US 20240131556A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2024/0131556 A1**

IWAKI et al. (43) **Pub. Date: Apr. 25, 2024**

(54) **COATING DEVICE**

(71) Applicant: **KANEKA CORPORATION**, Osaka-shi, Osaka (JP)

(72) Inventors: **Kazuo IWAKI**, Settsu-shi (JP); **Tatsuyuki MAEDA**, Settsu-shi (JP)

(73) Assignee: **KANEKA CORPORATION**, Osaka-shi, Osaka (JP)

(21) Appl. No.: **18/279,658**

(22) PCT Filed: **Feb. 18, 2022**

(86) PCT No.: **PCT/JP2022/006664**

§ 371 (c)(1),
(2) Date: **Aug. 30, 2023**

(30) **Foreign Application Priority Data**

Mar. 24, 2021 (JP) 2021-051391

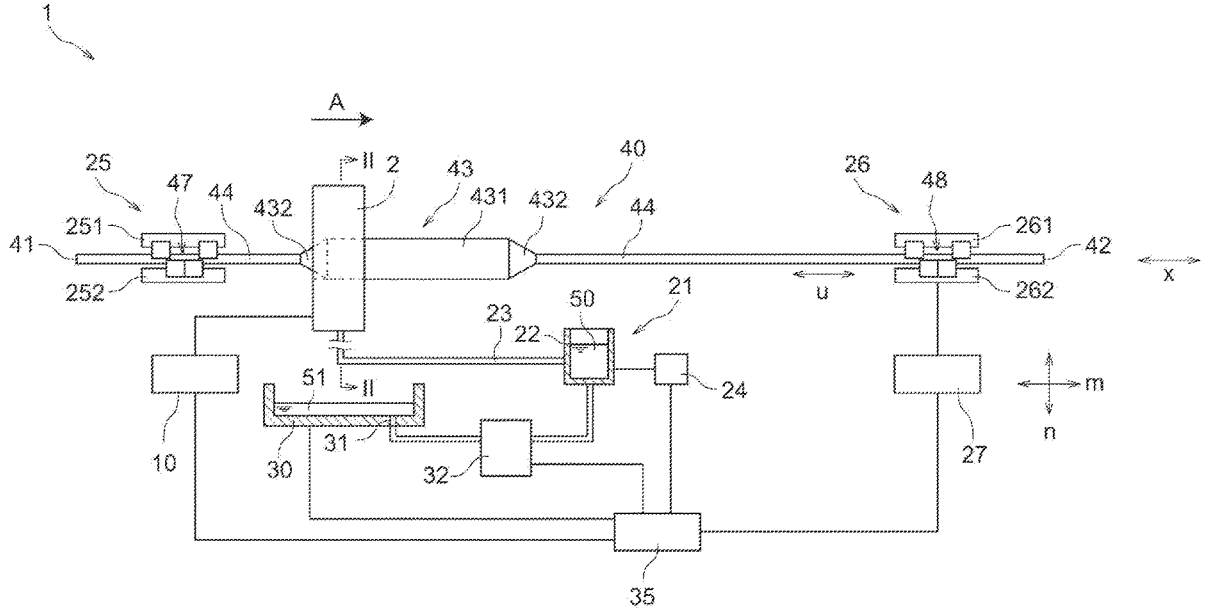
Publication Classification

(51) **Int. Cl.**
B05C 13/02 (2006.01)
B05C 5/02 (2006.01)

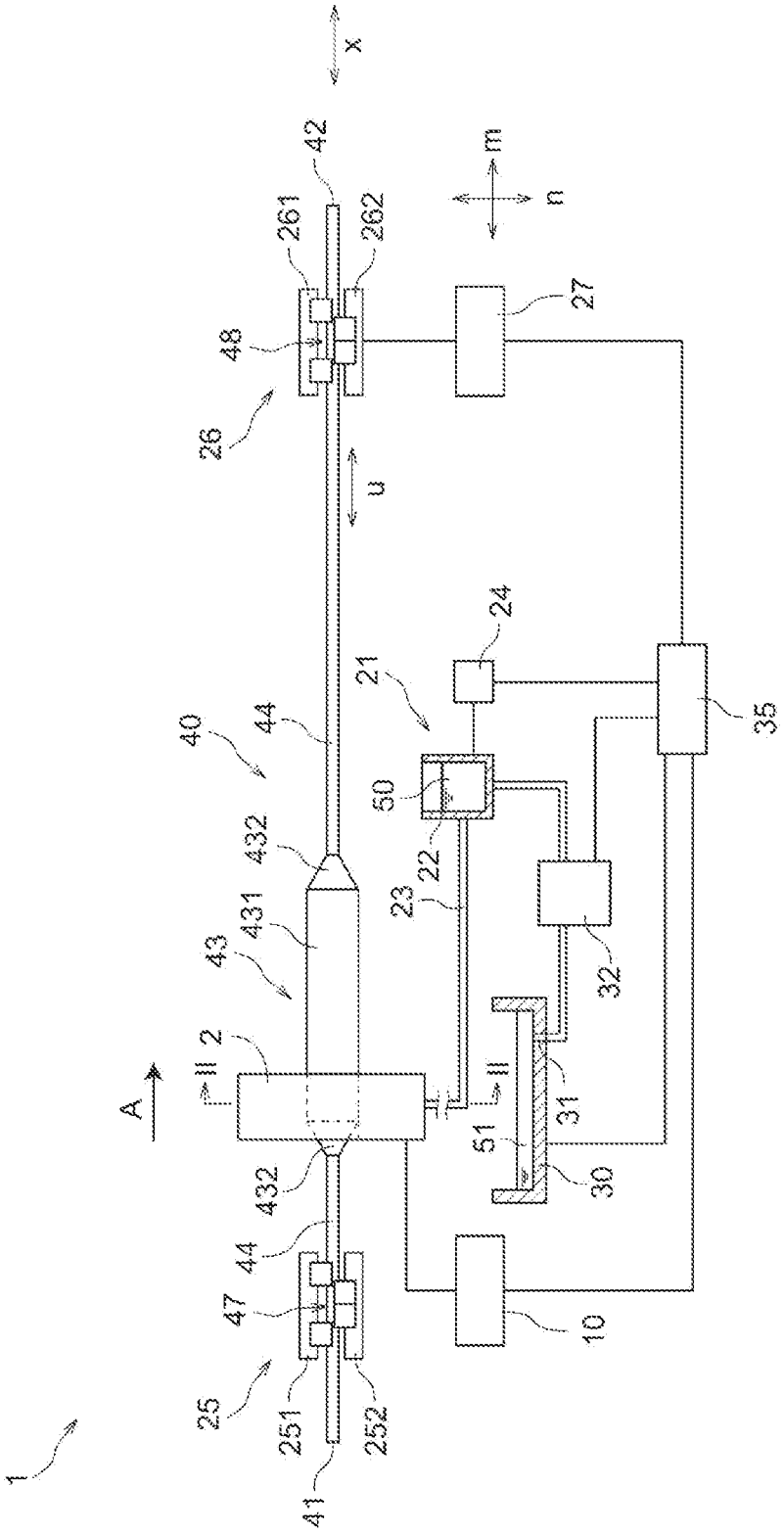
(52) **U.S. Cl.**
CPC ***B05C 13/02*** (2013.01); ***B05C 5/02*** (2013.01)

(57) **ABSTRACT**

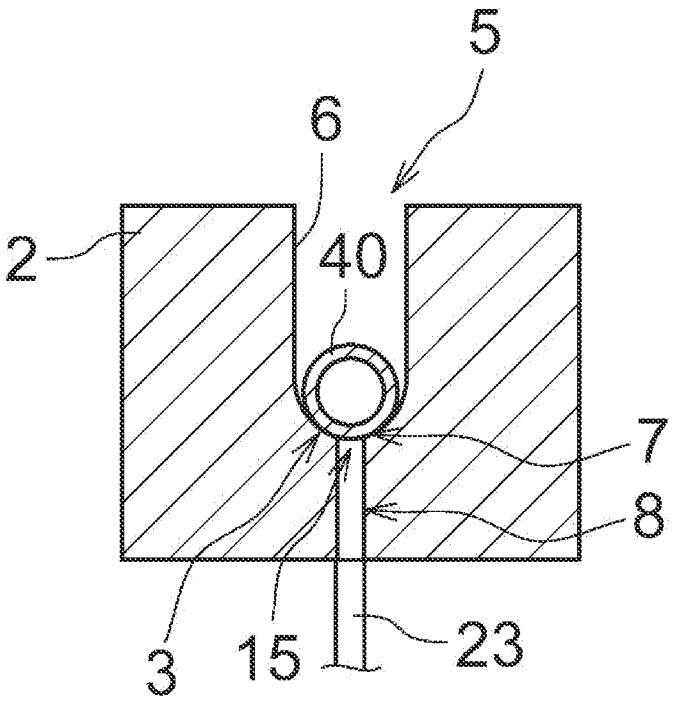
A coating device as a device for coating a long member (**40**) for medical use, the coating device comprising: a support part (**2**) capable of supporting the long member (**40**); and a discharge port (**15**) which is provided in the support part (**2**) or disposed at a higher location than the support part (**2**) and from which liquid to be applied to the long member (**40**) is discharged.



