[0015] **FIG. 2A** is an enlarged cross-sectional view of a distal tip portion of the ultrasonic therapeutic apparatus shown in **FIG. 1**;

[0016] **FIG. 2B** is an enlarged front view of the distal tip portion of the ultrasonic therapeutic apparatus shown in **FIG. 1**;

[0017] **FIG. 3** is a cross-sectional view showing the distal tip-end side of an ultrasonic therapeutic apparatus body according to a second embodiment of the invention;

[0018] **FIG. 4** is a perspective view showing the distal tip-end side of an ultrasonic therapeutic apparatus body according to a variation of the second embodiment;

[0019] **FIG. 5** is a cross-sectional view showing the distal tip-end side of an ultrasonic therapeutic apparatus body according to a third embodiment of the invention;

[0020] **FIG. 6** is a cross-sectional view showing the distal tip-end side of an ultrasonic therapeutic apparatus body according to a fourth embodiment of the invention;

[0021] **FIG. 7** is a cross-sectional view showing the distal tip-end side of an ultrasonic therapeutic apparatus body according to a fifth embodiment of the invention;

[0022] **FIG. 8** is a cross-sectional view showing the distal tip-end side of an ultrasonic therapeutic apparatus body according to a sixth embodiment of the invention;

[0023] **FIG. 9** is a perspective view showing the distal tip-end side of the ultrasonic therapeutic apparatus body shown in **FIG. 8**;

[0024] **FIG. 10** is a view showing a specific example of the observing field of view of the ultrasonic therapeutic apparatus body shown in **FIG. 8**; and

[0025] **FIG. 11** is a perspective view showing the distal tip-end side of an ultrasonic therapeutic apparatus body according to a seventh embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0026] Preferred embodiments of the invention will be described below with reference to the accompanying drawings.

[0027] **FIGS. 1, 2A** and 2B are views of an ultrasonic therapeutic system and apparatus according to a first embodiment of the invention. **FIG. 1** is a view showing the ultrasonic therapeutic system according to the first embodiment. **FIG. 2A** is an enlarged view of the distal tip portion of the ultrasonic therapeutic apparatus shown in **FIG. 1**, and **FIG. 2B** is a front view of the distal tip portion. In the first embodiment, an ultrasonic probe is fixed in a channel in the distal tip portion of an endoscope. Accordingly, a user does not need to perform the process of inserting the ultrasonic probe into the endoscope as a preparatory process before an operation nor as a process during an operation.

[0028] The ultrasonic therapeutic system **1** shown in **FIG. 1** has the function of performing treatment using ultrasonic waves under endoscopic observation. The ultrasonic therapeutic system **1** includes an endoscope (body) **2** for enabling endoscopic observation, a light source device **3** for supplying illuminating light to the endoscope **2**, an ultrasonic probe unit **5** incorporated in a channel **4** of the endoscope **2**, an ultrasonic driving device **8** for generating an ultrasonic driving signal to be used for generation of ultrasonic waves, and a suction device **11** for sucking and collecting a treated tissue and/or fluids.

[0029] Incidentally, as a matter of course, the ultrasonic therapeutic system **1** may also be defined as an ultrasonic therapeutic apparatus which excludes the ultrasonic driving device **8**, the light source device **3**, and the suction device **11**.

[0030] The ultrasonic driving device **8** and the ultrasonic probe unit **5** are removably connected to each other by a flexible signal cable **6** which extends from the rear end of the ultrasonic probe unit **5** and has an electrical connector **7** at its extending end for connection to a mating connector (not shown) at the ultrasonic driving device **8**. The suction device **11** and the ultrasonic probe unit **5** are removably connected to each other by a flexible tube **9** which extends from the rear end of the ultrasonic probe unit **5** and has a connecting portion **10** at its extending end for connection to a mating part (not shown) at the suction device **11**.

[0031] The endoscope **2** used in the first embodiment is a flexible endoscope, and has an elongated inserting section **13** having flexibility, an enlarged-diameter operating section **14** provided at the rear end of the inserting section **13**, an ocular section **15** provided at the rear end of the operating section **14**, and a light guide cable **16** extended from a side portion of the operating section **14**. A connecting portion **17** provided at the end of the light guide cable **16** is removably connected to the light source device **3**.

[0032] The ultrasonic probe unit (ultrasonic vibration unit) **5** which is an ultrasonic therapeutic instrument for giving treatment using ultrasonic waves is incorporated in the channel **4** of the endoscope **2** in a positioned state. The ultrasonic probe unit **5** may also be useful for imaging. In this manner, the endoscope **2** and the ultrasonic probe unit **5** form an ultrasonic therapeutic apparatus body **18**.

[0033] The inserting section **13** of the endoscope **2** has a rigid distal tip part **21**, a bending part **22** bendably provided at the rear end of the distal tip part **21**, and an elongated flexible part **23** having flexibility which extends from the rear end of the bending part **22** to the front end of the operating section **14**. The bending part **22** may be articulated by a user with a bending operation knob (not shown) typically located on the operating section **14**, as is known in the endoscope arts.

[0034] The light source device **3** contains a lamp (not show), and illuminating light of the lamp is supplied to a light-guide end surface (not shown) in the inside of the connecting portion **17**. The illuminating light supplied to the light-guide end surface is transmitted to the distal tip part **21** of the endoscope **2** through a light guide **24** (for example, an optical fiber) in the interior of the light guide cable **16** and through a light guide (not shown) inserted through the inserting section **13**.

[0035] The light guide is divided into two light guides in the interior of the inserting section **13**, and the respective distal tips of the divided light guides are fixed on the insides of observing windows of the distal tip part **21**. Illuminating light transmitted through each of the divided light guides exits from its distal tip end surface, and this exiting light passes through the corresponding one of illuminating optical systems **25** (refer to **FIG. 2B**) which are disposed at the distal tip end surface in mutually opposed relationship, and exits forwardly from the endoscope **2** in a diffused manner. This exiting light illuminates a subject such as an affected area in a body cavity.

[0036] As shown in **FIG. 2**B, illuminating optical systems **25** are disposed on opposite sides of a front surface **28** of the distal tip part **21** of the endoscope **2**, and an objective optical system (observing optical system) **26** is disposed in the center between the illuminating optical systems **25**. An image of the subject illuminated via the illuminating optical systems **25** is formed by the objective optical system **26**. As shown in **FIGS. 2A and 1**, an image guide (for example, an optical fiber) **27** is fixed in a hole portion of the distal tip part body **28** via a connecting portion at an image-forming position of the objective optical system **26**.

[0037] The image guide **27** transmits an optical image to its rear end surface. The rear end surface of the image guide **27** is fixed in the vicinity of the front end of the ocular section **15**. The user observes the optical image transmitted to the rear end surface of the image guide **27**, at a magnified scale via an ocular optical system (not shown) of the ocular section **15**.

