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

(11) **EP 1 594 703 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
30.05.2012 Bulletin 2012/22

(21) Application number: **05710258.4**

(22) Date of filing: **09.02.2005**

(51) Int Cl.:
B41J 2/175 *(2006.01)*

(86) International application number:
PCT/JP2005/002358

(87) International publication number:
WO 2005/075203 (18.08.2005 Gazette 2005/33)

(54) **INK CARTRIDGE**

TINTENPATRONE

CARTOUCHE D'ENCRE

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU MC NL PL PT RO SE SI SK TR

(30) Priority: **09.02.2004 JP 2004031712**
10.02.2004 JP 2004032872
20.02.2004 JP 2004043978
24.02.2004 JP 2004047768
25.02.2004 JP 2004049973
27.02.2004 JP 2004053164
08.03.2004 JP 2004063659

(43) Date of publication of application:
16.11.2005 Bulletin 2005/46

(73) Proprietor: **Brother Kogyo Kabushiki Kaisha**
Nagoya-shi, Aichi-ken 467-8561 (JP)

(72) Inventors:
- **TAKAGI, Atsuhiro,**
  Technology Planning & IP Dept.
  Nagoya-shi, Aichi 4678562 (JP)
- **SASAKI, Toyonori,**
  Technology Planning & IP Dept.
  Nagoya-shi, Aichi 4678562 (JP)
- **HATTORI, Shingo,**
  Technology Planning & IP Dept.
  Nagoya-shi, Aichi 4678562 (JP)
- **KANBE, Tomohiro,**
  Technology Planning & IP Dept.
  Nagooya-shi, Aichi 4678562 (JP)

(74) Representative: **Hofer, Dorothea et al**
Prüfer & Partner GbR
Patentanwälte
Sohnckestrasse 12
81479 München (DE)

(56) References cited:
EP-A1- 1 000 753
EP-A1- 1 147 903
EP-A2- 1 043 161
JP-A- 9 174 875
US-A1- 2003 067 518

Remarks:

The file contains technical information submitted after the application was filed and not included in this specification

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 1 594 703 B1

Description

Technical Field

[0001] This disclosure relates to an ink cartridge that is capable of being placed in an inkjet recording apparatus.

Background Art

[0002] An inkjet recording apparatus, structured such that an ink container (referred to as "ink cartridge") can be attached to and detached from a holder (installation part), is disclosed in Japanese Laid Open Patent Application No. H9-85963. A projection portion that opens an opening of the ink cartridge is formed at the installation part, and a through hole is provided at the projection portion so that ink can flow from a valve of the ink cartridge. When the ink cartridge is installed on the installation part, the valve is opened by the projection portion, and the ink in the ink cartridge flows through the opening.

Disclosure of the Invention

[0003] However, when the ink cartridge is installed and the opening of the ink cartridge is opened by the projection portion, the opening must be accurately placed relative to the projection portion in order to attach the ink cartridge. In addition, if the shape of the projection portion is not accurately manufactured, the ink cartridge may not be smoothly installed, and/or the ink may leak or evaporate.

[0004] Especially, for the ink cartridge, in the above-described Japanese Laid Open. Patent Application No. H9-85963, that is provided with an ink supply opening and an air introduction opening, the ink supply opening and the flow path on the installation part side must be sealed and accurately made so that the ink does not leak. In addition, two projection portions must accurately correspond to both the ink supply opening and the air introduction opening. Accordingly, it is necessary to manufacture the ink cartridge with a high accuracy.

[0005] The present invention is made to solve, among other things, the above-described problems and to provide an ink cartridge that is capable of being placed in an inkjet recording apparatus, by which the ink cartridge can be easily installed in the inkjet recording apparatus and the manufacturing thereof is made simple.

[0006] According to an aspect of the invention, an ink cartridge includes an ink chamber, a communication chamber that is capable of communicating with the ink chamber and an outside of the ink cartridge, a valve disposed within the communication chamber that is capable of moving from a first position where a communication between the ink chamber and the outside of the ink cartridge is blocked, to a second position where the communication is allowed, and an operation member that extends from the communication chamber to the outside of the ink cartridge and is capable of moving the valve from the first position to the second position. According to an aspect of the invention, when the ink cartridge is installed in an installation part of an inkjet recording apparatus, the operation member may be capable of moving the valve from the first position to the second position by contacting the installation part.

[0007] According to an aspect of the invention, the valve and the operation member may be formed as a one-piece member.

