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Takeda et al.

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(54) **LIQUID DISCHARGE APPARATUS HAVING LIQUID CONTAINER AND OPERATING MEMBER**

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B41J 2/175 (2006.01)

(52) **U.S. Cl.**
CPC ***B41J 2/17536*** (2013.01)

(58) **Field of Classification Search**
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See application file for complete search history.

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(57) **ABSTRACT**

A liquid discharge apparatus includes a liquid container and an operating member. The liquid container is configured to introduce liquid from a liquid introducing portion to an inside. The operating member is configured to rotate around a rotation shaft in a first direction from a first position for covering the liquid introducing portion to move to a second position for exposing the liquid introducing portion, and rotate in a second direction opposite to the first direction from the second position to move to the first position. The operating member includes a plug member and a covering portion. The plug member is retained to the operating member by a retaining member and configured to plug the liquid introducing portion at the first position. The covering portion is configured to cover the plug member in a direction intersecting with the first direction.

11 Claims, 14 Drawing Sheets

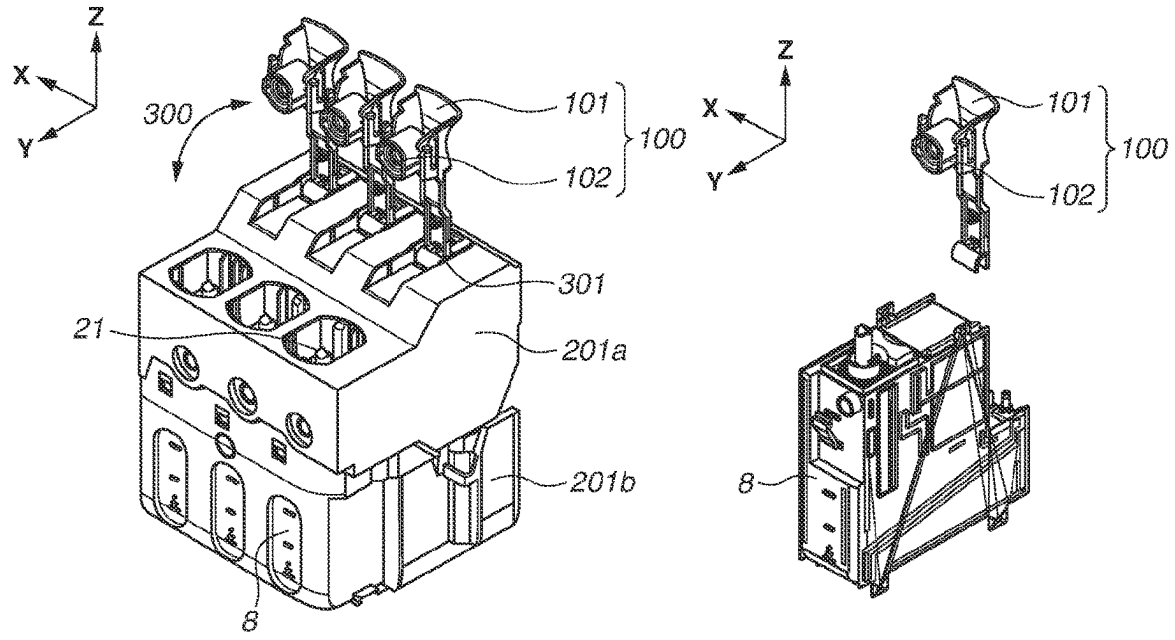


FIG.1

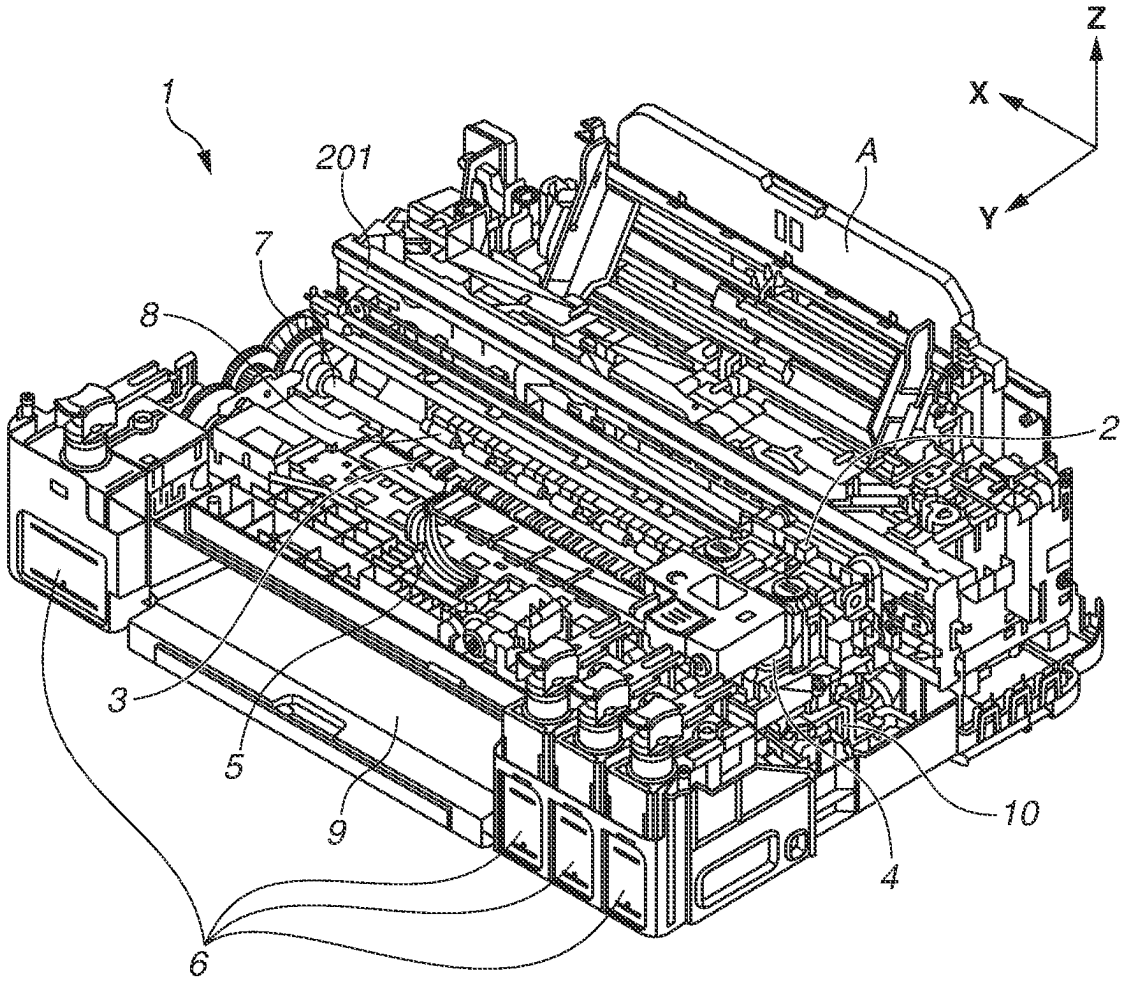


FIG.2

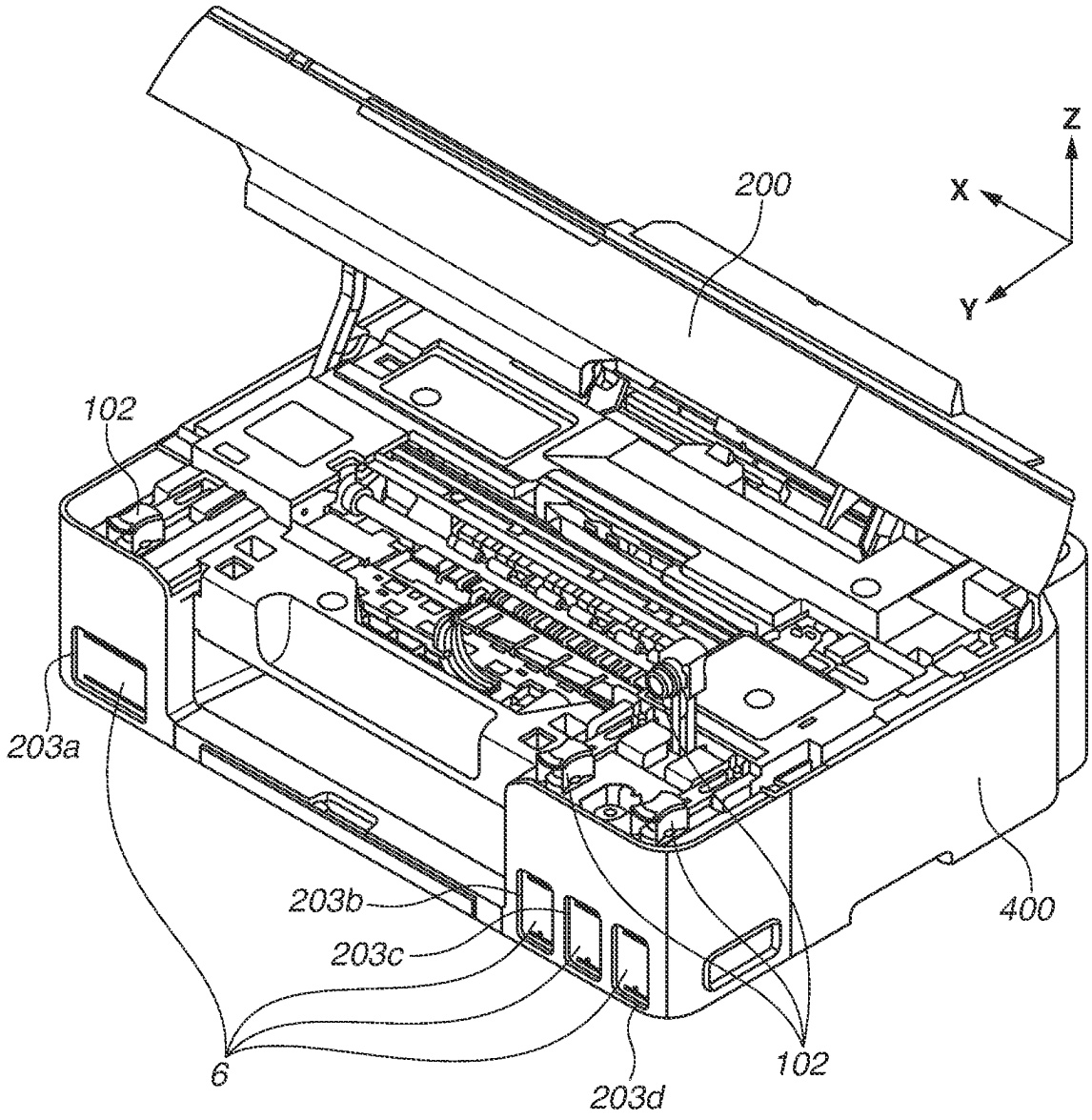


FIG.3A

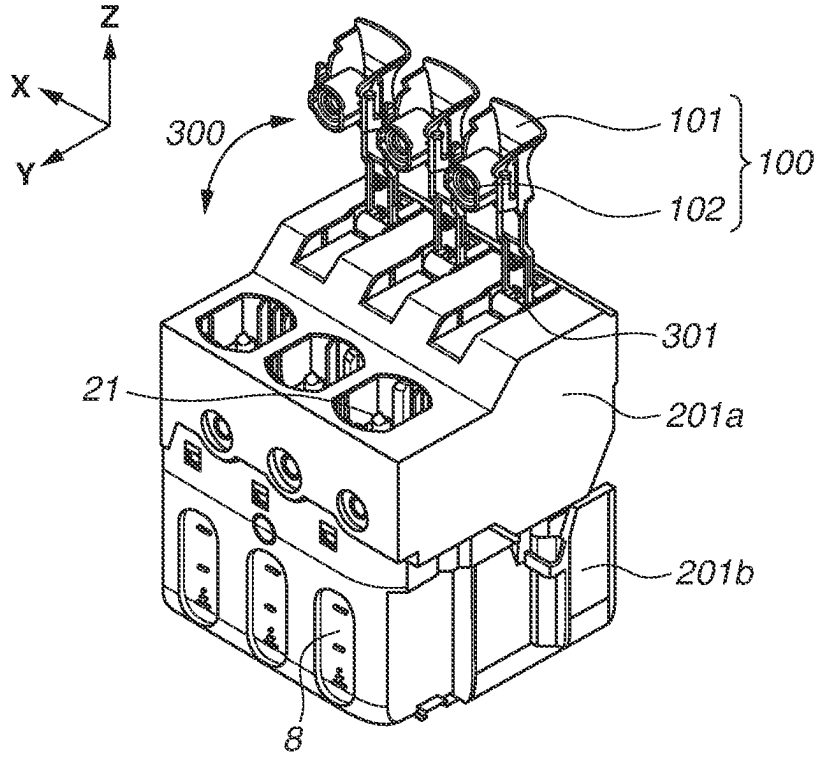


FIG.3B

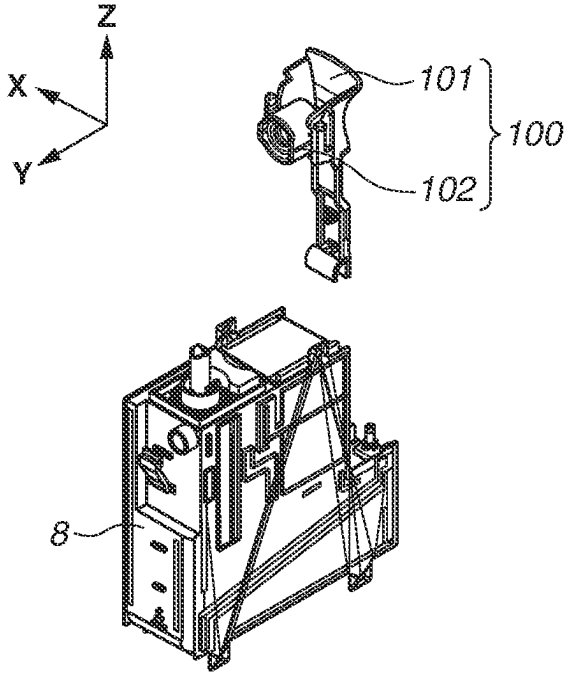


FIG.4

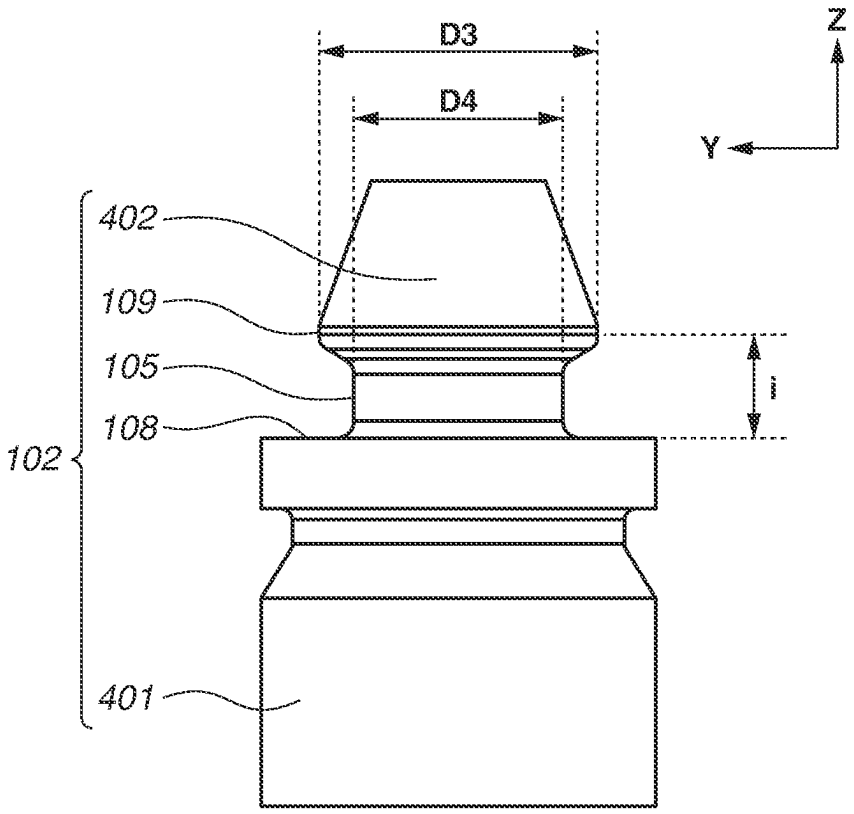


FIG.5A

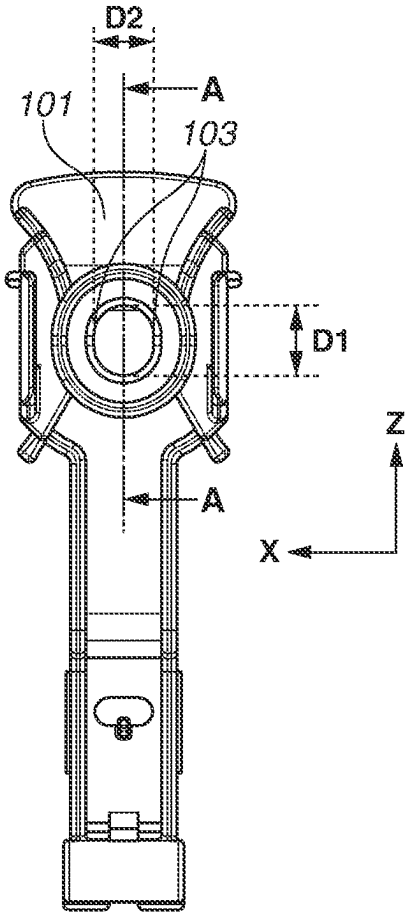


FIG.5B

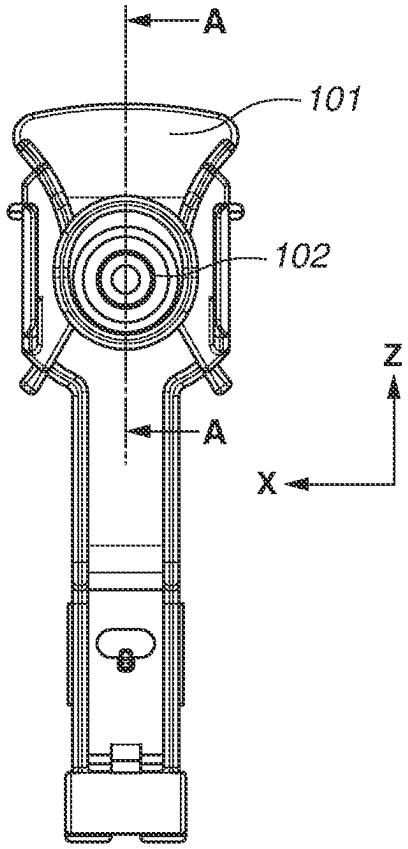


FIG.6A

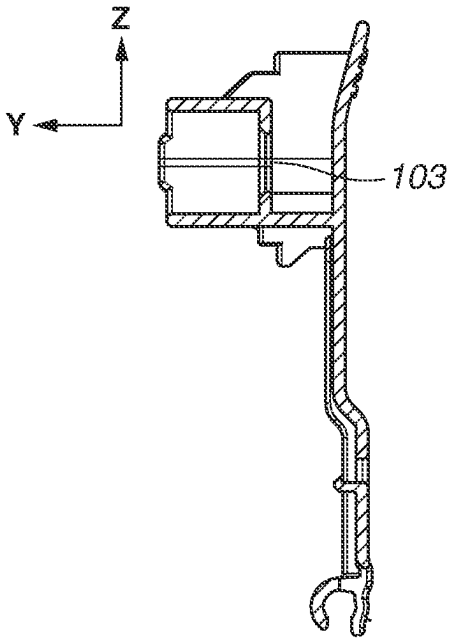


FIG.6B

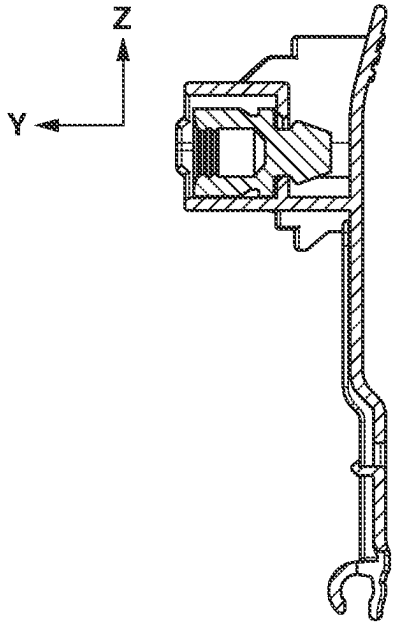


FIG.6C

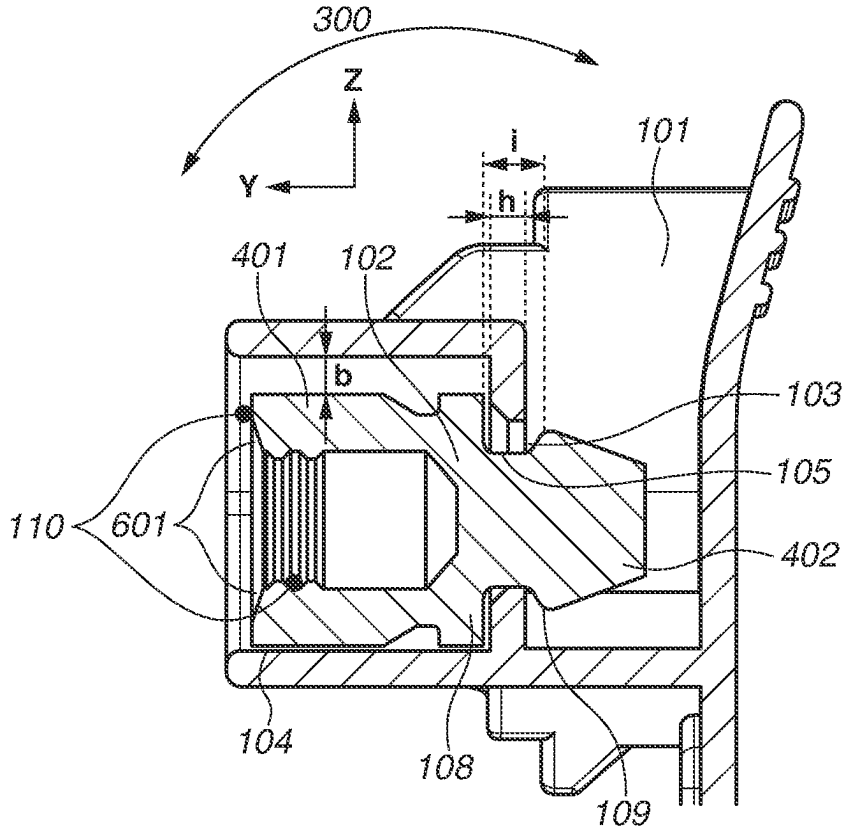


FIG.7A

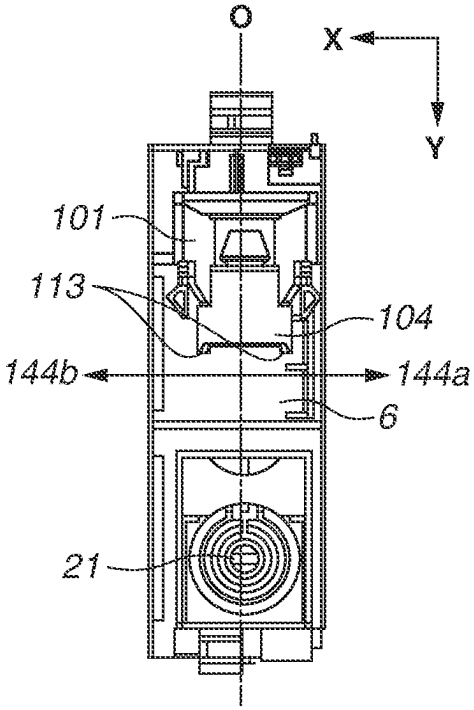


FIG.7B

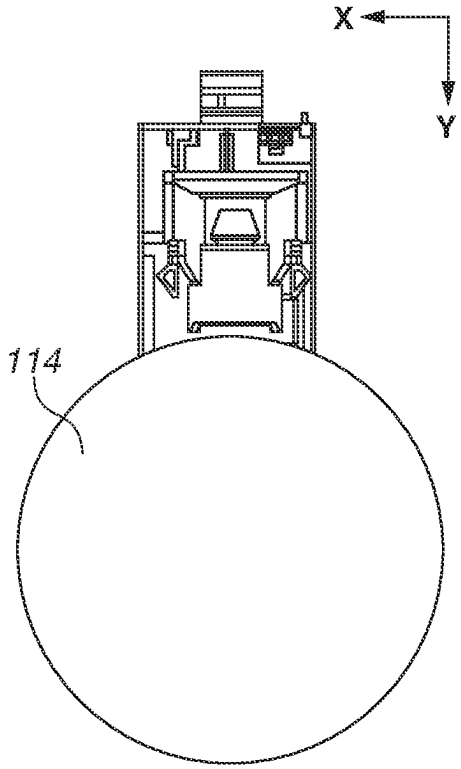


FIG.7C

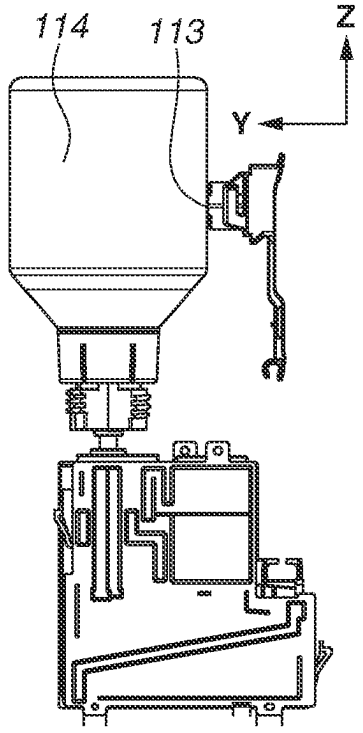


FIG.8A

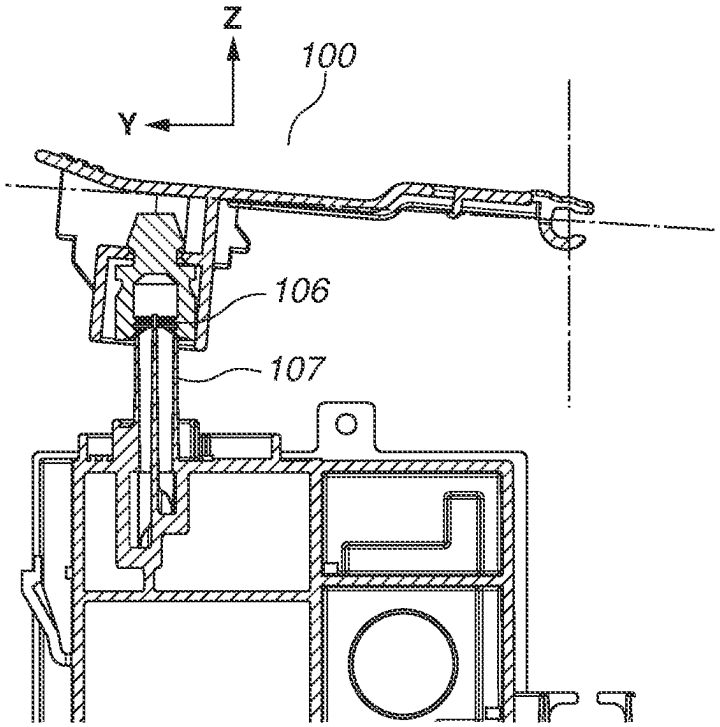


FIG.8B

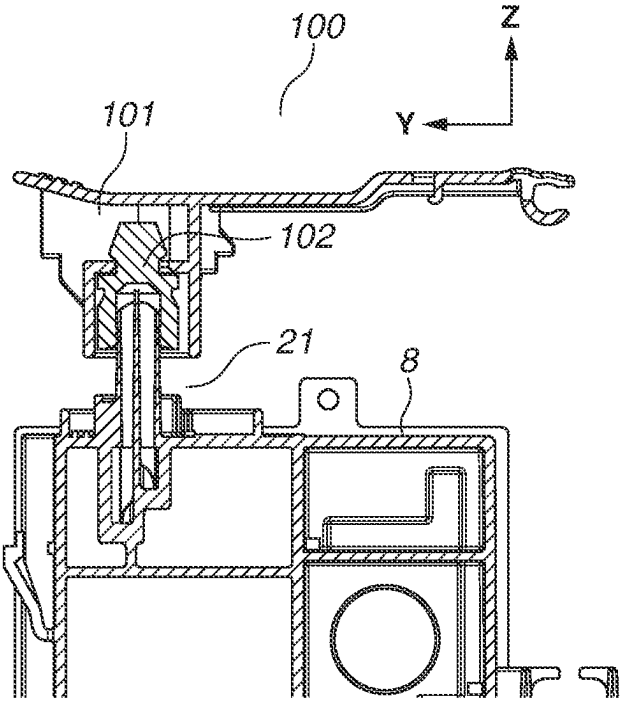


FIG.9A

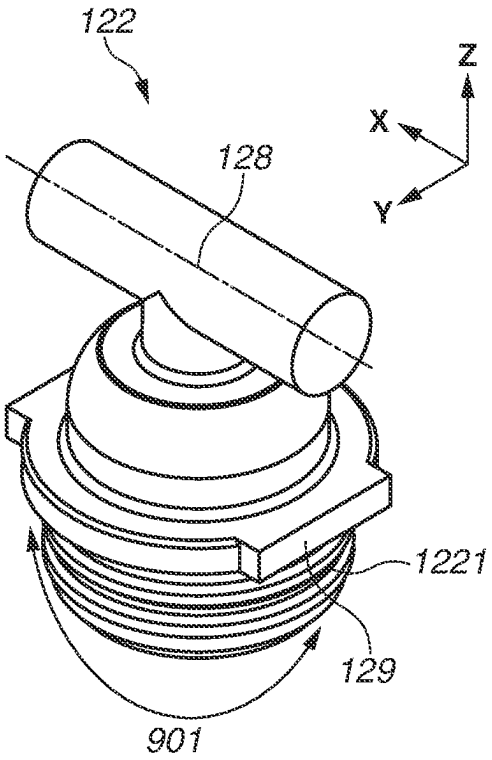


FIG.9B