[0038] As shown in **FIGS. 1 and 2**A, the front end of a first ring-shaped bending piece **29** is fixed to the periphery of the rear end of the distal tip part body **28**. A second bending piece **29** is turnably connected to the rear end of the first bending piece **29**, and a third bending piece **29** is turnably connected to the rear end of the second bending piece **29**. In this manner, a plurality of bending pieces **29** are turnably connected in series to form the bending part **22**.

[0039] The user can bend the bending part **22** in a desired direction by operating the bending operating knob (not shown) provided in the operating section **14**. Incidentally, the length of the rigid distal tip part **21** is the length from the front end of the distal tip part body **28** to the rear end of the first bending piece **29**. The peripheries of the respective bending pieces **29** are covered with a covering tube **30** (for example, a rubber tube).

[0040] The channel **4** is formed by a hollow flexible tube **31** inserted through the inserting section **13**. The front end of the flexible tube **31** is fixedly connected to the rear end of a hole portion **32** formed in the distal tip part body **28**. The hole portion **32** serves as an exit opening of the channel **4**. The rear end of the channel **4** communicates with an inserting channel opening **33** near the rear end of the inserting section **13** (or the front end of the operating section **14**).

[0041] A structure by which the ultrasonic probe unit **5** is incorporated will be described below. In the first embodiment, the ultrasonic probe unit **5** is incorporated in the channel **4** provided in the inserting section **13** of the endoscope **2**, to form part of the ultrasonic therapeutic apparatus body **18**. Accordingly, the ultrasonic therapeutic apparatus **1** has, in addition to a general endoscopic function, the function of giving treatment using ultrasonic waves.

[0042] Specifically, an ultrasonic vibrator **35** for generating ultrasonic waves for the ultrasonic probe unit **5** is mounted in the hole portion **32** (which serves as the exit opening of the channel **4**) of the distal tip part body **28** of the inserting section **13**. The ultrasonic vibrator **35** is mounted on a disk-shaped flange portion **36**. The flange portion **36** is accommodated in the hole portion **32**, and is watertightly fixed (held) in position by being fastened by a nut **37**.

[0043] The ultrasonic vibrator **35** has a construction in which, for example, a plurality of disk-shaped Langevin type vibrators are stacked. The ultrasonic vibrator **35** is disposed between the flange portion **36** and a fastening member **38** (such as a screw), and is mounted to the flange portion **36** by being fastened by the fastening member **38**. The flange portion **36** to which the ultrasonic vibrator **35** is mounted is fitted in the hole portion **32** and is fixed in position by being fastened by the nut **37** having a periphery around which a thread portion is formed.

[0044] The flange portion **36** having an enlarged diameter is fitted in the inside wall of the hole portion **32** and is in abutment with a stepped surface. A thread is formed around the inside circumferential surface of the hole portion **32** on the front side of the stepped surface. The nut **37** having the periphery around which the thread portion to screw into the thread is formed is fastened to fix the flange portion **36** watertightly in position. In this manner, a structure is realized which prevents water from penetrating the ultrasonic vibrator **35** on the rear side of the flange portion **36**.

[0045] A horn (probe) **40** which serves as an ultrasonic wave transmitting portion (vibration transmitting portion) is fixed at its rear end surface to the front surface of the flange portion **36** by bonding or the like. Alternatively, the horn **40** can be integrally formed with the flange portion **36**.

[0046] In this manner, the flange portion **36** is at least a part of a holding member which holds the ultrasonic vibrator **35** and the horn (vibration transmitting portion) **40** at the distal tip end of the inserting section **13** of the ultrasonic therapeutic apparatus **1**.

[0047] In the first embodiment, the horn (probe) **40** has a conical shape which has a cross-sectional size larger at the rear end part than at its front end part so that the amplitude of vibration is increased and transmitted to the distal tip portion of the horn (probe) **40**.

[0048] An ultrasonic vibration is transmitted through the horn **40** to the distal tip portion thereof having a small area size, and the distal tip portion is brought into abutment with a therapeutic target tissue to give treatment such as ablating, cauterizing or emulsifying. In this manner, the distal tip portion of the horn **40** serves as a therapeutic section for giving treatment using ultrasonic waves.

[0049] The length from the ultrasonic vibrator **35** to the distal tip of the horn **40** is set (the length of the horn **40** is adjusted) to a quarter wavelength of an ultrasonic vibration to be used, so that the ultrasonic vibration generated by the ultrasonic vibrator **35** can vibrate the distal tip portion of the horn **40** with high efficiency. In this case, a node of vibration appears at the flange portion **36** at the rear end of the horn **40**, and a loop of vibration appears at the distal tip end of the horn **40**.

[0050] In the first embodiment, as shown in **FIGS. 1 and 2A**, the ultrasonic vibrator **35** and the like are disposed in the hole portion **32** which serves as the exit opening of the channel **4** adjacent to the objective optical system **26**, so that the distal tip-end side of the horn **40** enters the observing field of view of the objective optical system **26**.

[0051] The fastening member **38**, the ultrasonic vibrator **35**, the flange portion **36** and the horn **40** have a hollow structure, and form a suction passage **41** through which to suck unnecessary tissues and the like resulting from a treatment such as ablating, cauterizing or emulsifying with the distal tip of the horn **40**. The suction passage **41** communicates with the tube **9** fixedly connected to a connecting portion of the fastening member **38**. This tube **9** is inserted through the channel **4** and is extended outwardly from the inserting channel opening **33**.

[0052] The signal cable **6** is connected to electrodes on the surface of the ultrasonic vibrator **35**. The signal cable **6** is inserted through the channel **4** and is extended outwardly from the inserting channel opening **33**. The electrical connector **7** provided at the rear end of the signal cable **6** is connected to the ultrasonic driving device **8**. When a foot switch (not shown) or the like is operated, a driving signal is applied to the ultrasonic vibrator **35** from the ultrasonic driving device **8**, whereby ultrasonic waves can be generated by the ultrasonic vibrator **35**.

[0053] In this manner, in the first embodiment, an ultrasonic vibration system part in the ultrasonic probe unit **5** is disposed in the interior of the channel **4** in the rigid distal tip part **21** of the inserting section **13**, and is incorporated in the endoscope **2** in such a manner as to be watertightly fixed in position in advance. However, the distal tip portion of the horn **40** protrudes from the distal tip part **21** so that the distal tip-end side of the horn **40** enters the observing field of view of the objective optical system **26**. In this construction, the user does not need an awkward process such as the process of inserting an ultrasonic probe unit into a channel and positioning a therapeutic section so that the therapeutic section can be observed in the field of view.