[0008] According to an aspect of the invention, the ink cartridge may further includes a valve seat that is adjacent to the valve and an urging device that urges the valve toward the valve seat. An opening may be formed at a substantially center of the valve seat in order to expose a bottom of the valve. The valve seat may contact the valve outside of the opening. The operation member may protrude from the valve through the opening.

[0009] According to an aspect of the invention, the urging device may extend from the valve seat and surround the valve, and the urging device may be formed integrally with the valve seat so as to urge the valve toward the valve seat on a first side of the valve opposite the valve seat.

[0010] According to an aspect of the invention, the operation member may be located on a second side of the valve opposite the first side.

[0011] According to an aspect of the invention, the ink cartridge may further include a sealing member that surrounds the operation member.

[0012] According to an aspect of the invention, an end of the operating member may be between an outside end of the communication chamber and an outside end of the sealing member.

[0013] According to an aspect of the invention, the sealing member may extend from a valve seat on a side opposite the valve and is formed integrally with the valve seat.

[0014] According to an aspect of the invention, the ink cartridge may further include a sealing member that surrounds the operation member wherein when the ink cartridge is installed in the installation part of the inkjet recording apparatus, the sealing member contacts the installation part and forms a path from a flow path in the installation part to the ink chamber.

[0015] According to an aspect of the invention, the valve seat, the urging device and the sealing member may be integrally formed of a rubber-like material.

[0016] According to an aspect of the invention, an ink cartridge includes an ink chamber, an air communication chamber that is capable of communicating with the ink chamber and an outside of the ink cartridge, a first valve system disposed within the air communication chamber, an ink communication chamber that is capable of communicating with the ink chamber and an outside of the ink cartridge and a second valve system disposed within the ink communication chamber. At least one of the first valve system or the second valve system includes a valve

seat, a valve that is capable of moving relative to the valve seat, and an operation member that extends outside at least one of the air communication chamber or the ink communication chamber and is capable of moving the valve from a first position where the valve contacts the valve seat to a second position where the valve is separated from the valve seal.

[0017] According to an aspect of the invention, when the ink cartridge is installed in an installation part of an inkjet recording apparatus, the operation member may be capable of moving the valve from the first position to the second position by contacting the installation part.

[0018] According to an aspect of the invention, the valve and the operation member may be formed as a one-piece member.

[0019] According to an aspect of the invention, the air communication chamber and the ink communication chamber may be formed on one side of the ink cartridge.

[0020] According to an aspect of the invention, the first valve system may include the valve seat, the valve, and the operation member and the second valve system may the valve seat and the valve. When the ink cartridge is installed in the installation part of the inkjet-recording apparatus, the operation member of the first valve system may be capable of moving the valve of the first valve system from the first position to the second position by contacting the installation part, and the valve of the second valve system may be capable of being moved from the first position to the second position by being pushed by an extraction tube provided in the installation part

[0021] According to an aspect of the invention, a valve system may include a valve, an operation member, a valve seat with an opening at a substantially center portion of the valve seat and an urging device that urges the valve in a first direction such that the valve contracts the valve seat . The operation member protrudes through the opening of the valve seat. The valve is between the valve seat and the urging device. The valve is separated from the valve seat when the operating member urges the valve in a second direction opposite the first direction.

[0022] According to an aspect of the invention, the valve system may further includes sealing member that surrounds the opening and a periphery of the operation member.

[0023] According to an aspect of the invention, an end of the operating member may be between the valve and an outside end of the sealing member.

[0024] According to an aspect of the invention, an inkjet recording apparatus may include an installation part that is capable of receiving one of the above-described ink cartridges. The installation part including a flow path through which air is introduced to the ink cartridge.

[0025] According to an aspect of the invention, an inkjet recording apparatus may include an ink jet head and an installation part that is capable of receiving one of the above-described ink cartridges. The installation part including an extraction tube through which ink is supplied to the ink jet head.

[0026] According to an aspect of the invention, there is no need to provide a protrusion for opening the opening of the valve member at the installation part of the inkjet recording apparatus. Therefore, there is an effect that positioning the ink cartridge and the installation part when installing the ink cartridge to the installation part becomes easy.

[0027] According to an aspect of the invention, when the ink cartridge is removed from the inkjet recording apparatus, the valve member contacts the valve seat by the urging device, and the ink is prevented from leaving or evaporating through the opening. Moreover, when the ink cartridge is installed on the inkjet recording apparatus, the valve can be opened by uniformly raising the valve by the operation member and separating the valve from the valve seat.

[0028] According to an aspect of the invention, a complex operational procedure to attach the urging device that urges the valve member in an area in which the valve member is positioned becomes unnecessary. Accordingly, there is an effect to reduce the manufacturing cost of the ink cartridge.