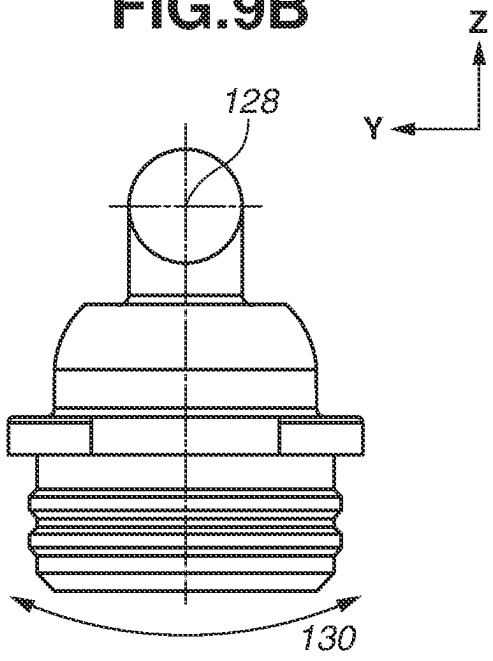


FIG.10A

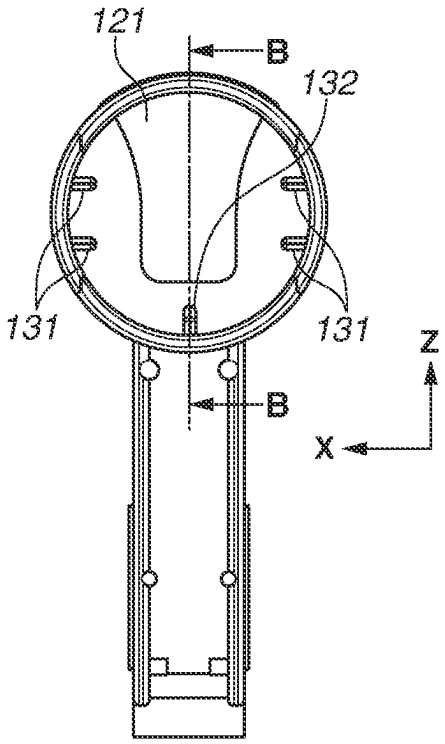


FIG.10B

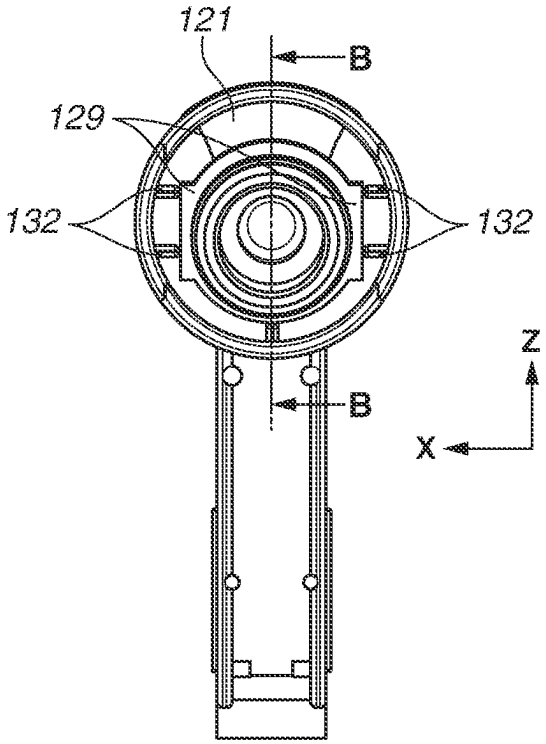


FIG.10C

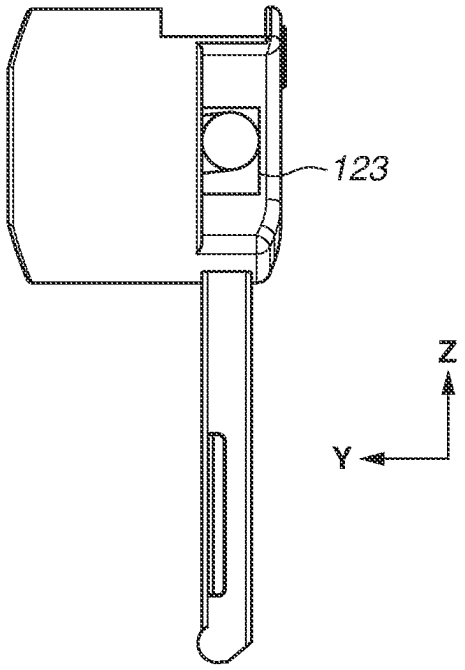


FIG.11A

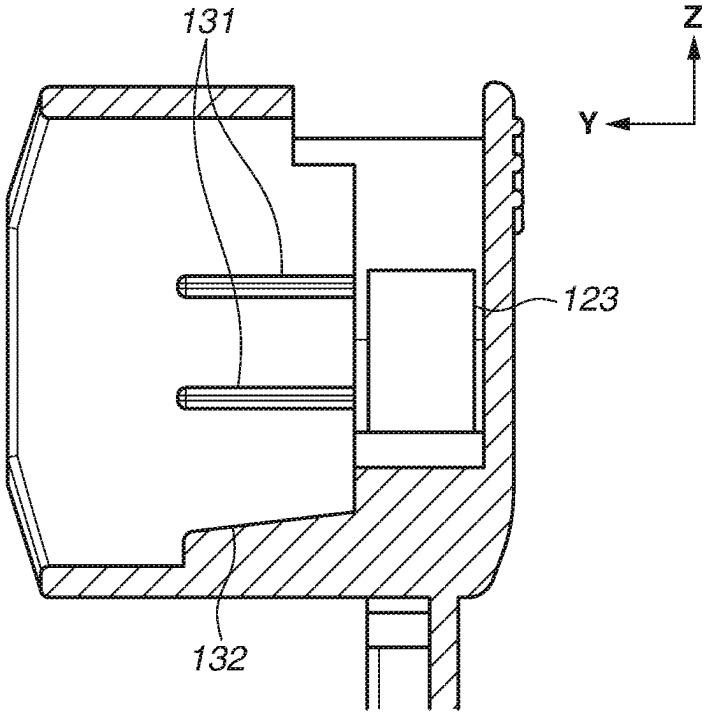


FIG.11B

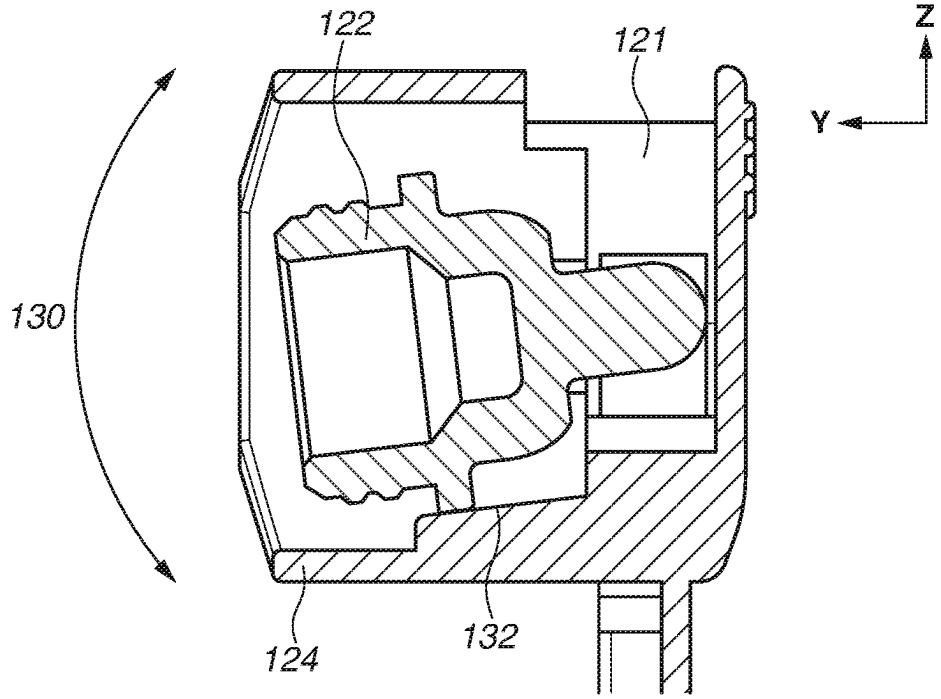


FIG.12A

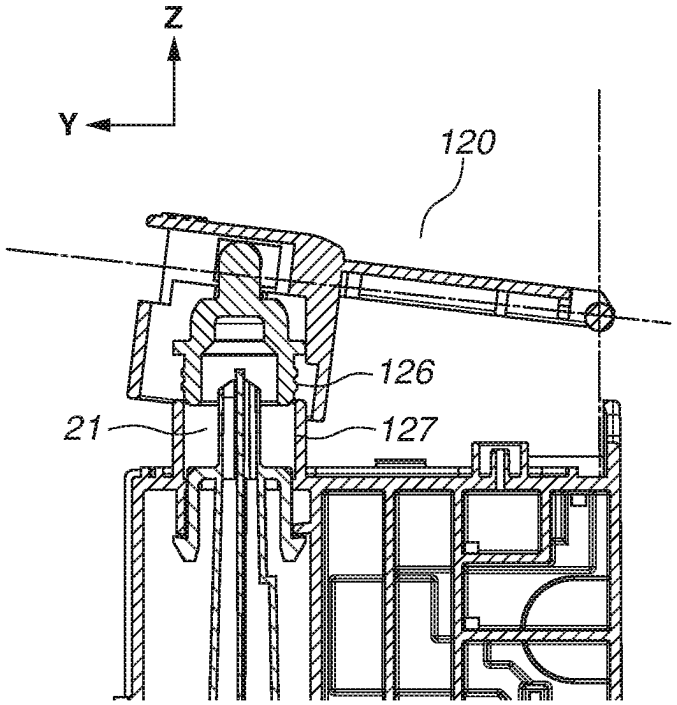


FIG.12B

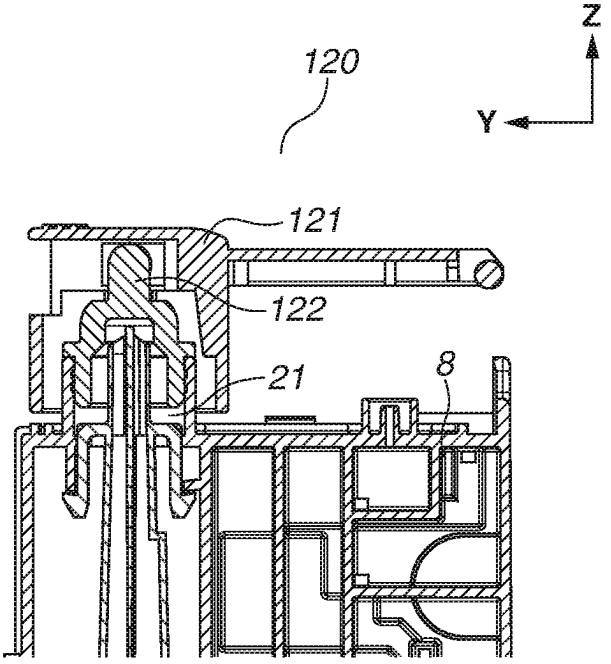


FIG.13A

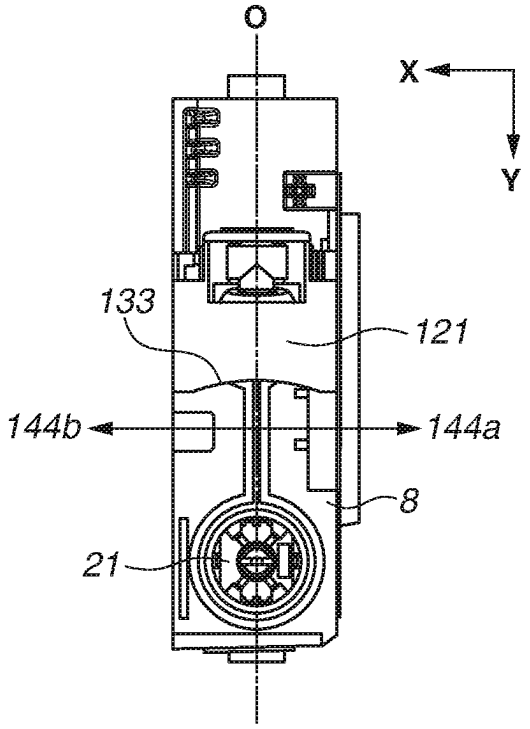


FIG.13B

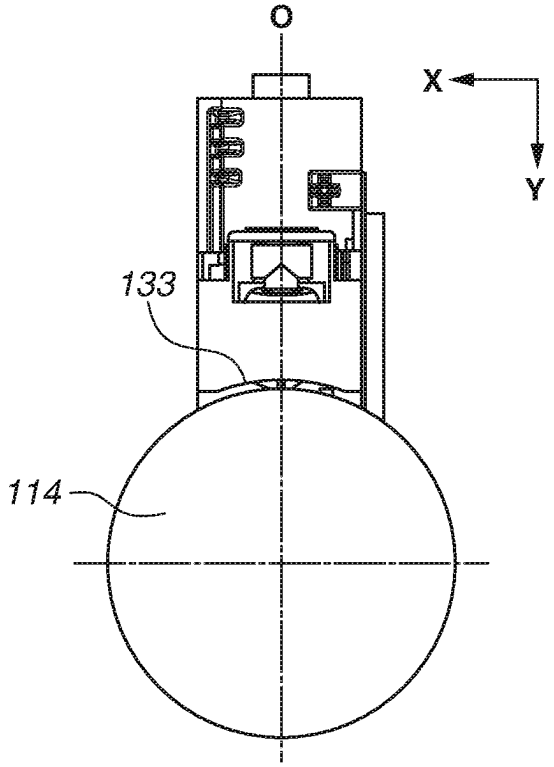


FIG.14A

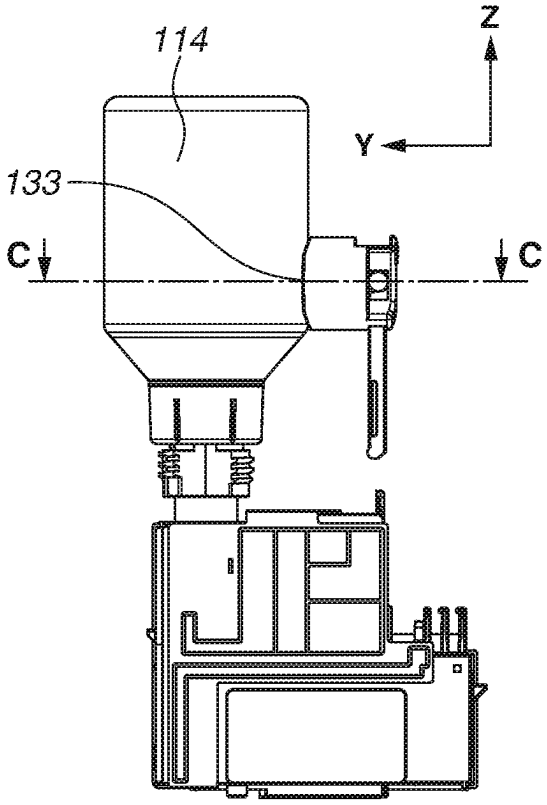
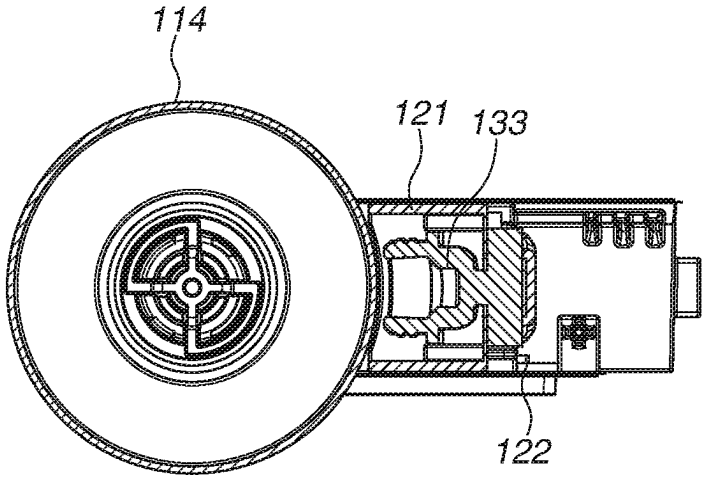


FIG.14B



LIQUID DISCHARGE APPARATUS HAVING LIQUID CONTAINER AND OPERATING MEMBER

BACKGROUND

Technical Field

One disclosed aspect of the embodiments relates to a liquid discharge apparatus.

Description of the Related Art

Conventional liquid discharge apparatuses are known to include ink tanks for storing ink to be supplied to a liquid discharge head for discharging ink. Some of such liquid discharge apparatuses allow a user to replenish ink by injecting ink into each ink tank. The user injects ink into the ink tank through an injection port provided on the ink