[0054] In addition, according to the first embodiment, merely by slightly modifying the construction of a front end portion of a channel in a general endoscope, it is possible to realize the endoscope **2** (or the ultrasonic therapeutic apparatus body **18**) in which the ultrasonic probe unit **5** according to the first embodiment is incorporated.

[0055] Namely, the ultrasonic therapeutic apparatus body **18** according to the first embodiment can be realized by providing a portion for fixing the ultrasonic vibrator **35** (in the first embodiment, the hole portion **32** having the threaded inside surface) in an exit opening of a channel of a general endoscope, and fixing the ultrasonic vibrator **35** in the portion. Contrarily, as is apparent from **FIG. 1, a** general endoscope provided with a channel can be obtained if the thread is omitted from the hole portion **32** which serves as the exit opening of the channel **4** in which the ultrasonic vibrator **35** and the like are fixed, and if the ultrasonic vibrator **35** and the like are removed and the tube **9** and the like are removed from the channel **4**. Therefore, according to the first embodiment, the ultrasonic therapeutic apparatus body **18** having an ultrasonic therapeutic function can be easily converted from an ordinary endoscope and vice versa. Accordingly, the manufacturing cost of the ultrasonic therapeutic apparatus can be reduced.

[0056] The operation of the first embodiment will be described below. The user inserts the inserting section **13** of the endoscope **2** into a body cavity, and, while observing through the ocular section **15**, disposes the distal tip end of the horn **40** on an therapeutic site to be treated with ultrasonic waves. Then, the user operates operating means (not shown) for generating ultrasonic waves (for example, a foot switch or a hand switch), to apply a driving signal to the ultrasonic vibrator **35** from the ultrasonic driving device **8**. Accordingly, the driving signal is converted to a mechanical vibration by the ultrasonic vibrator **35**, and the thus-obtained ultrasonic vibration is transmitted to the distal tip-end side of the horn **40**. In this manner, the user gives treatment such as ablation, cauterization, emulsification or the like to a living tissue by means of ultrasonic vibration under endoscopic observation.

[0057] In addition, the user can suck and collect ablated/cauterized/emulsified unnecessary tissues by activating the suction device **11**.

[0058] The first embodiment has many advantages, including the following. According to the first embodiment, since the ultrasonic probe unit **5** is previously incorporated in the endoscope **2**, the user does not need to perform the process of incorporating an ultrasonic probe unit before an operation or the like. Accordingly, the user does not need to perform the processes required in the related art, such as the process of disposing an ultrasonic probe so that the distal tip end thereof faces the inside of the observing field of view of an endoscope, and the complicated process of inserting an ultrasonic probe into a channel.

[0059] Accordingly, since it is not necessary to perform the process of inserting an elongated ultrasonic probe or the like into a channel before and/or during an operation, it is possible to ease stress which an operator and/or one responsible for preparation of equipment and materials may experience during the process.

[0060] Particularly in the case of a flexible endoscope such as the endoscope **2** according to the first embodiment, it is not necessary to perform the process of inserting a flexible ultrasonic probe, unlike the related art that needs such a difficult process.

[0061] In the case of the flexible endoscope according to the first embodiment, since the ultrasonic vibration system is disposed in the interior of the rigid distal tip part **21**, even if an ultrasonic vibration system is made to generate a vibration when a portion following the bending part **22** is bent, stresses can be prevented from being applied to the ultrasonic vibration system, whereby it is possible to improve the durability thereof. Therefore, it is possible to improve the reliability of the ultrasonic vibration system. In addition, the ultrasonic therapeutic apparatus has a structure which makes it possible to easily incorporate the ultrasonic probe unit **5** merely by making a small modification to a flexible endoscope provided with a general channel, whereby it is possible to reduce the manufacturing cost of the ultrasonic therapeutic apparatus.

[0062] In addition, repair and maintenance of the ultrasonic probe unit **5** are facilitated. Namely, the ultrasonic probe unit **5** can be comparatively easily removed by removing the nut **37**. Accordingly, repair and maintenance of the ultrasonic probe unit **5** can be easily performed. Therefore, it is possible to reduce the costs of repair and maintenance. In addition, the ultrasonic therapeutic apparatus according to the first embodiment can be used as a general endoscope if the ultrasonic probe unit **5**, the signal cable **6** and the tube **9** are removed.

[0063] Incidentally, in the first embodiment, the flange portion **36** of the ultrasonic vibrator **35** is fixedly screwed into the hole portion **32** of the distal tip part body **28**, but this fixing method is not to be construed as limitative. For example, a vibrator mounting frame (not shown) having a threaded inside circumferential surface may be fixed to the inside of the hole portion **32** by bonding or the like. Incidentally, the first embodiment has been described above with reference to the flexible endoscope having a construction in which the inserting section **13** is flexible, but can also be applied to a rigid endoscope having a rigid inserting section.

[0064] A second embodiment of the invention will be described below with reference to **FIG. 3**. According to the second embodiment, in the ultrasonic therapeutic apparatus according to the first embodiment, the ultrasonic vibrator **35** is made solid (no sucking space is provided), and a hook-shaped portion is formed in the distal tip portion of the horn **40**.

[0065] **FIG. 3** shows the structure of the distal tip-end side of the ultrasonic therapeutic apparatus body **18** according to the second embodiment. In the second embodiment, an ultrasonic probe unit **5**B is used in place of the ultrasonic probe unit **5** of the first embodiment.

[0066] As shown in **FIG. 3**, in the ultrasonic probe unit **5**B, the ultrasonic vibrator **35** and the like are solid (no sucking space is provided), and a hook-shaped portion is formed in the distal tip portion of the horn **40**. In addition, the ultrasonic therapeutic apparatus according to the second embodiment has a structure in which the suction passage **41** is not formed, because the ultrasonic vibrator **35** is solid. The other constituent elements are the same in structure as the corresponding ones of the first embodiment. Therefore, in **FIG. 3**, the same reference numerals are used to denote the same constituent elements as those described previously in connection with the first embodiment, and the description of the same constituent elements is herein omitted.

[0067] The operation of the second embodiment will be described below. According to the second embodiment, the

user can perform treatment such as coagulation or incision of a tissue by using ultrasonic waves with a hook-shaped portion **45** hooked on the tissue at a therapeutic site.

[**0068**] Incidentally, the distal tip portion of the horn **40** may be formed in various other shapes. For example, as shown in **FIG. 4, a** spatula-shaped portion **46** may also be formed. Incidentally, the horns **40** shown in **FIGS. 3 and 4** may also be hollow to provide sucking as described above.

[**0069**] The other operation of the second embodiment is the same as that of the first embodiment, except that suction is provided through the horn **40**.