[0029] According to an aspect of the invention, the ink is prevented from leaving or evaporating through the opening.

[0030] According to an aspect of the invention, at least one of the first and second valve systems include a valve seat and a valve movable with respect to the valve seat. The valve has an operation member protruding outside the ink cartridge and is structured such that the operation member contacts the installation part when the ink cartridge is installed on the installation part so as to separate the valve from the valve seat. When providing the installation part with the operation member that protrudes in correspondence with the first and second valve system, it must be sealed to prevent the ink from leaking and manufactured to accurately maintain the mutual positional relationships between two protruding operation members and the mutual positional relationships between the ink communication chamber and the air communication chamber. However, there is an effect that the ink cartridge can be easily installed to the installation part while easily manufacturing without requiring high accuracy in the positional relationships.

[0031] According to an aspect of the invention, the two valve systems can be opened by moving the ink cartridge simply in the direction of the installation part, providing better operability.

Brief Description of Drawings

[0032] Various exemplary embodiments of the disclosure will be described in detail with reference to the following figures, wherein:

FIG. 1 is a schematic diagram of an exemplary ink cartridge according to this disclosure and an exem-

plary inkjet recording apparatus according to this disclosure on which the ink cartridge is mounted;

FIGs. 2A and 2B are sectional diagrams showing the structure of an exemplary ink cartridge according to this disclosure: FIG. 2A shows the ink cartridge before the ink cartridge is loaded into an inkjet recording apparatus and FIG. 2B shows the ink cartridge after the ink cartridge is loaded into the inkjet recording apparatus;

FIGs. 3A-3E depict an exemplary valve member according to this disclosure: FIG. 3A is a plan view, FIG. 3B is a side view, FIG. 3C is a sectional view taken along a line I-I of FIG. 3A, FIG. 3D is a sectional, view taken along a line II-II of FIG 3A and FIG. 3E is a bottom view;

FIGs. 4A-4C depict an exemplary valve member according to this disclosure: FIG. 4A is a plan view, FIG. 4B is a side view and FIG. 4C is a bottom view;

FIGs. 5A and 5B depict an exemplary installation part according to this disclosure: FIG. 5A is a sectional view along a line III-III of FIG. 5B and FIG. 5B is a bottom view;

FIGs. 6A and 6B depict the exemplary installation part of FIG. 5B; FIG. 6A is a sectional view along a line IV-IV of FIG. 5B and FIg. 6B is a sectional view along a line V-V of FIG. 5B;

FIG. 7 is a perspective view of an exemplary check valve according to this disclosure;

FIGs. 8A-8C depict an exemplary ink cartridge according to this disclosure; FIG. 8A is a front view, FIG. 8B is a side view and FIG. 8C is a bottom view;

FIG. 9 is a perspective view of the ink cartridge of FIGs. 8A-8C.

FIG. 10. is a sectional diagram showing the structure of an exemplary ink cartridge recording to this disclosure before the ink cartridge is loaded into an inkjet recording apparatus;

FIGs. 11A and 11B are sectional diagrams of an exemplary ink extract tube and an exemplary valve member according to this disclosure: FIG. 11A shows the ink extract tube before the ink extract tube enters into a guide path and contacts the valve member and FIG. 11B shows the ink extract tube contacting the valve member and pushing the valve member toward an ink chamber;

FIG. 12 is an oblique perspective view of an exemplary valve member according to this disclosure;

FIG. 13 is a perspective view of an inside lower part of an exemplary cartridge main body according to this disclosure;

FIG. 14 is a sectional view of section VI of FIG. 13;

FIG. 15 is a sectional view of section VII of FIG. 13;

FIG. 16 is a sectional view of section VIII of FIG. 13;

FIG. 17 is a sectional view of section IX of FIG. 13;

FIG. 18 is a perspective view of an inside lower part of an exemplary cartridge main body according to this disclosure;

FIG. 19 is a perspective view of an inside lower part of an exemplary cartridge main body according to this disclosure;

FIGs. 20A and 20B are sectional diagrams of FIG. 19: FIG. 20A is a sectional view of section X and FIG. 20B is a sectional view of section XI;

FIG. 21 is a sectional diagram showing the structure of an exemplary ink cartridge according to this disclosure before the ink cartridge is loaded into an inkjet recording apparatus;

FIG. 22 is a bottom view of an exemplary main body case according to this disclosure;

FIGs. 23A and 23B are sectional diagrams of an exemplary ink cartridge with a valve member moved from a valve seat portion according to this disclosure: FIG. 23A shows the ink cartridge correctly installed in an installation part and FIG. 23B shows the ink cartridge incorrectly installed in the installation part;

FIG. 24 is a sectional diagram showing the structure of an exemplary ink cartridge according to this disclosure before the ink cartridge is loaded into an inkjet recording apparatus;

FIGs. 25A and 25B depict an enlarged front end portion of an exemplary air introduction member according to this disclosure: FIG. 25A is a sectional view and FIG. 25B is a top view; and

FIGs. 26A and 26B depict an enlarged front end portion of an exemplary air introduction member according to this disclosure: FIG. 26A is a sectional view and FIG. 26B is a top view.