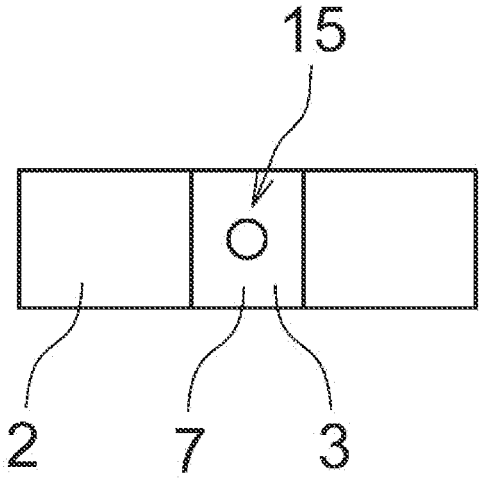
[Fig. 1]


x
m
n
42
261
262
48
27
26
u
24
21
35
40
44
50
22
23
432
431
43
32
2
II
II
A
51
31
30
432
44
47
10
25
251
252
41
1

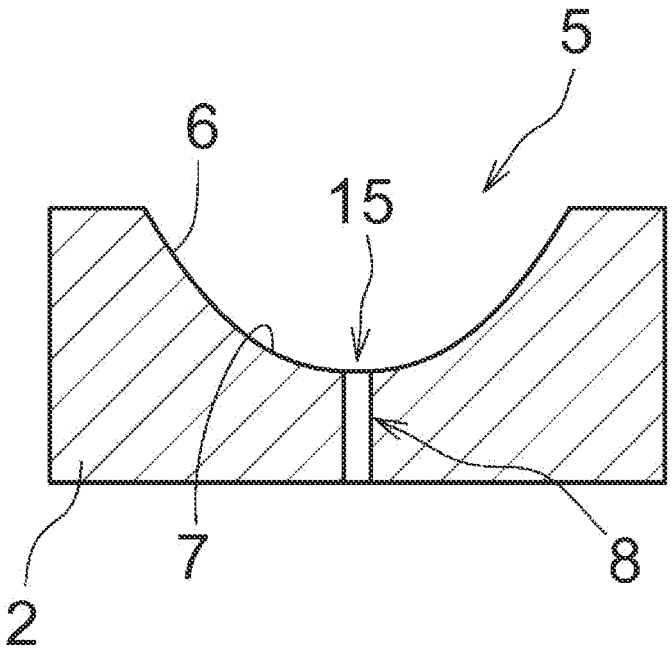
[Fig. 2]

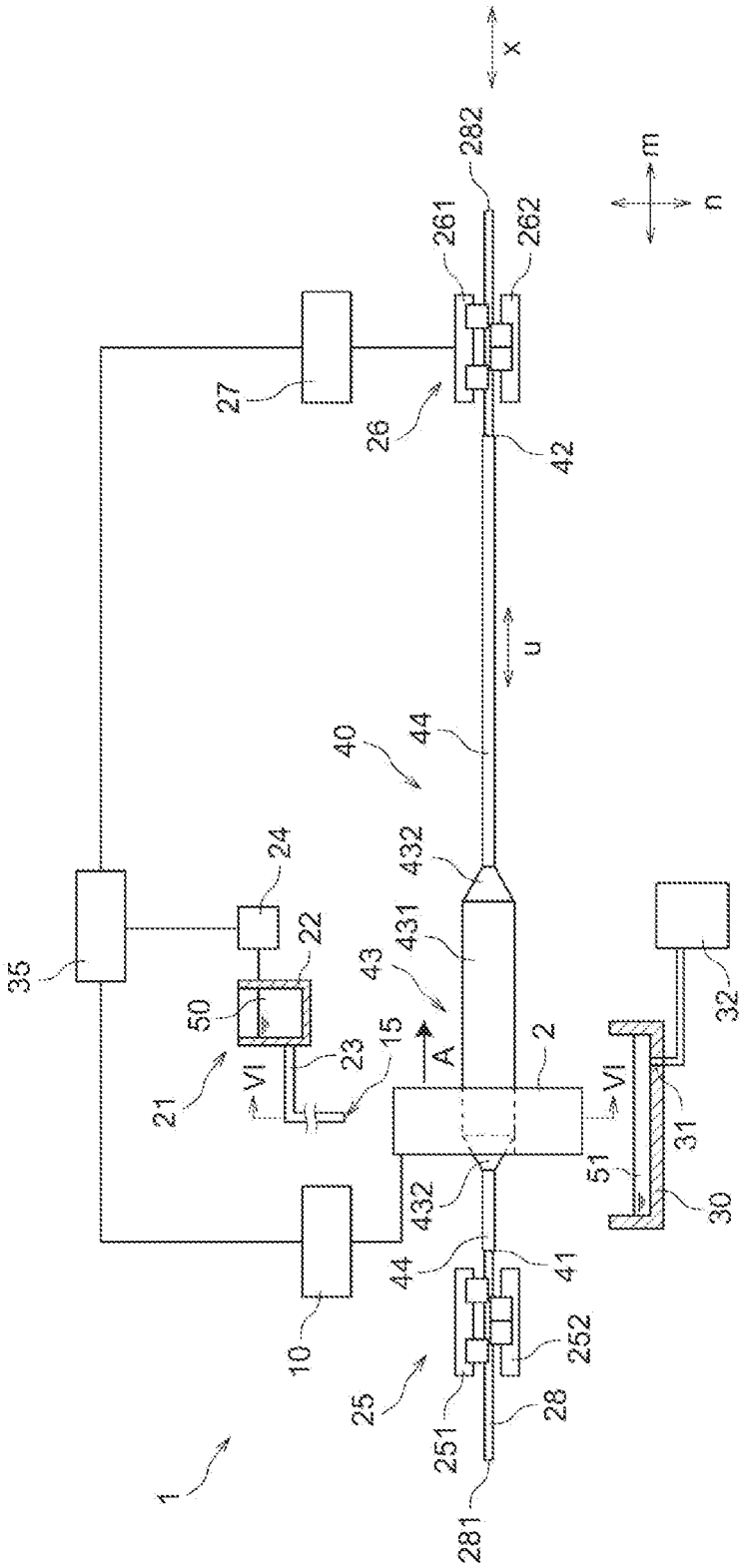


[Fig. 3]



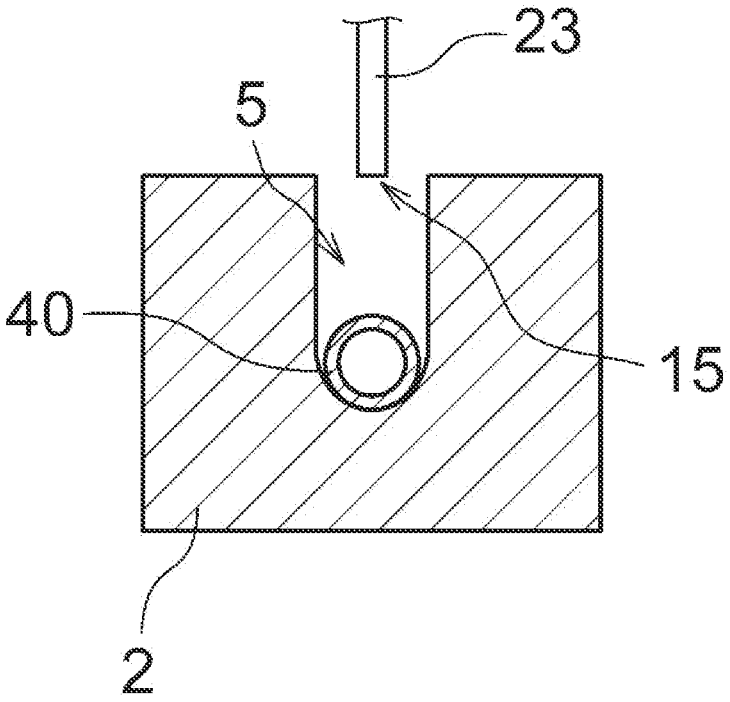
[Fig. 4]