[**0070**] A third embodiment of the invention will be described below with reference to **FIG. 5**. In the ultrasonic therapeutic apparatus according to the third embodiment, the horn **40** is constructed to allow various kinds of probe members to be interchangeably attached to the distal tip portion of the horn **40** so that a probe member suitable for a particular use can be selected. **FIG. 5** shows the structure of the distal tip part **21** of an ultrasonic therapeutic apparatus body according to the third embodiment. According to the third embodiment, in the ultrasonic therapeutic apparatus according to the first embodiment, the construction of part of the horn **40** provided on the front side of the ultrasonic probe unit **5** is modified into an ultrasonic probe unit **5**C capable of forming an ultrasonic therapeutic system suitable for the use of each individual treatment.

[**0071**] The shape of the distal tip part **21** (of the endoscope **2**) shown in **FIG. 5** is such that the distal tip-end side of the horn (or probe) **40** is cut to shorten the horn **40** and an internal thread portion **51** is formed in the distal tip end of the shortened horn **40**. Various kinds of (ultrasonic) therapeutic probe members **52**, **53** and **54** suitable for individual therapeutic uses can be selectively employed in such a manner that an external thread portion **55** formed at the rear end of a selected one of the therapeutic probe members **52**, **53** and **54** is fitted in the internal thread portion **51**.

[**0072**] Each of the therapeutic probe members **52**, **53** and **54** will be described below. The therapeutic probe member **52** has a hollow passage **56**, and the external thread portion **55** at the rear end of the therapeutic probe member **52** can be screwed into the internal thread portion **51** to constitute an ultrasonic probe unit having a function similar to the ultrasonic probe unit **5** of the first embodiment. The therapeutic probe member **53** is solid, and has the hook-shaped portion **45** provided in its therapeutic distal tip portion as described above in connection with the second embodiment. In addition, the therapeutic probe member **54** has the spatula-shaped portion **46** provided in its therapeutic distal tip portion as shown in **FIG. 4**.

[**0073**] In the case where a selected one of these therapeutic probe members **52**, **53** and **54** is fitted in the internal thread portion **51**, the length from the ultrasonic vibrator **35** to the distal tip of the selected one of the therapeutic probe members **52**, **53** and **54** is set to a quarter length of the wavelength of an ultrasonic vibration to be used, as described above in connection with the first embodiment. In this case, the length is set so that a node of vibration appears near the flange portion **36** and a loop of vibration appears near the distal tip end of the selected one of the therapeutic probe members **52**, **53** and **54**, and it is desirable that the internal thread portion **51** intermediate between the flange portion **36** and the distal tip end of the selected one of the therapeutic probe members **52**, **53** and **54** be closer to the node than to the loop. In the case where the length of the rigid distal tip part **21** is large, the position of the internal thread portion **51** may be made coincident with the node of vibration by using the setting of a quarter wavelength+a half wavelength, instead of by using the above-described quarter wavelength. The other constituent elements of the second embodiment are similar in construction to the corresponding ones of the first embodiment.

[**0074**] The operation of the third embodiment will be described below. The user connects a desired one of the therapeutic probe members **52**, **53** and **54** to the distal tip of the horn **40** according to a therapeutic use, and inserts the inserting section **13** of the endoscope **2** into a body cavity. During an operation, if a change occurs in the therapeutic use, the user draws out the endoscope **2** and replaces the selected one with another of the therapeutic probe members **52**, **53** and **54**. The other operation of the third embodiment is basically the same as that of the first embodiment.

[**0075**] The third embodiment has the following advantages in addition to the advantages of the first embodiment. Namely, it is possible to optimally select and replace the therapeutic probe members **52**, **53** and **54** according to various therapeutic uses, whereby various treatments can be given by one ultrasonic therapeutic apparatus.

[**0076**] A fourth embodiment of the invention will be described below with reference to **FIG. 6**. In the fourth embodiment, the horn **40** is capable of being rotated about its central axis, and the entire horn **40** is capable of being accommodated into the endoscope **2** during insertion of the endoscope **2**.

[**0077**] **FIG. 6** shows the structure of the distal tip-end side of the ultrasonic therapeutic apparatus body **18** according to the fourth embodiment. In the fourth embodiment, an ultrasonic probe unit **5**D in which the vicinity of a fixing portion of the ultrasonic vibrator **35** is modified is used in place of the ultrasonic probe unit **5**B of the second embodiment.

[**0078**] As shown in **FIG. 6**, the flange portion **36** at the rear end of the horn **40** of the ultrasonic vibrator **35** is fixed to a rotating and moving member (hereinafter referred to as a rotating member) **61** which has an approximately ring-like shape and is capable of being rotated and moved, by being fastened by the nut **37** which is screwed into the rotating member **61**. An O-ring **62** is fitted in a circumferential groove formed around the periphery of the rotating member **61**, and a hollow portion (enlarged-diameter portion) **63** is provided in the inside circumferential surface of the hole portion **32** of the distal tip part body **28** (of the endoscope **2**) so that the hollow portion **63** becomes larger in diameter than the inside circumferential surface of the hole portion **32**. The O-ring **62** is engaged with the hollow portion (enlarged-diameter portion) **63** in the state of causing frictional forces to act therebetween and in the state of holding a watertight function.

[**0079**] The hollow portion **63** is formed to extend by a predetermined length in the axial direction. Wires **64** which serve as a transmission member for transmitting rotation and movement are connected to the rotating member **61** at their front ends, and these wires **64** pass through the channel **4** and are connected to a rotation and movement operating member **65** on the operating-section side of the endoscope **2**.

[0080] The rotation and movement operating member **65** has a disk **66** to which the wires **64** are fixed at their rear ends and an operating knob **67** secured to the center shaft of the disk **66**. When the operating knob **67** is rotated, the rotating member **61** can be rotated, and when the operating knob **67** is moved back and forth (in **FIG. 6**, rightwardly and leftwardly), the rotating member **61** can be moved back and forth in the axial direction within the hollow portion **63**. The other constituent elements of the fourth embodiment are basically the same in construction as the corresponding ones of the first embodiment.

[0081] The operation of the fourth embodiment will be described below. When the user rotationally operates the rotation and movement operating member **65** provided on the operating-section side of the endoscope **2**, the wires **64** are interclockingly driven and the rotating member **61** is rotationally driven against the sliding friction of the O-ring **62**. As a result, the ultrasonic vibrator **35** fixed to the rotating member **61** is rotationally operated.

[0082] In addition, when the user operates the rotation and movement operating member **65** to move it back and forth, the rotating member **61** is moved back and forth in the axial direction within the range of the predetermined length of the hollow portion **63**. In this manner, the ultrasonic vibrator **35** fixed to the rotating member **61** is operated to move back and forth.