Best Mode for Carrying Out the Invention

[0033] An embodiment of this disclosure is described below with reference to the attached drawings. FIG. 1 is a schematic diagram of an exemplary ink cartridge 1 according to this disclosure and an exemplary inkjet recording apparatus 2 according to this disclosure on which the ink cartridge 1 is mounted.

[0034] The ink cartridge 1 is formed so as to be detachable with respect to the inkjet recording apparatus 2 that is provided with a recording head 7 that discharges ink. The ink cartridge 1 stores the ink to be supplied to the recording head 7.

[0035] The ink cartridge 1 is equipped with a hollow box-shaped main body case 1a and a top 1b that seals a top surface of the main body case 1a. The ink to be supplied to the recording head 7 is stored in an ink chamber 16 (see FIGs. 2A and 2B) formed inside the main body case 1a. In addition, in the inkjet recording apparatus 2, a plurality of ink cartridges can be installed, in which cyan, magenta, yellow and black ink are respectively filled. Color printing is thus made possible.

[0036] The inkjet recording apparatus 2 is provided with an installation part 3 to which the ink cartridge 1 is installed, a tank 5 that stores the ink to be supplied from the ink cartridge 1 via an ink supply tube 4, the recording head 7 that emits the ink stored in the tank 5 to a recording paper 6, a carriage 8 in which the tank 5 and the recording

head 7 are mounted and which is movable in two linear directions, a carriage shaft 9 which is a guide by which the carriage 8 moves in the two linear directions, a transport mechanism 10 which transports the recording paper 6, and a purge device 11.

[0037] The installation part 3 is composed of a base portion 3a and guide portions 3b which are set on both sides of the base portion 3a. A hollow, protruding ink extraction tube 12 extracts the ink stored in the ink cartridge 1, and an air supply opening 91 that introduces outside air to the ink cartridge 1 are arranged on the base portion 3a.

[0038] An end of an ink extraction tube 12 communicates with an ink flow path 94, and with the tank 5 through the ink supply tube 4. An air supply flow path 92 and an air intake opening 93 communicate with the air supply opening 91 (See FIGs. 5A and 5B).

[0039] The ink cartridge 1 is installed from a direction (arrow X direction) perpendicular to the installation part 3. At this time, the ink extraction tube 12 opens a later-described valve system 23 provided inside the ink cartridge 1 and communicates with the inside of the ink chamber 16. In addition, the air supply opening 91 communicates with the inside of the ink chamber 16.

[0040] A plurality of nozzle openings are provided in the recording head 7 on a surface to be opposite the recording paper 6. By driving an actuator composed of a piezoelectric elements, the ink stored in the tank 5 is emitted from the nozzle holes towards the recording paper 6. For the actual recording operation, the recording is made on the recording paper 6 as the carriage 8, which mounts the recording head 7, moves back and forth.

[0041] In addition, the recording head 7 is positioned above the installation part 3. A negative pressure (back pressure) is thus given to the ink within the nozzle holes due to the pressure head difference between the ink cartridge 1 mounted in the installation part 3 and the nozzle holes.

[0042] The purge device 11 is arranged outside the recording area so as to face the recording head 7. The purge device 11 is provide with a purge cap 11a that covers the surface of the recording head 7 forming the nozzle holes, a waste ink tube 11b that communicates with the purge cap 11a, and a pump 11c that intakes the ink from the nozzle holes to the waste ink tube 11b.

[0043] When executing the purge process, the carriage 8 is moved to a purging process execution position, and the surface of the recording head 7 on which the nozzle holes are formed is covered by the purge cap 11a. The pump 11c is driven in this state and sucks the defective ink containing bubbles accumulated in the recording head 7. The sucked defective ink is stored in an undepicted waste ink tank through the waste ink tube 11b. The recording operation and the purging process are controlled by a CPU (central processing unit) (not shown) installed in the inkjet recording apparatus 2.