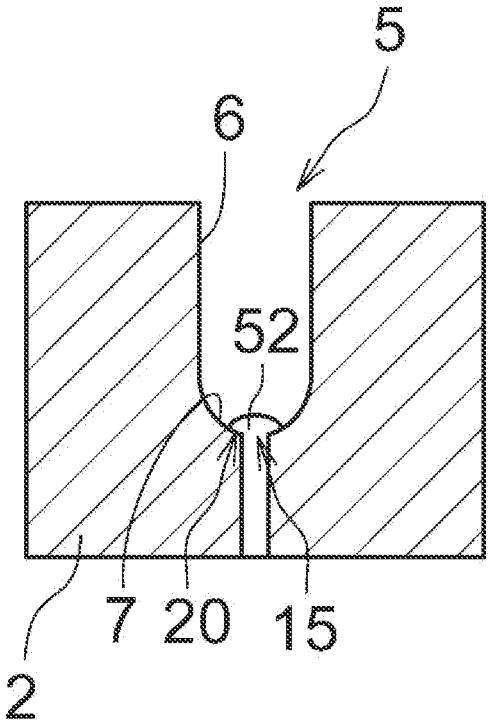

x
m
n
u
282
261
262
27
26
42
40
44
432
431
43
24
22
35
50
21
VI
23
15
A
2
32
31
51
30
41
252
25
28
251
281
10
1

[Fig. 5]

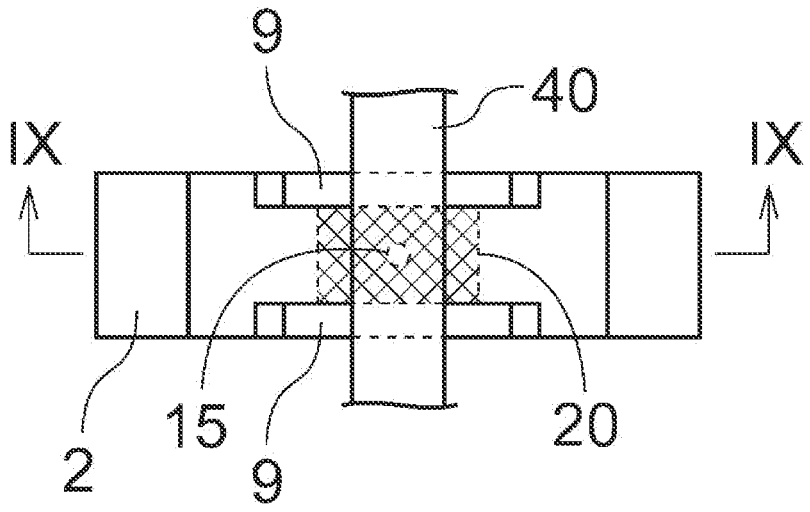
[Fig. 6]



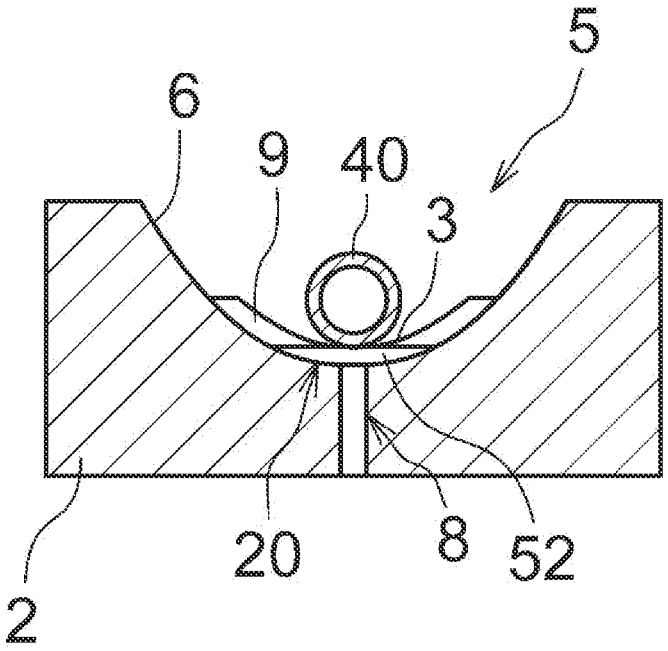
[Fig. 7]



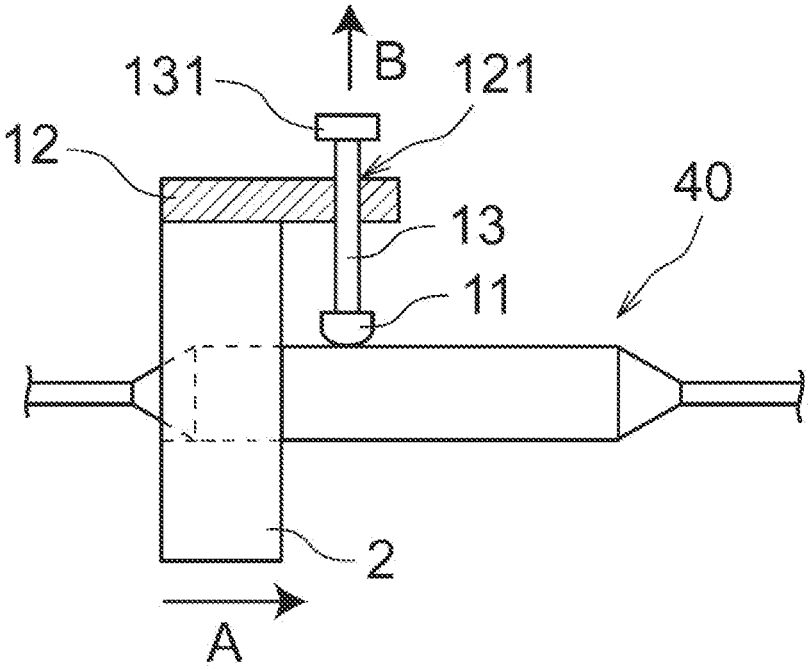
[Fig. 8]



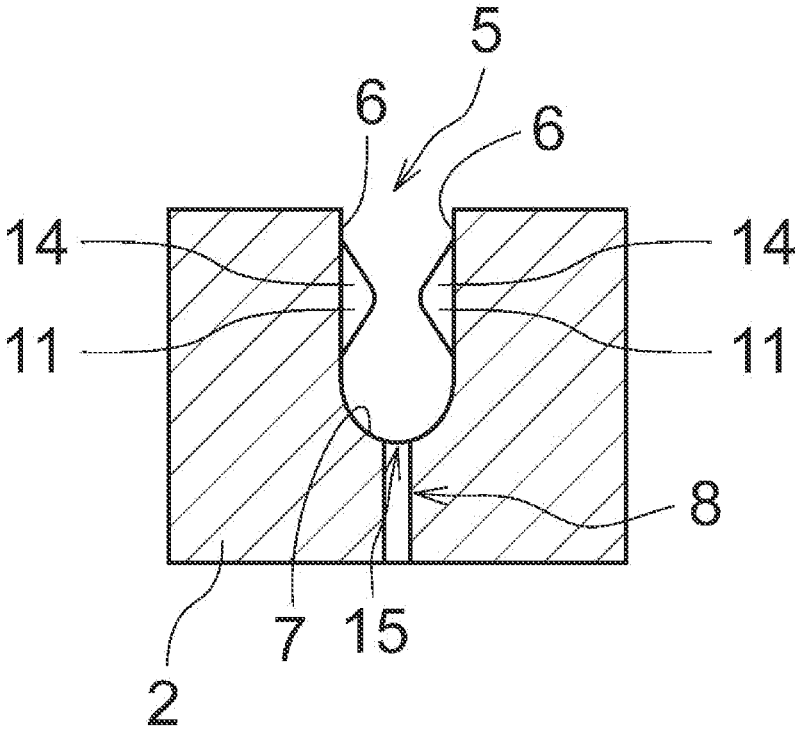
[Fig. 9]



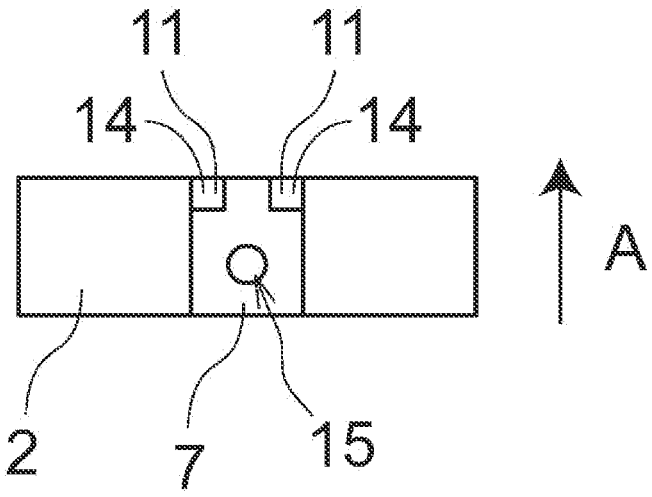
[Fig. 10]



[Fig. 11]



[Fig. 12]



COATING DEVICE

TECHNICAL FIELD

[0001] The present invention relates to a device for coating a long member for medical use.