[0083] The axial length of the hollow portion **63** is selected so that when the rotating member **61** is moved back to the closest position to the operating-section side, the distal tip portion of the horn **40** connected to the ultrasonic vibrator **35** is accommodated into the hole portion **32** which serves as the exit opening of the channel **4**. This state is shown by solid lines in **FIG. 6**.

[0084] When the user is to insert or draw out the distal tip part **21** of the endoscope **2** into or from a body cavity, the distal tip portion of the horn **40** connected to the ultrasonic vibrator **35** is set to the state of being accommodated in the hole portion **32** which serves as the exit opening of the channel **4** as shown by two dot-dash lines in **FIG. 6**. When the user is to perform treatment using ultrasonic waves, the user protrudes the therapeutic section (in this case, the hook-shaped portion **45**) provided in the distal tip portion of the horn **40**, from the hole portion **32** as shown by the solid lines in **FIG. 6**, and places the distal tip portion into the observing field of view and performs treatment using ultrasonic waves, as by rotating the distal tip portion to an angle suitable for incision or the like.

[0085] The other operation is the same as those of the second embodiment.

[0086] The fourth embodiment has the following advantages in addition to the advantages of the first and second embodiments. Namely, since the distal tip portion of the horn **40** of the ultrasonic vibrator **35** can be rotationally driven, it is possible to realize a far more accurate approach to a therapeutic section. Accordingly, an operator can easily give treatments, and can perform high-quality treatments. In addition, in the case where the ultrasonic therapeutic apparatus is used in combination with a flexible endoscope, the advantage of the fourth embodiment can be doubled when the fourth embodiment is used in combination with the bending operation of the flexible endoscope.

[0087] In addition, since the horn **40** can be slid in the axial direction to retract the distal tip portion of the horn **40** into the channel **4** when no treatment is being performed, the inserting section **13** of the endoscope **2** can be made to approach a therapeutic section far more easily during the insertion of the inserting section **13** into a body cavity, whereby during the insertion, the horn **40** of the ultrasonic therapeutic apparatus does not enter the observing field of view so that the user can ensure a clear observing field of view.

[0088] Incidentally, in the fourth embodiment, the distal tip portion of the horn (or probe) **40** has the hook-shaped portion **45**, but the shape of the distal tip portion of the horn **40** is not limited to only a hook-like shape. For example, the spatula-shaped portion **46** may be used, and a construction in which various therapeutic probe members having different kinds of distal tip shapes can be removably attached as described above in the third embodiment may also be used.

[0089] A fifth embodiment of the invention will be described below with reference to **FIG. 7**. The fifth embodiment has the feature that the horn **40** can be tilted, in addition to the feature of the fourth embodiment.

[0090] **FIG. 7** shows the structure of the distal tip-end side of the ultrasonic therapeutic apparatus body **18** according to the fifth embodiment. In the fifth embodiment, an ultrasonic probe unit **5**E which is a modification of the ultrasonic probe unit **5**D of the fourth embodiment is used in place of the ultrasonic probe unit **5**D. The ultrasonic probe unit **5**E basically uses a joint member **71** capable of tilting more than the rotating member **61** shown in **FIG. 6**, and is constructed to enable tilting operations to be performed on the operating-section side.

[0091] As shown in **FIG. 7**, the flange portion **36** to which the ultrasonic vibrator **35** is fixedly connected is fixed to the joint member **71**. The joint member **71** has an approximately ring-like shape, and its peripheral surface is formed as a spherical portion **72**. This spherical portion **72** is watertightly engaged with the hollow portion **63** provided in the hole portion **32** which forms the exit opening **32** of the channel **4**.

[0092] The hollow portion **63** is formed to extend by a predetermined length in the axial direction. Wires **73** (for example, four wires) which also effect joint driving are connected to the joint member **71**, and these wires **73** pass through the channel **4** and are connected to a joint operating section (not shown) on the operating-section side of the endoscope **2**. The joint operating section includes means for tiltably supporting the disk **66** in the rotation and movement operating member **65** shown in **FIG. 6**, and enables the user to perform the operation of tilting the operating knob **67**. The user can tilt the joint member **71** in various directions, such as upward, downward, rightward and leftward, by performing the operation of tilting the operating knob **67**.

[0093] The axial length of the hollow portion **63** is selected so that when the rotating member **71** is moved back to the closest position to the operating-section side, the distal tip portion of the horn **40** connected to the ultrasonic vibrator **35** is accommodated into the channel **4**. The other constituent elements are the same in structure as the corresponding ones of the first embodiment.

[0094] The operation of the fifth embodiment will be described below. When the user operates the joint operating

section to perform the operation of alternately pulling and pushing the wires **73** which also effect joint driving, the joint member **71** is driven to tilt through the operation of the spherical portion **72** of the joint member **71**. In this manner, the flange portion **36** and the ultrasonic vibrator **35** which are fixed to the joint member **71** are tilted. Accordingly, the distal tip portion of the horn **40** connected at the rear end to the flange portion **36** is tilted as indicated by the crossed arrows in **FIG. 7**.

[**0095**] The other operation is the same as that of the fourth embodiment. As described above in connection with the fourth embodiment in particular, the hollow portion **63** has the predetermined axial length, and when the user operates joint operating means to move the joint member **71**, the joint member **71** is moved back and forth in the axial direction within the range of the hollow portion **63**, whereby the ultrasonic vibrator **35** and the horn **40** are moved back and forth. Similarly, the user can rotate the ultrasonic vibrator **35** and the horn **40** by rotationally operating the joint operating means.

[**0096**] The fifth embodiment has the following advantage in addition to the advantages of the first and fourth embodiments. Namely, the distal tip portion of the horn **40** of the ultrasonic vibrator **35** can be driven to tilt in a larger number of arbitrary directions than those in the fourth embodiment, whereby the above-described advantage of the fourth embodiment is further improved. In addition, it is possible to realize not only ultrasonic treatment but also blunt peeling or the like using the distal tip portion of the horn **40** connected to the ultrasonic vibrator **35**.

[**0097**] Incidentally, in the fifth embodiment, the distal tip portion of the horn **40** connected to the ultrasonic vibrator **35** has the spatula-shaped portion **46**, but the shape of the distal tip portion of the horn **40** is not limited to only a spatula-like shape. For example, the hook-shaped portion **45** or the hollow shape described above in connection with the first embodiment may be used, and a construction in which various therapeutic probe members having different kinds of distal tip shapes can be removably attached as described above in the third embodiment may also be used.

[**0098**] A sixth embodiment of the invention will be described below with reference to FIGS. **8** to **10**. The sixth embodiment has, in addition to the feature of the fifth embodiment, the feature that the distal tip part body **28** of the endoscope **2** is provided with a jaw so that a living tissue or the like can be grasped between a tiltable horn and the jaw.