[0044] Next, the structure of the ink cartridge, in particular A of FIG 1, which is installed in the inkjet recording apparatus 2 is explained with reference to FIGs. 2A and 2B. FIGs. 2A and 2B are sectional diagrams showing the structure of the ink cartridge 1 according to this disclosure: FIG. 2A shows the ink cartridge 1 before the ink cartridge 1 is loaded into the inkjet recording apparatus 2 and FIG. 2B shows the ink cartridge 1 after the ink cartridge 1 is loaded into the inkjet recording apparatus 2.

[0045] The ink cartridge 1 is includes the main body case 1a with the ink chamber 16, the top 1b that covers the open upper surface of the main body case 1b, and a cap member 1f that covers a bottom wall le, of the main body case 1a. On the cap member 1f, two exposing holes 1fa, 1fb that expose the later-described valve systems 23, 24 on the installation part 3 side are formed. The ink cartridge 1 is formed with the top 1b and the cap member 1f being fused with the main body case 1a. The material for the main body case 1a, the top 1b and the cap member 1f may be a resin material.

[0046] In the bottom wall 1e, an ink supply opening 21, which is opened outwardly for externally supplying the ink in the ink chamber 16, is formed. The ink supply opening 21 is in direct communication with a communication chamber 30 provided inside a cylindrical wall 21a formed integrally with and protruding from a lower first surface of the bottom wall 1e. In addition, an air introduction opening 26, opened outwardly for introducing air into the ink chamber 16, is formed in the bottom wall 1e. The air introduction opening 26 is in direct communication with a communication chamber 50 provided inside a cylindrical wall 26a formed integrally with and protruding from the lower surface of the bottom wall 1e. When the ink cartridge 1 is installed on the installation part 3, the ink extraction tube 12 is inserted into the communication chamber 30.

[0047] A check valve 60 is positioned in and facing the ink supply opening 21. The check valve 60 is structured by integrally forming an umbrella-shaped elastic film part 60b facing a lower surface of the ink supply opening 21, and a shaft part 60c, an end of which holds the film part 60b, with a synthetic material. The shaft part 60c is inserted into a shaft hole In in the bottom will 1e slidably in the up/down direction. Normally, a protruding part 60a is in contact with the top surface of the bottom wall 1e at a position where the film part 60b is spaced from the ink supply opening 21 to allow the flow of the ink from the ink chamber 16 towards a valve member 32. When the ink flows from the ink extraction tube 12 towards the ink chamber 16, the flow is prevented by raising the film part 60b and sealing the ink supply opening 21.

[0048] A cylindrical member 25 surrounding the air introduction opening 26 is provided on the bottom wall 1e and projects inside the ink chamber 16. The cylindrical member 25 projects such that the air supply from outside is directed to the upper portion of the ink chamber 16 through the flow path inside the cylindrical member 25. The opening in the upper portion of the air introduction opening 26 is positioned higher than the ink surface.

[0049] The valve systems 23, 24, which are examples

of sealing members, are fixed to the communication chamber 30 on the ink supply side and the communication chamber 50 on the air introduction side, respectively.

[0050] The valve system 23 is equipped with a support member 46 produced integrally by a rubber elastic member, and a valve member 32 structured by a resin material. The support member 46 has a substantially cylindrical outer shape and is structured by integrally forming a valve seat part 46a and an urging part 46b that is closer to the ink chambers 16 relative to the valve seat part 46a, and an external wall 33 positioned on a side of the valve seat part 46a opposite the urging part 46b. The valve member 32 is urged in a direction toward the valve seat part 46a by the urging part 46b and is accommodated in a space between the valve seat part 46a and the urging part 46b.

[0051] The external wall 33 has an attachment part 33a projecting radially outwardly. The communication chamber 30 has a stepped surface 44 which has a diameter that increases towards the outside to accommodate the attachment part 33a. Protrusions 43 are formed on a surface of the attachment part 33a facing the stepped surface 44. By pressing the protrusions 43 onto the stepped surface 44 and placing the attachment part 33a between the stepped surface 44 and the cap member 1f while deforming the protrusions 43, the cap member 1f is fixed to the main body case 1a. As a result, the ink is prevented from flowing out from the space formed between the external wall 33 of the valve system 23 and the inner wall of the communication chamber 30.

[0052] An opening 41 is formed in the valve seat part 46a through the center of the valve seat part 46a in the axial direction. In addition, an introduction path 40, to which the ink extraction tube 12 is inserted, is formed on the external wall 33 in a manner that the introduction path 40 communicates with the opening 41.