BACKGROUND ART

[0002] Coating is applied to a surface of a medical tool such as a catheter for the purpose of easy insertion into a biological lumen, surface protection and reinforcement of a medical tool, and the like.

[0003] As an example of a device used for coating, Patent Document 1 discloses that a device for coating a medical instrument includes a coating application unit, the coating application unit includes a contact fluid applicator including a continuous U-shaped surface for forming a U-shaped groove, the contact fluid applicator is configured to be in contact with a medical instrument in the U-shaped groove, and the contact fluid applicator includes a fluid orifice.

[0004] Patent Document 2 discloses that a balloon coating device includes a rotation mechanism that rotates a balloon about an axial center of the balloon, an application unit that moves relative to the balloon in an axial center direction of the balloon and applies coating liquid containing a chemical agent to an outer surface of the balloon, and a balloon support part that comes into contact with an outer surface of the balloon on a moving direction side of the application unit to support the balloon.

RELATED ART DOCUMENTS

Patent Documents

[0005] Patent Document 1: JP-A-2016-504058

[0006] Patent Document 2: JP-A-2015-119801

SUMMARY OF THE INVENTION

Technical Problem

[0007] From the viewpoint of improving quality of a coating film, it is beneficial to provide a novel coating device. In view of the above, an object of the present invention is to provide a coating device in which a coating film thickness is easily made uniform.

Solutions to the Problems

[0008] The gist of one embodiment of a device for coating a long member for medical use according to the present invention that can overcome the above problems is as follows. The coating device comprising: a support part capable of supporting the long member, and a discharge port which is provided in the support part or disposed at a higher location than the support part and from which liquid to be applied to the long member is discharged. In the coating device according to the present invention, since the discharge port is provided in the support part or disposed at a higher location than the support part, the support part and the discharge port can be brought close to each other. Since the long member can be supported near the discharge port, even if the long member moves during application of liquid, the movement can be restricted by the support part. As a result, variation in a coating film thickness is less likely to occur, and the coating film thickness is likely to be uniformed.

[0009] The support part may have a recess on an upper surface, and the discharge port may be provided on a surface of the recess. The discharge port may be provided at a position including a lowermost point of an inner bottom surface of the recess. The liquid may be discharged upward from the discharge port.

[0010] The support part may have a liquid pool part which is disposed around the discharge port and in which the liquid discharged from the discharge port is accumulated.

[0011] The coating device may further include a pressing part that presses the long member from above. The support part may be movable in a longitudinal axis direction of the long member, and the pressing part may be disposed further on a side to which the support part advances than the discharge port in the longitudinal axis direction. The pressing part may be movable in a vertical direction. The support part may be movable in the longitudinal axis direction of the long member, the coating device further comprising: an attachment part that is connected to the support part, extends toward the side to which the support part advances, and attaches the pressing part to the support part. The coating device may further include a shaft extending in the vertical direction, and the pressing part may be disposed at a lower end portion of the shaft. In a case where the coating device may further include the shaft extending in the vertical direction and the pressing part is disposed at a lower end portion of the shaft, the attachment part may have a through hole penetrating in the vertical direction and the shaft may be inserted into the through hole. The support part may have the recess on an upper surface, the pressing part may be a protrusion provided on the surface of the recess. The protrusion may protrude from the surface of the recess so as to extend in a horizontal direction or a normal direction of the surface of the recess.

[0012] The discharge port may be movable in the longitudinal axis direction of the long member. The discharge port may be movable in a radial direction of the long member. The discharge port may be movable together with the support part. A plurality of the support parts may be included, and the discharge port may be provided in each of the plurality of the support parts.

[0013] The coating device may have a first holding part that holds a first end side in the longitudinal axis direction of the long member and a second holding part that holds a second end side in the longitudinal axis direction of the long member, wherein at least one of the first holding part and the second holding part may have a rotation mechanism that rotates the long member. The long member may be a member for forming a catheter.

Advantageous Effects of the Invention

[0014] In the coating device according to the present invention, since the discharge port is provided in the support part or disposed at a higher location than the support part, the support part and the discharge port can be brought close to each other. Since the long member can be supported near the discharge port, even if the long member moves during application of liquid, the movement can be restricted by the support part. As a result, variation in a coating film thickness is less likely to occur, and the coating film thickness is likely to be uniformed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIG. **1** is a schematic view of a coating device and a long member according to an embodiment of the present invention.

[0016] FIG. **2** is an end surface view (partial front view) of a cut portion taken along line II-II of the coating device and the long member illustrated in FIG. **1**.

[0017] FIG. **3** is a plan view of a support part and a discharge port illustrated in FIG. **2** and illustrates a state in which the long member is not supported by the support part.

[0018] FIG. **4** is an end surface view of a cut portion illustrating a variation of the support part and the discharge port illustrated in FIG. **2** and illustrate a state where the long member is not supported by the support part.

[0019] FIG. **5** is a schematic view illustrating a variation of the coating device and the long member illustrated in FIG. **1**.

[0020] FIG. **6** is an end surface view (partial front view) of a cut portion taken along line VI-VI of the coating device and the long member illustrated in FIG. **5**.

[0021] FIG. **7** is an end surface view of a cut portion illustrating a variation of the support part and the discharge port illustrated in FIG. **2** and illustrate a state where the long member is not supported by the support part.

[0022] FIG. **8** is a plan view illustrating a variation of the support part and the discharge port illustrated in FIG. **3** and illustrates a state in which the long member is supported by the support part.

[0023] FIG. **9** is a cross-sectional view taken along line IX-IX of the support part, the discharge port, and the long member illustrated in FIG. **8**.

[0024] FIG. **10** is a schematic view illustrating another variation of the support part and the discharge port illustrated in FIG. **2** and illustrates a state in which the long member is supported by the support part.

[0025] FIG. **11** is an end surface view of a cut portion illustrating a variation of the support part and the discharge port illustrated in FIG. **2** and illustrate a state where the long member is not supported by the support part.

[0026] FIG. **12** is a plan view of the support part and the discharge port illustrated in FIG. **11**.

DESCRIPTION OF EMBODIMENTS

[0027] The present invention will be specifically explained below based on the following embodiments; however, the present invention is not restricted by the embodiments described below of course, and can be certainly put into practice after appropriate modifications within in a range meeting the gist of the above and the below, all of which are included in the technical scope of the present invention. In the drawings, hatching, a reference sign for a member may be omitted for convenience, and in such a case, the description and other drawings should be referred to. In addition, sizes of various members in the drawings may differ from the actual sizes thereof, since priority is given to understanding the features of the present invention.

[0028] An embodiment of a coating device according to the present invention is a device for coating a long member for medical use, and has the gist in including a support part capable of supporting the long member, and a discharge port which is provided in the support part or disposed at a higher location than the support part and from which liquid to be applied to the long member is discharged. In the coating device according to the present invention, since the discharge port is provided in the support part or disposed at a higher location than the support part, the support part and the discharge port can be brought close to each other. Since the long member can be supported near the discharge port, even if the long member moves during application of liquid, the movement can be restricted by the support part. As a result, variation in a coating film thickness is less likely to occur, and the coating film thickness is likely to be uniformed.

[0029] A coating method using the coating device according to the present invention is classified as a pre-measuring system in which a predetermined amount of liquid is applied to a long member, so that an optional coating film thickness can be obtained. Therefore, it is different from a post-measuring system such as dip coating. A configuration example of the coating device will be described with reference to FIGS. **1** to **12**. FIG. **1** is a schematic view of the coating device and a long member according to an embodiment of the present invention. FIG. **2** is an end surface view (partial front view) of a cut portion taken along line II-II of the coating device and the long member illustrated in FIG. **1**. FIG. **3** is a plan view of a support part and a discharge port illustrated in FIG. **2**, and illustrates a state in which the long member is not supported by the support part. FIGS. **4**, **7**, and **11** are end surface views of a cut portion illustrating a variation of the support part and the discharge port illustrated in FIG. **2**, and illustrate a state where the long member is not supported by the support part. FIG. **5** is a schematic view illustrating a variation of the coating device and the long member illustrated in FIG. **1**. FIG. **6** is an end surface view (partial front view) of a cut portion taken along line VI-VI of the coating device and the long member illustrated in FIG. **5**. FIG. **8** is a plan view illustrating a variation of the support part and the discharge port illustrated in FIG. **3**, and illustrates a state in which the long member is supported by the support part. FIG. **9** is a cross-sectional view taken along line IX-IX of the support part, the discharge port, and the long member illustrated in FIG. **8**. FIG. **10** is a schematic view illustrating another variation of the support part and the discharge port illustrated in FIG. **2**, and illustrates a state in which the long member is supported by the support part. FIG. **12** is a plan view of the support part and the discharge port illustrated in FIG. **11**. Note that, in FIG. **8**, liquid discharged from the discharge port is omitted.