[**0099**] **FIG. 8** shows the structure of the distal tip-end side of the ultrasonic therapeutic apparatus body **18** according to the sixth embodiment, **FIG. 9** shows in perspective view the distal tip-end side shown in **FIG. 8**, and **FIG. 10** shows an example of the observing field of view of the ultrasonic therapeutic apparatus body **18**. In the sixth embodiment, an ultrasonic probe unit **5**F which is a modification of the ultrasonic probe unit **5**E of the fifth embodiment is used in place of the ultrasonic probe unit **5**E.

[**0100**] The sixth embodiment has a basic construction in which, as shown in **FIG. 8, a** jaw **81** is provided on the distal tip part body **28** so that a living tissue or the like can be treated in the state of being clamped between the distal tip portion of the rod-shaped tiltable horn **40** and the jaw **81**.

[**0101**] As shown in **FIGS. 8 and 9**, when no tilting operation is being performed, a central axis (Z) which passes through the center of the ultrasonic vibrator **35** and the center of the horn **40** connected thereto is arranged to extend along the optical axis of the objective optical system **26** (i.e., along the axis of the cylindrical distal tip part **21** of the endoscope **2**).

[**0102**] As shown in **FIG. 9**, during this state, at the distal tip end surface, the center of the objective optical system **26** is arranged so that the center of the horn **40** is positioned on an axis (Y) crossing the optical axis of the horn **40** at right angles.

[**0103**] Furthermore, the approximately plate-shaped jaw **81** is arranged to protrude from the distal tip end surface along the central axis Z at a position spaced apart from the central axis Z of the horn **40** along an axis (X) crossing the axis Y at right angles.

[**0104**] A hollow portion whose shape corresponds to, for example, the shape of the distal tip-end side of the horn **40** is formed on the surface of the jaw **81** that is opposed to the horn **40**, in such a manner that the hollow portion extends along the center line of the surface. Corrugated portions are respectively formed on the opposite sides of the hollow portion so that a tissue can be clamped firmly between the jaw **81** and the horn **40**. This jaw **81** is formed of a low-friction and heat-resistance material such as a fluororesin (for example, Teflon®). The other constituent elements are the same in construction as the corresponding one of the fifth embodiment.

[**0105**] The operation of the sixth embodiment will be described below. As shown in **FIG. 10**, the user puts the distal tip portion of the horn **40** and the jaw **81** close to a therapeutic site to be treated, while observing an image **40'** of the distal tip portion of the horn **40** and an image **81'** of the jaw **81**. Then, the user clamps a tissue of the therapeutic site between the distal tip portion of the horn **40** and the jaw **81**.

[**0106**] In this case, similarly to the case of the fifth embodiment, the joint member **71** is tilted like a joint by the operation of the joint operating means, and the distal tip portion of the horn **40** is tilted toward the jaw **81** to grasp the tissue between the distal tip portion of the horn **40** and the jaw **81**.

[**0107**] Then, the user performs the operation of generating ultrasonic waves, to generate frictional heat due to vibration so that the grasped tissue can be coagulated and/or incised.

[**0108**] In this manner, the sixth embodiment serves, in addition to the advantages of the above-described first to fifth embodiments, the advantage that the user can perform treatments such as coagulation and incision on a therapeutic tissue far more reliably and easily, by clamping the therapeutic tissue.

[**0109**] A seventh embodiment of the invention will be described below with reference to **FIG. 11**. In the seventh embodiment, small holes are provided in the peripheral wall of the horn **40** of the ultrasonic therapeutic apparatus according to the first embodiment, thereby enabling collection of a mist.

[**0110**] **FIG. 11** shows the structure of the distal tip-end side of the ultrasonic therapeutic apparatus body **18** according to the seventh embodiment. The seventh embodiment

provides an example in which the ultrasonic vibrator **35** of the first embodiment is improved.

[**0111**] As shown in **FIG. 11**, the horn **40** connected to the ultrasonic vibrator **35** has at least one small hole **82** on the distal tip side from the flange portion **36**, and the at least one small hole **82** communicates with the hollow suction passage **41**. The at least one small hole **82** is disposed at a position opposed to the objective optical system **26**. The other constituent elements are the same in construction as the corresponding ones of the first embodiment.

[**0112**] The operation of the seventh embodiment will be described below. During ultrasonic treatment, in the case where moisture neighboring a tissue is scattered as mist, the mist is sucked and collected through the small hole **82**.

[**0113**] The seventh embodiment serves the following advantage in addition to the advantage of the first embodiment. Namely, since mist can be collected, a far better field of view can be secured.

[**0114**] In the case where the seventh embodiment is combined with cleaning means for the objective optical system **26** of the endoscope **2**, it is possible to automatically suck and collect a cleaning liquid, whereby it is not only possible to secure a far better field of view, but it is also possible to omit a suction operation and improve the operability of an operator. Furthermore, since it is possible to suck and circulate air surrounding the objective optical system **26**, it is possible to prevent a fog from occurring on the objective optical system **26**. Incidentally, the invention further encompasses other embodiments which are formed by combining part of the above-described embodiments.

[**0115**] As is apparent from the foregoing description, according to each of the first to seventh embodiments, since an ultrasonic vibration is contained in an endoscope, it is possible to omit the process of positioning an ultrasonic therapeutic instrument at the distal tip end of the endoscope and the process of inserting the ultrasonic therapeutic instrument through a channel.

[**0116**] Furthermore, since the process of positioning an observing optical system in an observing field of view is not needed, the difficult and trouble some process of inserting the ultrasonic therapeutic instrument can be eliminated to enable an operator and the like to avoid stress due to such an inserting process. In addition, when the ultrasonic vibrator is combined with a flexible endoscope, no stress is applied to an ultrasonic vibration system, whereby it is possible to realize an ultrasonic therapeutic apparatus which is highly durable and hence highly reliable.

[**0117**] While there has been shown and described what is considered to be preferred embodiments of the invention, it will, of course, be understood that various modifications and changes in form or detail could readily be made without departing from the spirit of the invention. It is therefore intended that the invention be not limited to the exact forms described and illustrated, but should be constructed to cover all modifications that may fall within the scope of the appended claims.

What is claimed is:

1. An ultrasonic therapeutic apparatus comprising:

an endoscope having an inserting section to be inserted into an object;

an ultrasonic vibrator for generating ultrasonic vibration;

a vibration transmitting section for transmitting the ultrasonic vibration generated by the ultrasonic vibrator to the object; and

a holding member for holding the ultrasonic vibrator and the vibration transmitting section in a distal tip portion of the inserting section of the endoscope.