[0053] The inner diameter of the introduction path 40 is smaller than the outer diameter of the ink extraction tube 12 so the external wall 33 comes into close contact with the ink extraction tube 12. The opening 41 is formed larger than the inner diameter of the introduction path 40 and the outer diameter of the ink extraction tube 12. An end of the introduction path 40, on the side to which the ink extraction tube 12 is inserted, is formed in a tapered shape, which widens outwardly.

[0054] The urging part 46b is formed by a sidewall portion 36 that stands up cylindrically from the valve seat part 46a around the circumference of the opening 37a to the ink chamber 16, and a thrust portion 37 connected to the sidewall portion 36 and projects inwardly so as to contact a side of the valve member 32 opposite the ink chamber 16. The thrust portion 37 has an opening 37a in the center of the thrust portion 37.

[0055] The urging part 46b urges the valve member 32 by the elastic force of the sidewall portion 36 and the thrust portion 37 in a direction such that the valve member 32 contacts the valve seat part 46a, and normally attaches the valve member 32 to the valve seat part 46a. In addition, by inserting the ink extraction tube 12 into the introduction path 40 to push the valve member 32 toward the ink chamber 16, the sidewall portion 36 stretches and the thrust portion 37 inclines, allowing the formation of a gap so that ink can flow between the valve member 32 and the valve seat part 46a.

[0056] FIGs. 3A-3B show the details of the valve member 32. The valve member 32 is equipped with a bottom portion 57 and a valve sidewall portion 56 which extends vertically from the external circumference of the bottom portion 57. Communication paths 58 are formed continuously across the bottom portion 57 and the valve sidewall portion 56.

[0057] The bottom portion 57 has a protruding member 39 that projects toward the valve seat part 46a and is formed in a ring shape on an end surface facing the valve seat part 46a at a position internal from the communication path 58 and external from the opening 41. The valve sidewall portion 56 is closely contacted and pressed against the thrust portion 37 of the urging part 46b in a state when the valve member 32 is accommodated in the support member 46. By pressing the protruding member 39 downward, the protruding member 39 elastically deforms the valve seat part 46a and closely contacts the upper surface of the valve seat part 46a.

[0058] The valve system 24 on the air introduction side is similar to the valve system 23 and is equipped with a support member 46 produced integrally with a rubber elastic member and a valve member 65 structured with a ribbed material.

[0059] The support member 46 has a valve seat part 46a, and an urging part 46b and a seal portion 63. The valve seat part 46a and the urging part 46b have the same functions as those for the valve system 23.

[0060] An opening 41 is formed substantially at a center of the valve seat portion 46a. The cylindrical seal portion 63 surrounds the opening 41 and is integrally formed at the lower portion of the valve seat part 46a.

[0061] The valve member 65 has, as shown in FIGS. 4A-4C, a cylindrical portion 66 at the top portion, an operation member 67 at the lower portion, and a valve portion 68 at a substantially center portion thereof. Similar to the valve member 32 shown in FIGs. 3A-3E, the valve portion 68 is equipped with a bottom portion 57, a valve sidewall portion 56 extending vertically from the outer circumference of the bottom portion 57, and a communication path 58 formed continuously across the bottom portion 57 and the valve sidewall portion 56. The functions for these portions are the same as those for the valve member 32. Therefore, their descriptions are omitted.

[0062] The cylindrical portion 66 has a cylindrical shape raised from the bottom portion 57. When the ink cartridge 1 is correctly installed in the installation portion 3, the cylindrical portion 66 is positioned with a space between the top end of the cylindrical portion 66 and the inner surface of the cylindrical member 25, and secures the communication between the ink chamber 16 and the

opening 41 of the valve seat part 46a, even if the valve member 65 is pushed up from the valve seat part 46a.

[0063] The operation member 67 is a protrusion extending vertically and downwardly from the bottom portion 57, and is formed with a circular outer shape 67a and concaves 67b that extend in a radially and axial direction. The operation member 67 extends downwardly through the opening 41 of the support member 46 and has the lower end positioned slightly above the lower end of the seal portion 63. The cross-sectional area of the air path between the opening 41 and the concaves 67b can be made large by the cave-in 67b.

[0064] FIGs. 5A-6B show the details of the installation part 3. On the air supply side, an indentation 3d is positioned on the base portion 3a of the installation part 3 at a position facing the valve system 24. The indentation 3d has a side for the seal portion 63 to engage when the ink cartridge 1 is installed. On the bottom of the indentation 3d, an air supply opening 91 is formed through a wall structuring the base portion 3a at a position inside the seal portion 63 that does not face the lower end of the operation member 67. The air supply opening 91 may be formed in a slit shape having a smaller width and a linger length than the outer diameter of the operation member 67 or with a plurality of slits assembled in a radial shape.