[0030] First, a long member **40** to be coated will be described. The long member **40** is not particularly limited as long as it is a member for forming a medical tool. Examples of the medical tool include those referred to as a catheter, a guide wire, a tube, a stent, a pipe, and a rod. Examples of the catheter include a balloon catheter, a cannula, a stent delivery catheter, and a microcatheter.

[0031] The long member **40** has a first end **41** and a second end **42** in a longitudinal axis direction u. An outer diameter of the long member **40** may be constant entirely in the longitudinal axis direction u, or may be different depending on a position in the longitudinal axis direction u. For example, as illustrated in FIG. **1**, the long member **40** may have a large diameter portion **43** and a small diameter portion **44**. Since the long member **40** for balloon catheter formation is illustrated in FIG. **1**, the large diameter portion **43** has a straight pipe portion **431** and tapered portions **432** on both sides of the straight pipe portion **431**.

[0032] The long member **40** may have a tubular shape with one or more lumens. Further, the long member **40** may

have a solid shape. The long member **40** may have flexibility. Further, the long member **40** may have elasticity.

[0033] The long member **40** is preferably made from resin or metal. Examples of the resin constituting the long member **40** include polyamide-based resin, polyester-based resin, polyurethane-based resin, polyolefin-based resin, fluorine-based resin, vinyl chloride-based resin, silicone-based resin, and natural rubber. One kind of these may be used or two or more kinds of these may be used in combination. Examples of the metal constituting the long member **40** include stainless steel such as SUS304 or SUS316, platinum, nickel, cobalt, chromium, titanium, tungsten, gold, a Ni—Ti alloy, a Co—Cr alloy, or a combination of these.

[0034] A type of liquid applied to the long member **40**, that is, coating liquid is not particularly limited, and for example, liquid obtained by diluting silicone resin, urethane resin, acrylic resin, fluororesin, or a mixture of these with a solvent can be used. The liquid may contain a chemical agent or an additive. A type of liquid can be selected in consideration of a function required for coating, for example, improvement in operability such as slidability of the long member **40**, protection and reinforcement of the long member **40**, ease of handling at the time of coating, and the like.

[0035] The liquid may be applied only to a part in the longitudinal axis direction u of the long member **40**, or the liquid may be applied to the entire long member **40** in the longitudinal axis direction u.

[0036] A coating device **1** includes a support part **2** and a discharge port **15**. The support part **2** is a part capable of supporting the long member **40**. In other words, the support part **2** supports the long member **40** from the lower side in a vertical direction n. When at least a part of the long member **40** is placed on the support part **2**, the placed part remains on the support part **2** without falling off the support part **2**. Note that the present invention also includes an aspect in which the support part **2** is not always in contact with the long member **40**, for example, an aspect in which the long member **40** is temporarily separated from the support part **2** by a centrifugal force when coating is applied while the long member **40** is rotated, so that the long member is not in contact with the support part **2**.

[0037] The support part **2** can include one or a plurality of members. The support part **2** may have a block shape, a plate shape, a table shape, or the like. The support part **2** may have a support surface **3** with which the long member **40** comes into contact. The support surface **3** may be a flat surface or a curved surface. In a case where the support surface **3** is a flat surface, the support surface **3** may be parallel to a horizontal direction m or may be inclined with respect to the horizontal direction m. In a case where the support surface **3** is a curved surface, the support surface **3** may be curved or bent. In the support part **2**, the long member **40** may be supported at a point or may be supported on a plane. The support surface **3** may have a shape conforming to an outer surface shape of the long member **40**.

[0038] The support part **2** only needs to be configured to support at least a part in the longitudinal axis direction u of the long member **40**, and does not need to support the entire long member **40** in the longitudinal axis direction u. For example, the support part **2** is preferably able to support a part between the first end **41** and the second end **42** of the long member **40**. The support part **2** may support one position or a plurality of positions in the longitudinal axis direction u of the long member **40**.

[0039] The support part **2** is preferably movable in the longitudinal axis direction u of the long member **40**. A rail may be disposed above or below the support part **2**, and the support part **2** may move along the rail. The support part **2** may be movable in a radial direction of the long member **40**. The support part **2** may be movable in the horizontal direction m or may be movable in the vertical direction n. The support part may be movable in a circumferential direction of the long member **40**. In a case where the coating device **1** has a plurality of the support parts **2**, a plurality of the support parts **2** may be movable together or may be movable separately.

[0040] In order to move the support part **2**, the support part **2** may have a drive mechanism **10**. The drive mechanism **10** is connected to a control unit **35**, and movement of the support part **2** is controlled by the control unit **35**. The drive mechanism **10** preferably includes actuator with one or more axes that drive the support part **2**. The actuator may include a mechanical element such as a motor, a linear guide, a ball screw, a timing belt pulley, a slider, a rack-and-pinion, and the like.

[0041] The coating device **1** only needs to have at least one of the support part **2**, and may have a plurality of the support parts **2**. One of the long member **40** may be supported by one of the support part **2**, or one of the long member **40** may be supported by a plurality of the support parts **2**. In a case where the coating device **1** has a plurality of the support parts **2**, each of a plurality of the support parts **2** preferably supports each of the long members **40**. A plurality of the support parts **2** is preferably arranged in a direction perpendicular to the longitudinal axis direction u of the long member **40**. A plurality of the support parts **2** may be arranged in the horizontal direction m.

[0042] In FIGS. **2** to **3**, the support part **2** has a recess **5** on its upper surface. A part of a surface **6** of the recess **5** functions as the support surface **3**. The recess **5** has a depth direction, a length direction, and a width direction. The depth direction of the recess **5** is parallel to the vertical direction n. The length direction of the recess **5** is parallel to a direction of an axis x of the coating device **1**. The width direction of the recess **5** is a direction perpendicular to the depth direction and the length direction, and is a left-right direction on FIG. **2**. By disposing the long member **40** in the recess **5**, the long member **40** can be supported by the recess **5**. Specifically, the long member **40** is supported by an inner bottom surface **7** of the recess **5**.

[0043] The surface **6** of the recess **5** only needs to be at least partially bent and formed in a recessed shape, and may be curved or bent. As illustrated in FIG. **2**, the surface **6** of the recess **5** may be formed in a U shape. The surface **6** of the recess **5** may have a portion extending in the vertical direction n on both sides in the width direction of the recess **5**. The portion extending in the vertical direction n can restrict movement of the long member **40** in the width direction of the recess **5**. As illustrated in FIG. **4**, the surface **6** of the recess **5** may have a portion extending from the inner side to the outer side in the width direction from the lower side to the upper side in the vertical direction n on both sides in the width direction of the surface **6** of the recess **5**.

[0044] The support part **2** may have a plurality of the recesses **5**. In this case, a plurality of the recesses **5** may be arranged in the longitudinal axis direction u of the long member **40**. With this configuration, one of the long member **40** can be supported by a plurality of the recesses **5**. Further,

in a case where the support part **2** has the drive mechanism **10** and the support part **2** has a plurality of the recesses **5**, a plurality of the recesses **5** can be simultaneously moved by one of the drive mechanism **10**. A plurality of the recesses **5** may be arranged in the horizontal direction m, for example, in a direction perpendicular to the longitudinal axis direction u of the long member **40**. With this configuration, each of a plurality of the long members **40** can be supported by each of the recesses **5**.

[0045] A material constituting the support part **2** is not particularly limited, and the support part **2** can be made from metal or resin. As a material constituting the support part **2**, description of a material constituting the long member **40** can be referred to.

[0046] The discharge port **15** is provided in the support part **2** or disposed at a higher location than the support part **2**, and discharges liquid **50** to be applied to the long member **40**. In the coating device **1**, since the discharge port **15** is provided in the support part **2** or disposed at a higher location than the support part **2**, the support part **2** and the discharge port **15** can be brought close to each other. Since the long member **40** can be supported near the discharge port **15**, even if the long member **40** moves during application of liquid, the movement can be restricted by the support part **2**. As a result, variation in a coating film thickness is less likely to occur, and the coating film thickness is likely to be uniformed.