2. An ultrasonic therapeutic apparatus according to claim 1, wherein the vibration transmitting section is an ultrasonic probe coupled to the ultrasonic vibrator in such a manner as to be capable of transmitting the ultrasonic vibration generated by the ultrasonic vibrator, and wherein the holding member holding the ultrasonic probe so that a distal tip portion of the ultrasonic probe protrudes from the inserting section of the endoscope at least during treatment.

3. An ultrasonic therapeutic apparatus according to claim 2, wherein the ultrasonic probe has a therapeutic section for giving treatment to the object.

4. An ultrasonic therapeutic apparatus according to claim 2, wherein the distal tip portion of the ultrasonic probe that protrudes from the inserting section of the endoscope includes a therapeutic section for giving treatment to the object.

5. An ultrasonic therapeutic apparatus according to claim 1, wherein the holding member is positioned at a node of ultrasonic vibration generated on the basis of a vibration of the ultrasonic vibrator.

6. An ultrasonic therapeutic apparatus according to claim 1, wherein the vibration transmitting section has a length equivalent to a quarter wavelength of the ultrasonic wave.

7. An ultrasonic therapeutic apparatus according to claim 1, wherein the vibration transmitting section has a hollow passage.

8. An ultrasonic therapeutic apparatus according to claim 1, wherein the vibration transmitting section is solid.

9. An ultrasonic therapeutic apparatus according to claim 1, wherein the vibration transmitting section is solid and has a hook-shaped distal tip portion.

10. An ultrasonic therapeutic apparatus according to claim 1, wherein the vibration transmitting section is solid and has a spatula-shaped distal tip portion.

11. An ultrasonic therapeutic apparatus according to claim 1, wherein the ultrasonic vibrator and the vibration transmitting section are included in an ultrasonic vibration unit, and wherein the ultrasonic vibration unit being held in a hole portion communicating with a channel provided in the distal tip portion of the inserting section of the endoscope.

12. An ultrasonic therapeutic apparatus according to claim 11, wherein the ultrasonic vibration unit is connected to a flexible cable inserted through the channel.

13. An ultrasonic therapeutic apparatus according to claim 11, wherein the ultrasonic vibration unit is connected to a flexible tube inserted through the channel.

14. An ultrasonic therapeutic apparatus according to claim 1, wherein the inserting section of the endoscope is rigid at the distal tip portion and has a flexible portion except the distal tip portion.

15. An ultrasonic therapeutic apparatus according to claim 1, wherein the ultrasonic vibrator and the vibration transmitting section are included in an ultrasonic vibration unit, and wherein the holding member fixes the ultrasonic vibration unit in position in a hole portion communicating with a channel of the endoscope.

16. An ultrasonic therapeutic apparatus according to claim 2, wherein the ultrasonic probe is removably attached to the ultrasonic vibrator.

17. An ultrasonic therapeutic apparatus according to claim 16, wherein a location at which to removably attach the ultrasonic probe corresponds to a node of vibration.

18. An ultrasonic therapeutic apparatus according to claim 2, wherein the ultrasonic probe has a length equivalent to a quarter wavelength of the ultrasonic wave

19. An ultrasonic therapeutic apparatus according to claim 2, wherein the ultrasonic probe is hollow and the ultrasonic vibrator is also hollow.

20. An ultrasonic therapeutic apparatus according to claim 2, wherein the ultrasonic probe is made of a solid member having a hook-shaped tip portion.

21. An ultrasonic therapeutic apparatus according to claim 2, wherein the ultrasonic probe is made of a solid member having a spatula-shaped tip portion.

22. An ultrasonic therapeutic apparatus according to claim 2, wherein the ultrasonic vibrator is fixed to a rotary member rotatable with respect to a hole portion provided in the distal tip portion of the inserting section, the rotary member being capable of being rotationally operated by an operating member connected to the rotary member via a transmission member.

23. An ultrasonic therapeutic apparatus according to claim 2, wherein the ultrasonic vibrator is fixed to a joint member movable like a joint with respect to a hole portion provided in the distal tip portion of the inserting section, the joint member being capable of being tilted by an operating member connected to the joint member via a transmission member.

24. An ultrasonic therapeutic apparatus according to claim 2, wherein the ultrasonic probe is movable in an axial direction of a hole portion provided in the distal tip portion of the inserting section.

25. An ultrasonic therapeutic apparatus according to claim 2, wherein the ultrasonic probe is movable within at least a range in which when the ultrasonic probe is moved to a distal-most position, the distal tip portion of the ultrasonic probe is positioned in an observing field of view, while when the ultrasonic probe is moved to a proximal-most position, the distal tip portion of the ultrasonic probe is stored in the hole portion.

26. An ultrasonic therapeutic apparatus according to claim 2, further comprising a jaw, the jaw being disposed at an end surface of the distal tip portion of the inserting section at a position where a line connecting the ultrasonic probe and the jaw crosses at right angles a line connecting the ultrasonic probe and an observing optical system.

27. An ultrasonic therapeutic apparatus according to claim 2, wherein the ultrasonic probe has a hollow passage extending in an axial direction thereof, and further has at least one small hole communicating with the hollow passage, on a front side from a position where the ultrasonic vibrator is fixed.

28. An ultrasonic therapeutic apparatus for giving treatment under endoscopic observation, comprising:

an endoscope having a channel in its inside;

an ultrasonic vibrator which is at least partly accommodated in the channel and converts an electrical signal into a mechanical vibration; and

an ultrasonic probe coupled to the ultrasonic vibrator with at least a distal tip portion of the ultrasonic probe positioned in an observing field of view of the endoscope, the ultrasonic probe transmitting an ultrasonic vibration generated by the ultrasonic vibrator.

29. An ultrasonic therapeutic apparatus according to claim 28, wherein the ultrasonic probe has a hollow passage.

30. An ultrasonic therapeutic apparatus according to claim 28, wherein the ultrasonic probe is solid.

31. An ultrasonic therapeutic apparatus according to claim 28, wherein the ultrasonic probe has a hook-shaped distal tip portion.

32. An ultrasonic therapeutic apparatus according to claim 28, wherein the ultrasonic probe has a spatula-shaped distal tip portion.

33. An ultrasonic therapeutic apparatus according to claim 28, wherein the ultrasonic probe is removably attached to the ultrasonic vibrator, a location at which to removably attach the ultrasonic probe corresponding to a node of vibration.

34. An ultrasonic therapeutic apparatus according to claim 28, wherein the ultrasonic probe has a length equivalent to a quarter wavelength of an ultrasonic wave

35. An ultrasonic therapeutic apparatus according to claim 28, wherein the ultrasonic probe and the ultrasonic vibrator are hollow.