tank. The injection port is configured to be openable or closable when a plug member is detached or attached, respectively. Japanese Patent Application Laid-Open No. 2018-69705 discusses a configuration in which an elastically deformable plug member for plugging an injection port is attached to a highly rigid retaining member that is rotated to open or close the injection port.

However, in the configuration discussed in Japanese Patent Application Laid-Open No. 2018-69705, the positional relation between the plug member and the injection port may be shifted by the rotation of the retaining member. Attaching the plug member to the injection port in a shifted positional state may possibly cause insufficient closing of the injection port.

SUMMARY

One aspect of the embodiments has been devised in view of the above-described issue and is directed to more securely closing an injection port provided on a liquid container.

According to an aspect of the embodiments, a liquid discharge apparatus includes a liquid container and an operating member. The liquid container is configured to introduce liquid from a liquid introducing portion to an inside. The operating member is configured to rotate around a rotation shaft in a first direction from a first position for covering the liquid introducing portion to move to a second position for exposing the liquid introducing portion, and rotate in a second direction opposite to the first direction from the second position to move to the first position. The operating member includes a plug member and a covering portion. The plug member is retained to the operating member by a retaining member and is configured to plug the liquid introducing portion at the first position. The covering portion is configured to cover the plug member in a direction intersecting with the first direction.

Further features of the disclosure will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic view illustrating an overview of a liquid discharge apparatus according to a first exemplary embodiment.

FIG. **2** illustrates a configuration including a housing of the liquid discharge apparatus according to the first exemplary embodiment.

FIGS. **3**A and **3**B are schematic views illustrating a liquid storage unit or device according to the first exemplary embodiment.