[0047] The coating device **1** may have one of the discharge port **15** or a plurality of the discharge ports **15**. In a case where the coating device **1** has a plurality of the support parts **2**, the discharge port **15** is preferably arranged in each of a plurality of the support parts **2**. With this configuration, a plurality of the long members **40** can be coated at the same time. Note that a plurality of the discharge ports **15** may be arranged for one of the support part **2**. By using a plurality of the discharge ports **15**, a plurality of portions of one of the long member **40** can be coated at the same time, so that coating time can be shortened.

[0048] A shape of the discharge port **15** is not particularly limited, and may be a circular shape, an oval shape, a polygonal shape, or a shape obtained by combining these shapes. The oval shape includes an elliptical shape, an egg shape, and a rounded rectangular shape.

[0049] Liquid may be discharged from the discharge port **15** in a liquid state or in an atomized state. The liquid can be discharged at a flow rate of, for example, 0.05 mL/min or more and 1 mL/min or less.

[0050] In FIGS. **1** to **3**, the discharge port **15** is provided in the support part **2**. Specifically, the support part **2** has the recess **5** on an upper surface, and the discharge port **15** is provided on the surface **6** of the recess **5**. With this configuration, it is possible to discharge liquid to the long member **40** while restricting movement of the long member **40** by the support part **2**.

[0051] The discharge port **15** may be provided at any position in the recess **5**, but as illustrated in FIG. **2**, the discharge port **15** is preferably provided at a position including a lowest point of the inner bottom surface **7** of the recess **5**. Since the discharge port **15** is provided at a part where the long member **40** is likely to come into contact in the support part **2**, liquid is likely to adhere to the long member **40**.

[0052] As can be understood from FIG. **2**, liquid is preferably discharged upward from the discharge port **15**. With this configuration, an appropriate amount of liquid can be easily applied to the long member **40**, and a coating film thickness can be easily made uniform.

[0053] As illustrated in FIGS. **5** to **6**, the discharge port **15** may be disposed at a higher location than the support part **2**. In this case, the discharge port **15** is preferably provided on the upper side in the vertical direction n of the support part **2**, and the discharge port **15** is more preferably provided directly above the support part **2**. In a case where the discharge port **15** is disposed at a higher location than the support part **2**, liquid is preferably discharged downward from the discharge port **15**.

[0054] As illustrated in FIGS. **7** to **9**, the support part **2** may have a liquid pool part **20** which is disposed around the discharge port **15** and in which liquid discharged from the discharge port **15** is accumulated. When the long member **40** comes into contact with a liquid pool **52** in the liquid pool part **20**, coating of the long member **40** can be easily performed.

[0055] As illustrated in FIG. **7**, in the liquid pool part **20**, liquid discharged from the discharge port **15** preferably has a droplet shape. The droplet may have, for example, a hemispherical shape.

[0056] As illustrated in FIGS. **8** to **9**, a projection **9** may be disposed on the surface **6** of the recess **5** of the support part **2** at both end sides of the recess **5** in a length direction of the recess **5** rather than the discharge port **15**. A portion sandwiched between two of the projections **9**, that is, a portion lower than two of the projections **9** may be the liquid pool part **20**. In FIG. **8**, the liquid pool part **20** is indicated by intersecting hatching. The projection **9** functions as a wall for forming the liquid pool **52** on the support part **2**. By forming the liquid pool part **20** by providing the projection **9** in this manner, liquid can be accumulated in a wider range than the discharge port **15**, so that the long member **40** easily comes into contact with the liquid pool **52**, and it is possible to further prevent an uncoated portion. The projection **9** may protrude from the surface **6** of the recess **5** so as to extend upward in the vertical direction n, or may protrude from the surface **6** of the recess **5** so as to extend in a normal direction of the surface **6**. A surface of the projection **9** may function as the support surface **3** of the long member **40**. In this case, a surface of the projection **9** may have a shape conforming to an outer surface shape of the long member **40**.

[0057] In FIG. **1**, the coating device **1** includes a liquid supply unit **21** connected to the discharge port **15**. The liquid supply unit **21** includes a storage part **22** that stores the coating liquid **50** and a supply pipe **23** connected to the storage part **22**. The storage part **22** and the supply pipe **23** may be connected to a pump **24**. The pump **24** is connected to the control unit **35** and supplies a predetermined amount of the liquid **50** to the supply pipe **23** side. Examples of the pump **24** include a syringe pump and a tube pump. In FIG. **2**, an internal flow path **8** is provided inside the support part **2** and below the discharge port **15**. A first end side of the internal flow path **8** communicates with the discharge port **15**, and a second end side of the internal flow path **8** is connected to the supply pipe **23**. In FIG. **5**, the supply pipe **23** is disposed above the support part **2**, a first end side of the supply pipe **23** communicates with the discharge port **15**, and a second end side of the supply pipe **23** is connected to the storage part **22**.

[0058] An inner diameter of the internal flow path **8** and an inner diameter of the supply pipe **23** is not particularly limited, but can be set to, for example, 0.1 mm or more and 3.0 mm or less.

[0059] As illustrated in FIGS. **1** and **5**, the coating device **1** may include a recovery part **30** for recovering residual liquid **51** that does not adhere to the long member **40**. The recovery part **30** may be a groove of a container such as a saucer or a tray, a tank, a pit, or the like that can receive the residual liquid **51**. The recovery part **30** preferably has a wall for temporarily storing the residual liquid **51**.

[0060] The recovery part **30** is disposed below the discharge port **15**. The recovery part **30** may move along with movement in the longitudinal axis direction u of the discharge port **15**. In this case, the recovery part **30** is preferably also connected to the drive mechanism **10**.

[0061] The recovery part **30** preferably communicates with the discharge port **15**. With this configuration, liquid recovered by the recovery part **30** can be reused by being transferred to the discharge port **15** side.

[0062] The recovery part **30** may have a discharge part **31** from which residual liquid recovered by the recovery part **30** is discharged. A configuration of the discharge part **31** is not particularly limited, but may be an openable and closable opening formed on a bottom or a side of the recovery part **30**. In order to transfer residual liquid recovered by the recovery part **30** to the liquid supply unit **21**, the discharge part **31** may be connected to the liquid supply unit **21**. The discharge part **31** can be connected to the liquid supply unit **21** via a pipe or a pump.

[0063] The recovery part **30** is preferably connected to a liquid adjustment unit **32**, and the recovery part **30** is more preferably connected to the liquid adjustment unit **32** via the discharge part **31**. The residual liquid **51** is preferably transferred to the liquid supply unit **21** after a parameter such as concentration is adjusted by the liquid adjustment unit **32**.

[0064] The discharge port **15** is preferably movable in the longitudinal axis direction u of the long member **40**. By the above, coating can be performed along the longitudinal axis direction u of the long member **40**. The discharge port **15** may move from the first end **41** side toward the second end **42** side of the long member **40** as indicated by an arrow A in FIG. **1**. Further, although not indicated by an arrow, the discharge port **15** may move from the second end **42** side toward the first end **41** side.

[0065] The discharge port **15** may be movable in the radial direction of the long member **40**. The discharge port **15** is easily moved along a shape of the long member **40**, and a coating film thickness is easily made uniform.

[0066] As can be understood from FIGS. **1** to **2**, the discharge port **15** is preferably movable together with the support part **2**. As the discharge port **15** follows movement of the support part **2**, liquid is easily discharged to the long member **40** while movement of the long member **40** is restricted by the support part **2**.

[0067] In a case where the discharge port **15** is provided in a member different from the support part **2** as illustrated in FIGS. **5** to **6**, the supply pipe **23** communicating with the discharge port **15** may be connected to the drive mechanism **10** to which the support part **2** is connected or a second drive mechanism (not illustrated) different from the drive mechanism **10**. In this case, the discharge port **15** may be movable separately from the support part **2**.

[0068] The coating device **1** may further include a first holding part **25** that holds the first end **41** side in the longitudinal axis direction u of the long member **40** and a second holding part **26** that holds the second end **42** side in the longitudinal axis direction u of the long member **40**. With this configuration, since the long member **40** is stably held during coating, positional displacement of the long member **40** with respect to the discharge port **15** can be prevented.

[0069] The first holding part **25** and the second holding part **26** only need to have a mechanism capable of holding and releasing the long member **40** or a core material **28** to be described later, and can hold the long member **40** or the core material **28** by, for example, a method of pinching, sandwiching, gripping, sucking, fitting, or the like. The first holding part **25** or the second holding part **26** can include one or a plurality of members. The first holding part **25** and the second holding part **26** may have chuck pieces facing each other in the horizontal direction m or the vertical direction n. In FIG. **1**, the first holding part **25** has chuck pieces **251** and **252**, and the second holding part **26** has chuck pieces **261** and **262**.