36. An ultrasonic therapeutic apparatus according to claim 28, wherein the ultrasonic probe is a solid member having a hook-shaped distal tip portion.

37. An ultrasonic therapeutic apparatus according to claim 28, wherein the ultrasonic probe is a solid member having a spatula-shaped distal tip portion.

38. An ultrasonic therapeutic apparatus according to claim 28, wherein the ultrasonic vibrator is fixed to a rotary member rotatable with respect to the channel of the endoscope, the ultrasonic therapeutic apparatus further comprising a transmitting member connected to the rotary member and an operating member connected to the transmitting member.

39. An ultrasonic therapeutic apparatus according to claim 28, wherein the ultrasonic vibrator is fixed to a joint member movable with respect to the channel of the endoscope for tilting the ultrasonic probe, the ultrasonic therapeutic apparatus further comprising a transmitting member connected to the joint member and an operating member connected to the transmitting member.

40. An ultrasonic therapeutic apparatus according to claim 28, wherein the ultrasonic probe is movable in the channel of the endoscope in an axial direction of the channel.

41. An ultrasonic therapeutic apparatus according to claim 28, wherein the ultrasonic probe is movable within at least a range in which when the ultrasonic probe is moved to a distal-most position, the distal tip portion of the ultrasonic probe is positioned in an observing field of view, while when the ultrasonic probe is moved to a proximal-most position, the tip portion of the ultrasonic probe is stored in the channel.

42. An ultrasonic therapeutic apparatus according to claim 39, further comprising a jaw, the jaw being disposed at an end surface of a distal tip portion the inserting section of at a position where a line connecting the ultrasonic probe and the jaw crosses at right angles a line connecting the ultrasonic probe and an observing optical system.

43. An ultrasonic therapeutic apparatus according to claim 28, wherein the ultrasonic probe has a hollow passage

extending in an axial direction thereof, and further has at least one small hole communicating with the hollow passage, on a front side from a position where the ultrasonic vibrator is fixed in the channel of the endoscope.

44. An ultrasonic therapeutic apparatus comprising:

an endoscope;

an ultrasonic vibrator held in a tip portion of the endoscope in such a manner as not to be removed by at least a user; and

an ultrasonic probe to which a vibration of the ultrasonic vibrator is transmitted.

45. An ultrasonic therapeutic apparatus according to claim 44, wherein a distal tip portion of the ultrasonic probe is positioned in an observing field of view of the endoscope.

46. An ultrasonic therapeutic apparatus according to claim 44, wherein the endoscope has a channel, the ultrasonic vibrator being at least partly accommodated in the channel.

47. An ultrasonic therapeutic apparatus according to claim 46, further comprising a mechanism for moving the ultrasonic probe back and forth according to an operation of the user.

48. An ultrasonic therapeutic apparatus according to claim 47, wherein when the ultrasonic probe is moved to a distal-most position, a distal tip portion of the ultrasonic probe is positioned distally to a front end of the channel, while when the ultrasonic probe is moved to a proximal-most position, the distal tip portion of the ultrasonic probe is positioned proximally to the front end of the channel.

49. An ultrasonic therapeutic apparatus according to claim 47, wherein when the ultrasonic probe is moved to the distal-most position, a distal tip portion of the ultrasonic probe is positioned in an observing field of view of the ultrasonic probe.

50. An ultrasonic therapeutic apparatus according to claim 44, further comprising a mechanism for rotating the ultrasonic probe according to an operation of the user.

51. An ultrasonic therapeutic apparatus according to claim 44, further comprising a mechanism for tilting the ultrasonic probe according to an operation of the user.

52. An ultrasonic therapeutic apparatus according to claim 51, further comprising a jaw for grasping an object in cooperation with the ultrasonic probe, the jaw being provided in the distal tip portion of the endoscope.

53. An ultrasonic therapeutic apparatus according to claim 52, wherein a distal tip portion of the jaw is positioned in an observing field of view of the endoscope.

54. An ultrasonic therapeutic apparatus according to claim 46, wherein the ultrasonic vibrator is positioned entirely in the channel, and wherein the ultrasonic therapeutic apparatus further comprising a member for sealing the ultrasonic vibrator in the channel.

55. An ultrasonic therapeutic apparatus according to claim 54, wherein the member for sealing also has a function to hold the ultrasonic vibrator.

56. An ultrasonic therapeutic apparatus according to claim 44, wherein the ultrasonic vibrator is mounted with a screw.

57. An ultrasonic therapeutic apparatus according to claim 44, wherein the ultrasonic probe is interchangeably removable from the ultrasonic vibrator.

57. An ultrasonic therapeutic apparatus according to claim 44, wherein the ultrasonic probe has a suction passage in its inside.

58. An endoscope comprising a channel having a structure for holding at least one of an ultrasonic vibrator and an ultrasonic probe, the structure being formed in an inside wall of a distal tip end opening of the endoscope.

59. An endoscope according to claim 58, wherein the structure is a thread formed on the inside wall.

60. An endoscope comprising:

an ultrasonic probe positioned in a distal portion of the endoscope;

means for transmitting ultrasonic vibration to the ultrasonic probe; and

means for one of fixing and movably fixing the ultrasonic probe to the distal portion.

* * * * *

专利名称(译)	超声治疗仪		
公开(公告)号	US20030225332A1	公开(公告)日	2003-12-04
申请号	US10/445581	申请日	2003-05-27
[标]申请(专利权)人(译)	奥林巴斯株式会社		
申请(专利权)人(译)	奥林巴斯光学有限公司.		
当前申请(专利权)人(译)	奥林巴斯光学有限公司.		
[标]发明人	OKADA MITSUMASA HONMA SATOSHI		
发明人	OKADA, MITSUMASA HONMA, SATOSHI		
IPC分类号	A61B18/00 A61B1/00 A61B17/22 A61B17/28 A61B17/32 A61B8/00		
CPC分类号	A61B17/22012 A61B17/2202 A61B2018/00982 A61B17/320068 A61B17/320092 A61B17/29 A61B1/00133 A61B2017/320069 A61B2017/32007 A61B2017/320071 A61B2017/320082 A61B2017/320089 A61B2017/320093 A61B2017/320094 A61B2017/320095		
优先权	2002160557 2002-05-31 JP		
外部链接	Espacenet USPTO		

摘要(译)

本发明公开了一种超声波治疗装置，其包括具有插入物体的插入部分的内窥镜，用于产生超声波振动的超声波振动器，用于将由超声波振动器产生的超声波振动传递到物体的振动传递部分，以及保持装置。用于将超声波振动器和振动传递部分保持在内窥镜的插入部分的尖端部分中的构件。该结构不需要相对于内窥镜定位超声治疗设备的过程。振动传递部分的一个例子是探针（喇叭）。