FIG. **4** is a schematic view illustrating a plug member according to the first exemplary embodiment.

FIGS. **5**A and **5**B are schematic views illustrating a retaining member and the plug member, respectively, configuring an operating member according to the first exemplary embodiment.

FIGS. **6**A to **6**C are cross-sectional views illustrating the retaining member and the plug member taken along the A-A lines in FIGS. **5**A and **5**B in a state where the operating member is positioned at an opening position according to the first exemplary embodiment.

FIGS. **7**A and **7**B are top views and FIG. **7**C is a lateral view illustrating the liquid storage unit according to the first exemplary embodiment.

FIGS. **8**A and **8**B are cross-sectional views illustrating the liquid storage unit according to the first exemplary embodiment.

FIGS. **9**A and **9**B are schematic views illustrating a plug member according to a second exemplary embodiment.

FIGS. **10**A to **10**C are schematic views illustrating a retaining member and a plug member configuring the operating member according to the second exemplary embodiment.

FIGS. **11**A and **11**B are cross-sectional views illustrating the retaining member and the plug member configuring the operating member according to the second exemplary embodiment.

FIGS. **12**A and **12**B are cross-sectional views illustrating a liquid storage unit according to the second exemplary embodiment.

FIGS. **13**A and **13**B are top views illustrating an ink tank and the operating member according to the second exemplary embodiment.

FIGS. **14**A and **14**B illustrate the ink tank and the operating member according to the second exemplary embodiment.

DESCRIPTION OF THE EMBODIMENTS

First Embodiment

An overview of an ink jet recording apparatus as an example of a liquid discharge apparatus according to the disclosure will now be described. FIG. **1** is a schematic view illustrating an ink jet recording apparatus according to the first embodiment.

An ink jet recording apparatus **1** (hereinafter referred to as a recording apparatus **1**) includes a feed roller (not illustrated) that feeds each of recording media stacked on a paper feed tray A. A fed recording medium is sent to between a conveyance roller **7** and a pinch roller **8** and then conveyed in the +Y direction in FIG. **1**. The rear surface of the conveyed recording medium is supported by a platen **3**. The recording medium is retained such that the distance between the nozzles (not illustrated) of a recording head **4** as a liquid discharge head and the recording medium as a medium subjected to liquid discharge is maintained to be a constant or predetermined distance. In this state, the nozzles of the recording head **4** discharge ink (a liquid containing a coloring material) to the recording medium to perform recording on the recording medium.

The recording head **4** having the nozzles for discharging ink (liquid) is mounted on a carriage **2** that is reciprocated along a carriage rail **201** in the X direction by a driving unit

or device, such as a motor. The recording head **4** discharges ink drops while moving in the main scanning direction, together with the carriage **2**, to record an image for one band on the recording medium on the platen **3**. When an image for one band has been recorded, the recording medium is conveyed by a predetermined amount in the conveyance direction by a conveyance roller **7** (intermittent conveyance operation). Repeating the recording operation for one band and the intermittent conveyance operation records an image on the recording medium based on image data. The recording medium having been subjected to recording by the recording head **4** is sent to between a discharge roller (not illustrated) and a driven roller and then is discharged onto a discharge tray **9**.

The recording apparatus **1** is provided with ink tanks **6** as a plurality of independent liquid containers corresponding to different ink colors to be discharged from the recording head **4**. The ink tanks **6** and the recording head **4** are connected by tubes **5** (see FIGS. **3**A and **3**B) corresponding to different ink colors via joints (not illustrated). This configuration enables supplying ink of different colors stored in the ink tanks **6** to the nozzles of the recording head **4** corresponding to the different ink colors.

The recording apparatus **1** includes a cap member **10** for covering a surface where the nozzles of the recording head **4** are formed. The cap member **10** is made of a flexible material and configured to be movable to a capping position for covering an ink discharge portion **81** of the recording head **4** and to a separated position not for covering the ink discharge portion **81**. The cap member **10** is connected to a pump (not illustrated). When the pump is driven in a state where the cap member **10** is positioned at the capping position, the internal pressure of the cap member **10** becomes negative and hence ink is absorbed from the recording head **4**. This sequence recovers the ink discharge performance of the recording head **4**. The cap member **10** also has a role of preventing ink discharge failures due to the dried nozzles for the following reason. The cap member **10** is positioned at the capping position in a standby state where the recording head **4** is not performing the reading operation. This reduces the time during which the nozzles of the recording head **4** are exposed in the atmosphere.

The recording apparatus **1** is covered by a housing **400**, as illustrated in FIG. **2**. The housing **400** is provided with opening windows **203***a*, **203***b*, **203***c*, and **203***d* corresponding to the different arrangement positions of the ink tanks **6**, allowing the user to visually recognize the ink tanks **6** from the front side through the opening windows. This configuration allows the user to visually check the remaining amounts of ink stored in the ink tanks **6**. With each of the ink tanks **6** according to the present exemplary embodiment, ink can be injected (introduced) from an injection port **21** (see FIG. **3**A) as a liquid introducing portion that is plugged by a plug member **102**. The plug member **102** is configured to be movable to the closing position for plugging the injection port **21** or the opening position for opening the injection port **21**. The ink tanks **6** and the recording head **4** are connected by the tubes **5** as paths for supplying ink from the ink tanks **6** to the recording head **4**.

The recording apparatus **1** is provided with a cover **200** that is configured to be rotatable between the closing position for covering the interior of the apparatus **1** and the opening position for opening the interior of the apparatus **1**. When the user injects ink into an ink tank **6**, the user moves the cover **200** and the plug member **102** to the opening positions and then injects ink in a state where the injection port **21** is open.

FIGS. **3**A and **3**B are schematic views illustrating a liquid storage unit or device. As illustrated in FIG. **3**A, the ink tanks **6** are positioned by a housing **201***b*. Operating members **100** are attached to a rotation shaft **301** provided in a housing **201***a* that is positioned by the housing **201***b*, so that the operating members **100** are rotatable in a direction **300** around the rotation shaft **301**. Thus, the ink tanks **6** are integrally retained by the housings **201***a* and **201***b*. According to the present exemplary embodiment, the rotation shaft **301** is disposed in the X direction, and the direction **300** intersects with the axial direction of the rotation shaft **301**. According to the present exemplary embodiment, the ink tanks **6** and the operating members **100** are collectively referred to as a liquid storage unit.

FIG. **3**B illustrates an ink tank **6** and an operating member **100** in a state where the housings **201***a* and **201***b* are removed from the state in FIG. **3**A. According to the present exemplary embodiment, one operating member **100** is provided for each ink tank **6**. Each operating member **100** is formed of a plug member **102** and a retaining member **101**.

The structure of the operating member **100** will now be described with reference to FIGS. **4**, **5**A, and **5**B. As described above, the operating member **100** is formed of a plug member **102** and a retaining member **101**. The plug member **102** is supported by the retaining member **101** and integrally moves with the operating member **100**. The plug member **102** is formed of a closing portion **401**, an engaging portion **105**, and a retaining portion **402** as illustrated in FIG. **4**. The engaging portion **105** is a recessed portion ranges from an upper portion **108** of an injection port retaining portion to an expanding portion **109** of the retaining portion **402**, and has a length i and a length of a width D**4**. The expanding portion of the retaining portion **402** has a length of a width D**3**.

As illustrated in FIG. **5**A, the retaining member **101** in a state where the plug member **102** is not retained includes an engaging portion (opening portion) **103** having an oblong hole shape where the length of a longitudinal width D**1** of the retaining member **101** is larger than the length of a lateral width D**2** of the retaining member **101**. When the plug member **102** is attached to the retaining member **101** such that the engaging portion **105** of the plug member **102** engages with the engaging portion **103** of the retaining member **101**, the retention of the plug member **102** by the retaining member **101** is completed, as illustrated in FIG. **5**B. According to the present exemplary embodiment, the retaining portion **402** has a shape expanding from the upper portion to the expanding portion **109**, where the length of an outer diameter D**3** of the expanding portion **109** is larger than the length of the width D**2** of the engaging portion **103**. When the plug member **102** is attached to the retaining member **101**, the upper portion of the retaining portion **402** is inserted into the engaging portion **103** all the way to the engaging portion **105**. Thus, the engaging portion **103** engages with the engaging portion **105**. The length of the width D**4** of the engaging portion **105** is set to be smaller than the lengths of the widths D**1** and D**2**. When the plug member **102** engages with the retaining portion **402**, as described below, the plug member **102** is retained by the retaining member **101**.

As described above, the outer diameter of the expanding portion **109** of the retaining portion **402** is larger than the length of the width D**2** of the engaging portion **103** in the X direction. The plug member **102** is made of an elastically deformable material, and the retaining member **101** is made of a material having a higher rigidity than the material of the plug member **102**. Thus, when the retaining portion **402** is

inserted into the engaging portion **103**, the retaining portion **402** is elastically deformed along the engaging portion **103**.

Thus, whole of the retaining portion **402** can be inserted into the engaging portion **103**. In this case, the engaging portion **103** has an oblong hole shape with the longitudinal width D**1** as the larger width and the lateral width D**2** as the smaller width.

In a state where the retaining portion **402** has been inserted into the engaging portion **103**, and the engaging portion **103** engages with the engaging portion **105**, the expanding portion **109** of the retaining portion **402** having been elastically deformed returns to the original shape, preventing the retaining portion **402** from coming off from the engaging portion **103**. This maintains the engagement between the engaging portions **103** and **105**. As described above, the retaining portion **402** has a shape expanding from the upper portion to the expanding portion **109**. Thus, the retaining portion **402** can be smoothly inserted into the engaging portion **103** if the length of the outer diameter of the upper portion of the retaining portion **402** is formed to be smaller than the length of the width D**2** of the engaging portion **103**. The retaining portion **402** does not necessarily need to be shaped to expand from the upper portion to the expanding portion **109**. For example, the retaining portion **402** can be shaped in step or wave form as long as the plug member **102** can be retained by the retaining member **101**.