[0070] At least one of the first holding part **25** and the second holding part **26** preferably has a rotation mechanism **27** that rotates the long member **40**. With this configuration, since coating can be applied while the long member **40** is rotated, liquid can be easily applied uniformly in a circumferential direction of the long member **40**. Note that, although FIG. **1** illustrates an example in which the second holding part **26** has the rotation mechanism **27**, the first holding part **25** may have the rotation mechanism **27**, and the first holding part **25** and the second holding part **26** may each have the rotation mechanism **27**.

[0071] The rotation mechanism **27** may revolve the long member **40** around the axis x of the coating device **1**, or may rotate the long member **40** about an axial center of its longitudinal axis. Note that a direction of the axis x of the coating device **1** may be parallel to the horizontal direction m. A direction of the axis x may be a direction from the first holding part **25** toward the second holding part **26**. The direction of the axis x may be parallel to the longitudinal axis direction u of the long member **40**. The direction of the axis x may be a longitudinal axis direction of the core material **28** before the long member **40** revolves. The rotation mechanism **27** includes an actuator such as a motor that drives the first holding part **25** or the second holding part **26**. For a configuration of the actuator, reference can be made to description of the drive mechanism **10**.

[0072] The first holding part **25** and the second holding part **26** may directly hold the long member **40** or may indirectly hold the long member **40** via another member. In FIG. **1**, the first holding part **25** directly holds an end portion on the first end **41** side of the long member **40**, and the second holding part **26** directly holds an end portion on the second end **42** side of the long member **40**. Since liquid is not applied to a first held part **47** held by the first holding part **25** in the long member **40** and a second held part **48** held by the second holding part **26** in the long member **40**, the first and second held parts **47** and **48** may be removed after completion of application.

[0073] In FIG. **5**, the long member **40** has a lumen extending in its longitudinal axis direction, and the coating device **1** further has the long core material **28** disposed in the lumen of the long member **40**. The core material **28** has a

first end **281** and a second end **282** in its longitudinal axis direction. The core material **28** passes through the lumen of the long member **40**, the first end **281** side of the core material **28** extends from the first end **41** of the long member **40**, and the second end **282** side of the core material **28** extends from the second end **42** of the long member **40**. The first holding part **25** holds an end portion on the first end **281** side of the core material **28**, and the second holding part **26** holds an end portion on the second end **282** side of the core material **28**. As the long member **40** is held via the core material **28** in this manner, coating of the entire long member **40** in the longitudinal axis direction u is made possible. Further, since the long member **40** is not directly held, it is possible to prevent a surface of the long member **40** from being scratched.

[0074] The core material **28** is a long rod-like member. The core material **28** may be solid or hollow. As a material constituting the core material **28**, description of a material constituting the long member **40** can be referred to.

[0075] The coating device **1** preferably includes the control unit **35** that controls operation of each part constituting the coating device **1**. Specifically, the control unit **35** is connected to at least one of the liquid supply unit **21**, the rotation mechanism **27** included in at least one of the first holding part **25** and the second holding part **26**, the drive mechanism **10** that drives the support part **2**, the recovery part **30**, the discharge part **31**, and the liquid adjustment unit **32**. Note that unlike FIG. **1**, connection of the recovery part **30** and the liquid adjustment unit **32** to the control unit **35** is omitted in FIG. **5**.

[0076] A function of the control unit **35** may be realized by hardware or software. Examples of the hardware include a logic circuit formed in an integrated circuit.

[0077] The coating device **1** may include a computer that executes a command of a program that is software for realizing a function of the control unit **35**. The computer preferably includes a processor, and a computer-readable storage medium storing the program. The function can be implemented when the processor executes the program stored in the computer-readable storage medium. Examples of the processor include a central processing unit (CPU). Examples of the storage medium include a read only memory (ROM). The storage medium can also include a random access memory (RAM). The program may be supplied to the computer via an appropriate transmission medium configured to transmit the program. Examples of the transmission medium include a communication network and a communication line.

[0078] The coating device **1** may be provided with an element for restricting movement of the long member **40** in a direction other than a downward direction of the vertical direction n. For example, as illustrated in FIGS. **10** to **12**, the coating device **1** preferably further includes a pressing part **11** that presses the long member **40** from above. With the pressing part **11**, since the long member **40** can be pressed by the pressing part **11** from a direction different from the support part **2**, movement of the long member **40** is easily restricted.

[0079] The pressing part **11** is a portion that comes into contact with the long member **40**. The pressing part **11** may be in point contact, line contact, or surface contact with the long member **40**. The pressing part **11** may be attached to a member different from the support part **2** as illustrated in FIG. **10**, or may be provided on the support part **2** as illustrated in FIGS. **11** to **12**.

[0080] The pressing part **11** may extend in the longitudinal axis direction u of the long member **40** or may extend in a direction perpendicular to the longitudinal axis direction u. Further, the pressing part **11** may extend in a circumferential direction of the long member **40**.

[0081] In the pressing part **11**, the long member **40** may be pressed using drive of a motor connected to the pressing part **11**, or the long member **40** may be pressed by its own weight. Further, by forming the pressing part **11** from an elastic body such as a spring or rubber, the long member **40** may be pressed by the pressing part **11** using a biasing force of the elastic body.

[0082] As the material constituting the pressing part **11**, description of a material constituting the long member **40** can be referred to. In order to make sliding with respect to the long member **40** excellent, the pressing part **11** is preferably made from metal such as stainless steel such as SUS304 or SUS316. Further, in order to prevent the long member **40** from being scratched, the pressing part **11** may be made from rubber or elastomer. Constituent materials of the pressing part **11** and constituent materials of the support part **2** may be the same or different from each other.

[0083] In a case where the support part **2** is movable in the longitudinal axis direction u of the long member **40**, the pressing part **11** is preferably disposed further on a side A to which the support part **2** advances than the discharge port **15** in the longitudinal axis direction u. By disposing the pressing part **11** in this manner, an uncoated portion of the long member **40** can be pressed by the pressing part **11**. Since the pressing part **11** is less likely to come into contact with a coating portion of the long member **40**, it is possible to enhance an effect of preventing peeling of coating and the uniformity of a coating film thickness.

[0084] The pressing part **11** is preferably movable in the longitudinal axis direction u of the long member **40**. Further, the pressing part **11** is preferably movable in the radial direction of the long member **40**. Furthermore, the pressing part **11** is preferably movable in the vertical direction n. It is easy to move the pressing part **11** along a shape of the long member **40**. In FIG. **10**, since the pressing part **11** is located at a lowermost position, it is indicated that the pressing part **11** is movable in an upward direction B. However, the pressing part **11** may be movable in a downward direction.

[0085] The pressing part **11** is preferably movable together with the support part **2**. As the pressing part **11** follows movement of the support part **2**, movement of the long member **40** can be more easily restricted. Further, the pressing part **11** is preferably movable together with the discharge port **15**. As the pressing part **11** follows movement of the discharge port **15**, liquid can be easily discharged to the long member **40** while movement of the long member **40** is restricted by the pressing part **11**.

[0086] In a case where the support part **2** is movable in the longitudinal axis direction u of the long member **40**, as illustrated in FIG. **10**, the coating device **1** preferably further includes an attachment part **12** which is connected to the support part **2**, extends to the side A to which the support part **2** advances, and attaches the pressing part **11** to the support part **2**. The pressing part **11** can be attached to the support part **2** via the attachment part **12**. Further, since the attachment part **12** extends to the side A to which the support part

2 advances, an uncoated portion of the long member **40** is easily pressed by the pressing part **11**.

[0087] The attachment part **12** only needs to have a shape extending from the support part **2** to the side to which the support part **2** advances, and may have, for example, a plate shape, a block shape, or an arm shape. The attachment part **12** may be attached to the pressing part **11** or the support part **2** by a method such as crimping, adhesion, engagement, or fitting.

[0088] The attachment part **12** is preferably not in contact with the long member **40**. An attachment position of the attachment part **12** with respect to the support part **2** is not particularly limited, but the attachment part **12** is preferably disposed on an upper portion of the support part **2** in order to prevent contact with the long member **40**.

[0089] As illustrated in FIG. **10**, the coating device **1** may further include a shaft **13** extending in the vertical direction n, and the pressing part **11** may be disposed at a lower end portion of the shaft **13**. In that case, the shaft **13** is preferably movable in the vertical direction n. As the shaft **13** moves in the vertical direction n with respect to the support part **2**, the pressing part **11** can be easily moved along a shape of the long member **40**.