[0065] A groove-shaped air supply flow path 92 is formed on the lower surface of the wall structuring the base portion 3a. One end of the air supply flow path 92 is connected to the air supply opening 91 as the cross-sectional area thereof increases, and the other end is connected to the air intake opening 93 formed through the wall structuring the base portion 3a in the up/down direction. A part of the air supply flow path 92 is formed with a plurality of curves along the lower surface of the wall to suppress the flow of air and to prevent evaporation of the composition and moisture in the ink when connected to the air introduction opening 26 of the ink cartridge 1.

[0066] The air intake opening 93 opens on the upper surface of the base portion 3a but has a space from the bottom surface of the installed ink cartridge 1 by which the air is supplied to the ink cartridge 1 through the air supply flow path 92 and the air supply opening 91. The upper surface of the air intake opening 93 may be covered by the later described porous elastic body 3c to allow ventilation with outside air.

[0067] On the ink extraction side, the ink extraction tube 12 is integrally and protrudingly formed on the upper surface of the wall structuring the base portion 3a, and an ink flow path 94 is formed on the lower surface. Ends 94a of the ink flow path 94 are connected to a lower end of ink flow path 94 formed through the ink extraction tube 12 in the up/down direction, and ends 94b open up a part of the upper surface at which the base portion 3a is extended outside the guide portion 3b, and is connected to the ink supply tube 4 on the upper surface.

[0068] The communication opening 81a for opening the ink flow path 94 to the outside is formed on the top end of the ink extraction tube 12. By the connection opening 81a, the communication between the ink flow path 94 and the ink chamber 16 is secured in the manner such that the top end contacts the valve member 32. The porous elastic body 3c, such as a sponge, is positioned around the ink extraction tube 12 on the top surface of the base portion 3a. The porous elastic body 3c absorbs the ink, which may leak from the valve system 23.

[0069] The installation part 3 is provided at a plurality of locations for a multiple number of ink cartridges. Each wall structuring the base portion 3a and the guide portion 3b extends integrally in the direction of the arrangement of the ink cartridges. The above-described ink extraction tube 12, ink flow path 94, guide portion 3b, air supply opening 91, and air supply flow path 92 are provided for each installation location. The end parts 94a, 94b of each of the ink flow paths 94 connected to each respective ink supply tube 4 are positioned laterally at the extension portion of the base portion 3a as shown in FIG. 5B.

[0070] In addition, the above-described ink flow paths 94 and the air supply flow path 92 are formed by covering the open lower surface of the grooves with a cover member, such as a resin film 95. The film 95 is fixed by fusion on the lower end surface of ribs 94c, 92c forming the circumference of the ink flow path 94 and the air supply flow path 92, respectively. The ink flow paths 94 and the air supply flow path 92 of the same installation location are covered together by a single film 95.

[0071] Next, the installation of the ink cartridge 1 at the installation part 3 of the inkjet recording apparatus 2 will be described with reference to FIGS. 2A and 2B. FIG. 2A shows a state in which the ink cartridge 1 has not been installed in the installation part 3 of the inkjet rewording apparatus 2. In this state, both the valve member 32 on the ink supply side and the valve member 65 on the air introduction side are pressed against the valve seat part 46a by the elastic force of the urging part 46b of the support member 46, and thus, each valve, system 23, 24 has not been opened.

[0072] As shown in FIG. 2B, when the ink cartridge 1 is installed, the valve system 23 is opened on the valve supply side by the front end of the ink extraction tube 12 pushing the valve member 32 and the sidewall portion 36 of the support member 46 that extends to separate the valve member 32 from the valve seat part 46a. As a result, the ink flow path extends to the ink extraction tube 12 through the ink chamber 16, the ink supply opening 21, the opening 37a of the valve system 23, the communication path 58, and a space between the valve member 32 and the valve seat part 46a. The ink is thus supplied to the recording head 7.

[0073] On the other hand, on the air supply side, the front end of the operation member 67 contacts the bottom of the indentation 3d, which causes the valve member 65 to be lifted up. With the stretching of the sidewall portion 36 of the support member 46, the valve portion 68 of the valve member 65 is separated from the valve seat part 46a. Therefore, the valve system 24 is opened.