FIGS. **6**A to **6**C are cross-sectional views illustrating the retaining member **101** and the plug member **102** taken along the A-A line in FIGS. **5**A and **5**B in a state where the operating member **100** is positioned at the opening position. FIG. **6**A is a cross-sectional view illustrating only the retaining member **101**. FIG. **6**B is a cross-sectional view illustrating a state where the plug member **102** is attached to the retaining member **101**. FIG. **6**C is an enlarged view illustrating the periphery of the plug member **102** illustrated in FIG. **6**B. As illustrated in FIG. **6**C, the length of a width h of the engaging portion **103** in the direction **300** is set to be smaller than the length i of the engaging portion **105**. The plug member **102** attached to the retaining member **101** is therefore loosely fitted in the direction **300**. As described above, the width D**4** of the engaging portion **105** of the plug member **102** is set to be smaller than the widths D**1** and D**2** of the engaging portion **103**. The plug member **102** is therefore configured to loosely fit the retaining member **101** to be movable in any of the X, Y, and Z directions (see FIG. **6**C). This also applies to the changed orientation of the operating member **100**. The dimensions of the engaging portions **103** and **105** may be set according to the amount of loose fitting to be prepared in the engagement between the engaging portions **103** and **105**. However, the range where the plug member **102** is movable through the loose fitting of the engaging portion **103** is within the range regulated by the retaining portion **402**, the upper portion **108** of the closing portion **401**, and a covering portion **104** (described below). Referring to FIG. **6**C, one side of the inner wall of the covering portion **104** (−Z direction side in a FIG. **6**C) is in contact with the lower side of the plug member **102**. The other side of the inner wall of the covering portion **104** (+Z direction side in FIG. **6**C) is not in contact with the upper portion of the plug member **102**, and there is a gap b between the inner wall and the upper portion. The length of the gap b needs to be suitably determined in consideration of the dimensions of the operating member **100** and the movable range of the loosely fitted plug member **102**, and can be, for example, about 1.0 to 3.0 mm.

The loose fitting between the engaging portion **105** and the engaging portion **103** enables the plug member **102** to be movable in association with the rotation of the retaining member **101** or the insertion into an injection port **21**. A leading edge **601** of the closing portion **401** is shaped such that the opening gradually decreases toward the center of the plug member **102**, i.e., toward the depth side of the plug member **102** (−Y direction). Thus, when the injection port **21** comes into contact with the leading edge **601** of the closing portion **401**, as illustrated in FIG. **8**A, the injection port **21** is guided to the center of the closing portion **401**, and the closing is smoothly accomplished.

The retaining member **101** is longer than the plug member **102** in the direction **300**, and is provided with a covering portion **104** that covers the closing portion **401** of the plug member **102** when the plug member **102** is retained by the retaining member **101**. When the injection port **21** is closed, ink **110** transferred from the injection port **21** may adhere to the leading edge or the inside of the closing portion **401** of the plug member **102**. If the user touches the leading edge or the inside of the closing portion **401** in a state where the operating member **100** is positioned at the opening position, the ink **110** may possibly adhere to the user.

According to the present exemplary embodiment, the leading edge of the covering portion **104** protrudes in the direction **300** more than the leading edge of the closing portion **401**. This allows the user to touch the covering portion **104** before touching the leading edge of the closing portion **401**, preventing ink adhesion to the user's hand.

FIGS. **7**A and **7**B are top views illustrating the liquid storage unit according to the present exemplary embodiment. FIG. **7**A illustrates a state where the operating member **100** is rotated to open the plug member **102**, viewed from above in the Z direction. FIG. **7**B illustrates a state where the injection port **21** of the ink tank **6** is inserted into an ink bottle **114** in the state in FIG. **7**A, viewed from above in the Z direction. FIG. **7**C illustrates the state in FIG. **7**B, viewed from the X direction. The amount of opening of the operating member **100** with respect to the ink tank **6** needs to be suitably determined in consideration of the dimension or weight of the operating member **100**. According to the present exemplary embodiment, for example, the amount of opening is set to about 90 to 100 degrees. Even when the cover **200** is moved to the closing position in a state where the operating member **100** is positioned at the opening position, the operating member **100** is pushed by the cover **200** and accordingly moved from the opening position to the closing position.

When ink is replenished into the ink tank **6**, the injection port **21** is inserted into the ink bottle **114** in the Z direction to inject ink from the ink bottle **114** into the ink tank **6**. The amount of opening of the operating member **100** is set to about 90 degrees. Thus, when the injection port **21** is inserted into the ink bottle **114**, the outer surface of the ink bottle **114** and the covering portion **104** interfere with each other, and the ink bottle **114** may possibly come into contact with the covering portion **104**. As described above, since the leading edge of the covering portion **104** more outwardly protrudes than the closing portion **401** of the plug member **102**, ink adhering to the leading edge of the closing portion **401** is prevented from adhering to the ink bottle **114**. However, if ink adheres to the leading edge of the covering portion **104**, ink on the covering portion **104** adheres to the ink bottle **114**, and possibly adheres to the user replenishing ink.

The leading edge of the covering portion **104** is therefore provided with a pair of protruding portions **113** at positions farthest in the X direction from the extension line along the center O of the injection port **21** in the Y direction.

According to the present exemplary embodiment, the ink bottle **114** has a cylindrical shape. Thus, when the injection port **21** is inserted into the ink bottle **114**, the ink bottle **114** and the covering portion **104** come close to each other at the position on the extension line along the center O of the injection port **21** in the Y direction. Thus, providing the protruding portions **113** as described above allows the covering portion **104** to be kept away from the ink bottle **114** even if the ink bottle **114** comes into contact with the protruding portions **113**. Thus, even if the ink bottle **114** comes into contact with the leading edge of the covering portion **104**, the ink bottle **114** can avoid the contact with portions at the leading edge of the covering portion **104** where the protruding portions **113** are not provided.

Instead of being provided with the protruding portions **113**, the leading edge of the covering portion **104** may be provided with an arc shape protruding at positions farthest in the X direction from the extension line along the center O of the injection port **21** in the Y direction.

FIGS. **8**A and **8**B are Y-Z cross-sectional views illustrating the liquid storage unit. FIG. **8**A illustrates a state where the plug member **102** and the injection port **21** start coming into contact with each other during the closing motion for the injection port **21** by the operating member **100**.

FIG. **8**B illustrates a state where the injection port **21** has been closed by the operating member **100**. The closing portion **401** of the plug member **102** is provided inside with protruding portions **106**. The inner diameter of the protruding portions **106** is slightly smaller than the outer diameter of an injection port engaging portion **107** of the injection port **21**. Thus, when the protruding portions **106** and the injection port **21** engage with each other during the closing motion for the injection port **21** by the operating member **100**, the protruding portions **106** elastically deform to fit the outer diameter of the injection port **21**. This structure enables more securely closing the injection port **21**.

During the closing motion for the injection port **21** by the operating member **100**, the plug member **102** attached to the retaining member **101** rotates in the direction **300** following the rotation of the operating member **100** from the opening position to the closing position. According to the present exemplary embodiment, in the period during which the plug member **102** starts coming into contact with the injection port **21** until the injection port **21** is closed, the plug member **102** performs the closing motion by engaging with the injection port **21** in the approximate Z direction. During the closing motion, the position of the engaging portion **105** of the plug member **102** in the engaging portion **103** moves following the closing motion for the injection port **21**. In particular, the plug member **102** moves in the Y direction (FIG. **8**B) following the rotation in the direction **300**.

In this state, the plug member **102** is retained by the retaining member **101** in a state of loosely fitting in all directions (X, Y, and Z directions), as described above. The engaging portion **103** has an oblong hole shape with the larger width D1 in the longitudinal direction of the retaining member **101** (Y direction in FIGS. **8**A and **8**B). Thus, the retaining member **101** keeps retaining the plug member **102** while allowing the movement of the plug member **102** in the Y direction.

If a shift occurs in the contact between the injection port **21** and the plug member **102** during the closing motion by the operating member **100**, the plug member **102** moves along the engaging portion **103** so as to guide the injection port **21** toward the center of the plug member **102**, thus absorbing the positional shift.

With this configuration, the loose-fitting of the plug member **102** absorbs the positional shift of the plug member **102** with respect to the injection port **21** during the closing motion for the injection port **21** by the operating member **100**. This structure enables more securely closing the injection port **21**. Although, according to the present exemplary embodiment, the operating member **100** rotates around the rotation shaft **301**, the operating member **100** can plug the injection port **21** through a sliding motion. Although, according to the present exemplary embodiment, the engaging portion **103** has an oblong hole shape, the engaging portion **103** can have a horizontally oblong hole shape, a round hole shape, or other shapes depending on the direction or type of the motion of the operating member **100**.

Second Embodiment

A second embodiment will now be described. For configurations similar to those according the first embodiment, redundant descriptions will be omitted.

FIGS. **9**A and **9**B are schematic views illustrating a plug member according to the present exemplary embodiment. FIG. **9**A is a perspective view illustrating the outer appearance of a plug member **122**. FIG. **9**B illustrates the plug member **122**, viewed from the X direction in FIG. **9**A. The plug member **122** is provided with a plug member rotation axis **128** and plug member regulating portions **129**. In a state where the plug member **122** is retained by a retaining member **121** (described below), the plug member **122** is engaged with the retaining member **121** by the plug member rotation axis **128**. In a state where the plug member **122** is retained by the retaining member **121**, the plug member **122** is rotatable in a direction **130** around the plug member rotation axis **128**.

FIGS. **10**A to **10**C are schematic views illustrating the retaining member **121** and the plug member **122** configuring an operating member. FIG. **10**A is a schematic view illustrating the retaining member **121**. FIG. **10**B illustrates a state where the plug member **122** is retained by the retaining member **121**. The retaining member **121** is provided with plug member regulation ribs **131**. When the plug member **122** is retained by the retaining member **121** as illustrated in FIG. **10**B, the upper surfaces of plug member regulating portions **129** of the plug member **122** come into contact with the plug member regulation ribs **131**. This structure regulates the rotation of the plug member **122** in a direction **901** (see FIG. **9**A) perpendicularly intersecting with the direction **130**.