[0090] One or a plurality of the shafts **13** may be disposed. For example, two of the shafts **13** may be arranged in a direction perpendicular to the longitudinal axis direction u of the long member **40**, and the pressing part **11** may extend in a direction perpendicular to the longitudinal axis direction u so as to connect lower end portions of two of the shafts **13**.

[0091] In a case where the coating device **1** further includes the shaft **13** extending in the vertical direction n and the pressing part **11** is disposed at a lower end portion of the shaft **13**, the attachment part **12** preferably has a through hole **121** penetrating in the vertical direction n and the shaft **13** is preferably inserted into the through hole **121**. Since the shaft **13** is easily held by the attachment part **12**, movement of the pressing part **11** can be stably performed.

[0092] The through hole **121** is preferably disposed in a portion extending further to the side A in an advancing direction than the support part **2** of the attachment part **12**. This facilitates insertion of the shaft **13** into the through hole **121**.

[0093] In order to prevent the shaft **13** from coming off the through hole **121**, a large-diameter part **131** having an outer diameter larger than that of the through hole **121** may be disposed at an upper end portion of the shaft **13**.

[0094] As illustrated in FIGS. **11** to **12**, in a case where the support part **2** has the recess **5** on an upper surface, the pressing part **11** is preferably a protrusion **14** provided on the surface **6** of the recess **5**. Since a width in the recess **5** can also be narrowed by providing the protrusion **14** in this manner, movement of the long member **40** during coating can be restricted by the support part **2** and the protrusion **14**.

[0095] Only one of the protrusion **14** may be provided with respect to the support part **2**, or a plurality of the protrusions **14** may be provided. In FIGS. **11** to **12**, two of the protrusions **14** are provided. When a plurality of the protrusions **14** is arranged on the support part **2**, protruding directions of a plurality of the protrusions **14** may be the same or different from each other.

[0096] The protrusion **14** may have a smaller width toward its tip, or may have the same width toward its tip.

[0097] A plurality of the protrusions **14** is preferably arranged such that their tips face each other. By making a plurality of the protrusions **14** face each other, a width in the recess **5** is easily narrowed, so that movement of the long member **40** is easily restricted.

[0098] In a case where two of the protrusions **14** face each other, a distance between tips of the protrusions **14** is preferably smaller than a maximum outer diameter of the long member **40**. Movement of the long member **40** is easily restricted by the protrusion **14**.

[0099] A protruding direction of the protrusion **14** is not particularly limited, but as illustrated in FIGS. **11** to **12**, the protrusion **14** preferably protrudes from the surface **6** of the recess **5** so as to extend in the horizontal direction m or a normal direction of the surface **6** of the recess **5**. With this configuration, the long member **40** moved during coating easily abuts on the protrusion **14**, and the movement of the long member **40** is easily restricted.

[0100] The protrusion **14** may be a part of the recess **5** of the support part **2**, or may be configured by an element different from the support part **2**.

[0101] The protrusion **14** may be configured to be able to protrude and recessed from the surface **6** of the recess **5**. By the above, the protrusion **14** can be protruded from the surface **6** of the recess **5** during coating to restrict movement of the long member **40**, and the protrusion **14** can be accommodated in the support part **2** before and after coating, so that the long member **40** can be easily set and taken out.

[0102] The protrusion **14** only needs to be provided at an upper location than a lowest point of the inner bottom surface **7** of the recess **5** and below an uppermost point of the support part **2**. The protrusion **14** is preferably provided on the upper side when a region from an uppermost point to a lowermost point of the surface **6** of the recess **5** is equally divided into two in the vertical direction n.

[0103] When a portion having a maximum outer diameter of the long member **40** is supported by the support part **2**, a lower end of the protrusion **14** is preferably disposed above an upper end of the long member **40**.

[0104] The protrusion **14** may be provided on the surface **6** of the recess **5** of the support part **2**, and the pressing part **11** that presses the long member **40** may be provided further on the side A to which the support part **2** advances than the protrusion **14**.

[0105] This application claims the benefit of the priority date of Japanese patent application No. 2021-051391 filed on Mar. 25, 2021. All of the contents of the Japanese patent application No. 2021-051391 filed on Mar. 25, 2021 are incorporated by reference herein.

REFERENCE SIGNS LIST

[0106] **1**: Coating device
[0107] **2**: Support part
[0108] **3**: Support surface
[0109] **5**: Recess
[0110] **6**: Surface
[0111] **7**: Inner bottom surface
[0112] **8**: Internal flow path
[0113] **9**: Projection
[0114] **10**: Drive mechanism
[0115] **11**: Pressing part
[0116] **12**: Attachment part
[0117] **13**: Shaft
[0118] **14**: Protrusion
[0119] **15**: Discharge port
[0120] **20**: Liquid pool part

[0121] **21**: Liquid supply unit
[0122] **22**: Storage part
[0123] **23**: Supply pipe
[0124] **24**: Pump
[0125] **25**: First holding part
[0126] **26**: Second holding part
[0127] **27**: Rotation mechanism
[0128] **28**: Core material
[0129] **30**: Recovery part
[0130] **31**: Discharge part
[0131] **32**: Liquid adjustment unit
[0132] **35**: Control unit
[0133] **40**: Long member
[0134] **41**: First end
[0135] **42**: Second end
[0136] **50**: Liquid
[0137] **51**: Residual liquid
[0138] **52**: Liquid pool
[0139] u: Longitudinal axis direction
[0140] m: Horizontal direction
[0141] n: Vertical direction

1. A coating device for coating a long member for medical use, the coating device comprising:
a support part capable of supporting the long member for medical use; and
a discharge port which is provided in the support part or disposed at a higher location than the support part and from which liquid to be applied to the long member is discharged.

2. The coating device according to claim **1**, wherein the support part has a recess at an upper surface, and the discharge port is provided at a surface of the recess.

3. The coating device according to claim **2**, wherein the discharge port is provided at a position including a lowermost point of an inner bottom surface of the recess.

4. The coating device according to claim **2**, wherein the support part and the discharge port are configured so that the liquid is discharged upward from the discharge port.

5. The coating device according to claim **2**, wherein the support part has a liquid pool part which is disposed around the discharge port so that the liquid discharged from the discharge port is accumulated at the liquid pool part.

6. The coating device according to claim **1**, further comprising a pressing part that presses the long member downwardly.

7. The coating device according to claim **6**, wherein the support part is configured to be movable in a longitudinal axis direction of the long member so as to apply the liquid, which is supplied from the discharge port, to the long member, and
the pressing part is disposed forward of the discharge port in a direction in which the support part advances in the longitudinal axis direction, and the pressing part presses the long member toward the support part.

8. The coating device according to claim **6**, wherein the pressing part is configured to be movable in a vertical direction to press the long member.

9. The coating device according to claim **6**, wherein the support part is configured to be movable in a longitudinal axis direction of the long member, and
the coating device further comprises:
an attachment part that is connected to the support part, extends toward the side to which the support part advances, and attaches the pressing part to the support part.

10. The coating device according to claim **6**, further comprising:
a shaft extending in a vertical direction, wherein the pressing part is disposed at a lower end portion of the shaft.

11. The coating device according to claim **9**, further comprising:
a shaft extending in a vertical direction, wherein the pressing part is disposed at the lower end portion of the shaft,
the attachment part has a through hole penetrating in the vertical direction; and
the shaft is inserted into the through hole so that the shaft is movable in the vertical direction.

12. The coating device according to claim **6**, wherein the support part has a recess at an upper surface, and
the pressing part comprises a protrusion disposed on a surface of the recess.

13. The coating device according to claim **12**, wherein the protrusion protrudes from the surface of the recess so as to extend in a horizontal direction or a direction perpendicular to the surface of the recess from which the protrusion protrudes.

14. The coating device according to claim **1**, wherein the discharge port is configured to be movable in a longitudinal axis direction of the long member so as to apply the liquid to the long member.

15. The coating device according to claim **1**, wherein the discharge port is configured to be movable in a radial direction of the long member so as to apply the liquid to the long member.

16. The coating device according to claim **1**, wherein the discharge port is configured to be movable together with the support part.

17. The coating device according to claim **1**, wherein a plurality of the support parts is included, and
the discharge port is provided in each of the plurality of the support parts.

18. The coating device according to claim **1**, further comprising:
a first holding part that holds a first end side in a longitudinal axis direction of the long member; and
a second holding part that holds a second end side in the longitudinal axis direction of the long member, wherein at least one of the first holding part and the second holding part has a rotation mechanism that rotates the long member.

19. The coating device according to claim **1**, wherein the long member is a member for forming a catheter.

* * * * *