FIG. **10**C is a Y-Z cross-sectional view illustrating the operating member. In a state where the plug member **122** is retained by the retaining member **121**, the plug member rotation axis **128** is attached in a shaft attachment portion **123** provided on the retaining member **121**. The plug member rotation axis **128** loosely fits the shaft attachment portion **123** and is rotatable in the direction **130** as the rotational direction of the plug member **122**.

FIGS. **11**A and **11**B are cross-section views illustrating the retaining member **121** and the plug member **122**, respectively, configuring the operating member. FIG. **11**A is a partial cross-sectional view taken along the B-B line illustrated in FIG. **10**A. FIG. **11**B is a partial cross-sectional view taken along the B-B line illustrated in FIG. **10**B. The retaining member **121** is provided with a covering portion **124** that covers the periphery of the plug member **122**. The covering portion **124** is provided inside with a rotation regulating portion **132** that regulates the rotation of the plug member **122** in the direction **130** not to exceed a predeter-

mined amount. When the plug member **122** rotates in the direction **130** inside the covering portion **124**, the side surface of the plug member **122** comes into contact with the rotation regulating portion **132** to regulate the rotation of the plug member **122**.

FIGS. **12**A and **12**B are cross-sectional views illustrating the liquid storage unit. FIG. **12**A illustrates a state where the plug member **122** and the injection port **21** start coming into contact with each other during the closing motion for the injection port **21** by an operating member **120**.

FIG. **12**B illustrates a state where the injection port **21** has been closed by the operating member **120**. According to the present exemplary embodiment, the outer surface of a closing portion **1221** of the plug member **122** is provided with a protruding portion **126**. A plug member engaging portion **127** is provided around the injection port **21**. When the operating member **120** moves from the opening position to the closing position, the plug member **122** rotates inside the covering portion **124** following the motion of the operating member **120**. However, since the inside the covering portion **124** is provided with the rotation regulating portion **132**, as described above, the plug member **122** does not rotate any more than in the state when the plug member **122** comes into contact with the rotation regulating portion **132**. As illustrated in FIG. **12**A, the closing portion **1221** of the plug member **122** and the injection port **21** start coming into contact with each other in a state where the center of the plug member **122** and the center of the injection port **21** exist approximately on the same axis.

When the operating member **120** is further rotated to the closing position from the state in FIG. **12**A, the motion of the plug member **122** is guided by the plug member engaging portion **127**. Thus, the plug member **122** and the rotation regulating portion **132** do not come into contact with each other inside the covering portion **124**. This enables the plug member **102** to move along the attachment portion **123**. Thus, the plug member **122** can suitably perform the closing motion to the injection port **21** even if the position of the operating member **120** shifts with respect to the injection port **21** during the closing motion. This structure therefore enables securely closing the injection port **21**.

FIGS. **13**A and **13**B illustrate the ink tank **6** and the operating member **120** according to the present exemplary embodiment. FIG. **13**A illustrates a state where the operating member **120** is rotated to open the plug member **122**, viewed from above in the Z direction. FIG. **13**B illustrates a state where the injection port **21** of the ink tank **6** is inserted into the ink bottle **114** in the state in FIG. **13**A, viewed from above in the Z direction. FIG. **14**A illustrates the state in FIG. **13**B viewed from the X direction. FIG. **14**B is a cross-sectional view taken along the C-C line illustrated in FIG. **14**A. According to the present exemplary embodiment, the amount of opening of the operating member **120** with respect to the ink tank **6** is set to about 90 degrees. When the injection port **21** is inserted into the ink bottle **114**, the outer surface of the ink bottle **114** and the covering portion **104** may possibly interfere with each other. Thus, the ink bottle **114** may possibly come into contact with the covering portion **104**.

According to the present exemplary embodiment, a leading edge **133** of the covering portion **124** of the retaining member **121** more outwardly protrudes than the leading edge of the plug member **122**. Further, in a state where the operating member **120** is positioned at the opening position as illustrated in FIGS. **13**A, **13**B, **14**A, and **14**B, the leading edge **133** of the covering portion **124** has a circular arc shape when viewed from above in the Z direction. More specifically, the leading edge **133** of the covering portion **124** has such a circular arc shape that gradually protrudes along directions **144***a* and **144***b* in the X direction from the extension line along the center O of the injection port **21** in the Y direction. Thus, even in a situation where the outer surface of the ink bottle **114** comes close to the covering portion **124** as illustrated in FIGS. **13**B and **14**B, the contact between the outer surface of the ink bottle **114** and the covering portion **124** can be prevented. This also prevents the ink bottle **114** from coming into contact with the leading edge of the closing portion **1221** that is more inward than the covering portion **124**, preventing ink adhesion to the ink bottle **114**.

According to the present exemplary embodiment, the injection port **21** is closed by the protruding portion **126** on the outer surface of the closing portion **1221** of the plug member **122** and the plug member engaging portion **127**, the injection port **21** can be closed by a protruding portion provided on the inner side of the closing portion **1221**, similarly to the first exemplary embodiment.

According to either exemplary embodiment, no protruding portion can be provided at the closing portion of the plug member. The shape of the leading edge of the covering portion can be flat instead of being partly protruding. Also, in this case, making the entire leading edge of the covering portion more outwardly protrude than the leading edge of the closing portion enables preventing ink adhesion from the closing portion to the user or ink bottle **114**.

The above-described configuration makes it possible to absorb the positional shift of the operating member by the loose-fitting of the plug member during the closing movement of the injection port **21**. This allows the injection port **21** to be inserted into the plug member with a suitable orientation, thus more securely plugging the injection port **21**. In addition, since the closing portion of the plug member is covered by the covering portion, it is possible to prevent the closing portion from coming into contact with the user or the ink bottle **114** and hence prevent ink adhesion thereto even in a state where the operating member is positioned at the opening position.

The above-described configuration makes it possible to more securely close the injection port **21** of the liquid container.

While the disclosure has been described with reference to exemplary embodiments, it is to be understood that the disclosure is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

This application claims the benefit of Japanese Patent Application No. 2022-035638, filed Mar. 8, 2022, which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. A liquid discharge apparatus comprising:

a liquid container configured to introduce liquid from a liquid introducing portion to an inside; and

an operating member, including a retaining member and a covering portion, configured to rotate around a rotation shaft in a first direction from a first position for covering the liquid introducing portion to move to a second position for exposing the liquid introducing portion, and rotate in a second direction opposite to the first direction from the second position to move to the first position; and

a plug member retained to the operating member by the retaining member which is covered by the covering portion in a direction intersecting with the first direc-

tion, and configured to plug the liquid introducing portion at the first position,

wherein the plug member includes a first engaging portion configured to engage with a second engaging portion provided on the retaining member, and the first engaging portion and the second engaging portion loosely fit each other in a case where the plug member is retained by the retaining member, and

wherein the second engaging portion is an opening of the retaining member, and a length of a width of the opening in a direction intersecting with an axial direction of the rotation shaft is larger than a length of a width of an engaging portion of the plug member.

2. The liquid discharge apparatus according to claim **1**, wherein, in a case where the operating member is positioned at the second position, at least a part of an edge of the covering portion in the second direction protrudes in the second direction more than an edge of the plug member in the second direction.

3. The liquid discharge apparatus according to claim **1**, wherein the covering portion includes a regulating portion configured to regulate a motion of the plug member in a direction intersecting with the first direction and the second direction.

4. The liquid discharge apparatus according to claim **1**, wherein the plug member is made of an elastically deformable member, and the retaining member is made of a material having a higher rigidity than the plug member.

5. The liquid discharge apparatus according to claim **1**, wherein the plug member includes a retaining portion configured to maintain an engagement between the first engaging portion and the second engaging portion, and a length of at least a part of an outer diameter of the retaining portion is larger than a length of at least a part of a width of the second engaging portion.

6. The liquid discharge apparatus according to claim **5**, wherein the second engaging portion has an oblong hole shape where a length of a width in a direction intersecting with an axial direction of the rotation shaft is larger than a length of a width in the axial direction of the rotation shaft, and a length of at least a part of the width of the retaining portion is larger than the length of the width in the axial direction of the rotation shaft.

7. The liquid discharge apparatus according to claim **1**, wherein the plug member includes a closing portion having a protruding portion configure to come into contact with the liquid introducing portion in a state where the liquid introducing portion is closed.

8. The liquid discharge apparatus according to claim **7**, wherein an edge portion of the closing portion in the second direction inclines toward the inside of the closing portion.

9. The liquid discharge apparatus according to claim **7**, wherein the liquid container includes a plug member engaging portion configured to engage with the closing portion of the plug member positioned at the first position.

10. The liquid discharge apparatus according to claim **1**, wherein the liquid container is retained by a housing member, and the rotation shaft is disposed on the housing member.

11. A liquid discharge apparatus comprising:

a liquid container configured to introduce liquid from a liquid introducing portion to an inside; and

an operating member, including a retaining member and a covering portion, configured to rotate around a rotation shaft in a first direction from a first position for covering the liquid introducing portion to move to a second position for exposing the liquid introducing portion, and rotate in a second direction opposite to the first direction from the second position to move to the first position; and

a plug member retained to the operating member by the retaining member which is covered by the covering portion in a direction intersecting with the first direction, and configured to plug the liquid introducing portion at the first position,

wherein the plug member includes a first engaging portion configured to engage with a second engaging portion provided on the retaining member, and the first engaging portion and the second engaging portion loosely fit each other in a case where the plug member is retained by the retaining member, and

wherein the plug member includes a retaining portion configured to maintain an engagement between the first engaging portion and the second engaging portion, and a length of at least a part of an outer diameter of the retaining portion is larger than a length of at least a part of a width of the second engaging portion.

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