[0074] At the same time, the sealing portion 63 closely

contacts the indentation 3d, which allows the communication between the air introduction opening 26 of the ink cartridge 1 and the air supply opening 91 of the installation part 3 in a state that the communication is blocked from the outside. As a result, the air flow path is formed to the upper part of the ink chamber 16 through the air intake opening 93, the air supply flow path 92 and the air supply opening 91 of the installation part 3, the opening 41, a space between the valve member 65 and the valve seat part 46a of the valves system 24, the communication path 58, the air introduction opening 26, and the flow path inside the cylindrical member 25.

[0075] In this embodiment, the position of the valve system 23 is regulated because the ink extraction tube 12 engages the introduction path 40. However, unless the air supply opening 91 is blocked, the operation member 67 may contact any part of the bottom of the indentation 3d. Therefore, the ink cartridge 1 may be manufactured with a moderate dimensional tolerance for the respective positional relationship between the ink supply opening 21 and the air introduction opening 26, the valve systems 23, 24, the ink extraction tube. 12 of the installation part 3 and the air supply opening 91. In addition, the operation for the user to install the ink cartridge 1 in the installation part becomes easy.

[0076] As should be appreciated, various modifications are available. For example, in the above-described embodiment, the valve system 24 of the air supply side is provided with an operation member 67 that protrudes outside the ink cartridge, and the ink extraction tube 12 for the installation part 3 protrudes on the ink extraction side. However, the operation member that protrudes outside the ink cartridge 1 can be provided to the valve system 23 on the ink extraction side.

[0077] In addition, in the embodiment, a valve system is used to seal the ink supply opening 21 and the air introduction opening 26. However, the opening on the side that does not use the valve system may be sealed with a rubber, and a needle shape ink extracting tube may protrude from the installation part.

[0078] As shown in FIG. 2A, the operating member 67 is positioned such that the lower end thereof is positioned slightly above the lowest end of a seal portion 63. The valve member 65 closely contacts the valve seat part 46a. Similarly, on the ink supply side, the valve member 32 closely contacts the valve seat part 46a by the urging part 46b. As shown in FIG. 2B on the ink supply side, when the ink cartridge 1 has been installed, the front end of the ink extraction tube 12 pushes up the valve member 32 to open the valve system 23.

[0079] On the air introduction side, the front end of the operation member 67 contacts the bottom of the indentation 3d, and the valve seat part 46a of the support member 46 is relatively moved downwardly to open the valve system 24.

[0080] The ink cartridge 1 is packaged under a reduced pressure. The ink chamber 16 is also depressurized. When the valve system 24 on the air introduction side and the valve system 23 on the ink supply side open substantially at the same time, a flow of ink from the ink extraction tube 12 towards the ink chamber 16 occurs . However, a reverse-flow of the ink remaining in the flow path between the ink extraction tube 12 and the recording head 7 is prevented by the check valve 60. Furthermore, air is able to rapidly flow to the upper part of the ink chamber 16 from the air supply opening 91 through the cylindrical member 25. As a result, even if the ink enters into the cylindrical member 25 due to the falling of the ink cartridge 1 in a package during transportation, the ink is brought back into the ink chamber 16 with the flow of air. Assuming that the ink cartridge 1 is tilted during the installation of the ink cartridge 1 to the installation part 3 and that the valve member 32 on the ink supply side opens earlier than the valve member 65 on the air introduction side, the above-described rapid flow of ink from the ink extraction tube 12 to the ink chamber 16 occurs . However, the check valve 60 raises due to the flow to close the ink supply opening 21 by the film part 60d, and thus the flow is prevented. Favorably, by appropriately setting the length of the ink extraction tube 12 and the operation member 67 of the valve member 65, the valve system 24 on the air introduction side is made to open earlier than the valve system 23 on the ink supply side, to prevent the rapid reverse-flow of ink from the ink extraction tube 12.

[0081] Under the normal state, the film part 60b of the check valve 60 falls down by its weight at a position remote from the ink supply opening 21. The ink from the ink chamber 16 is supplied to the recording head 7 through the ink supply opening 21, the communication path 58 of the valve member 32 and the ink extraction tube 12. In accordance with the ink flow from the ink chamber 16, the air is supplied to the upper part of the ink chamber 16 from the air supply opening 91 through the cylindrical member 25. At this time, the cylindrical portion 66 of the valve member 25 on the air introduction side is positioned a space from an interior of the cylindrical member 25 in order to secure an air flow path.

[0082] In addition, during the recording operation, the ink in the ink supply tube 4 moves by inertia with the movement of the carriage 8, and the pressure in the tube 4 changes. However, because the check valve 60 leaves the ink supply opening 21 open in the normal state as described above, a slight flow of ink between the ink extraction tube 12 and the ink chamber 16 due to the pressure change can be tolerated. As a result, the pressure changes in the recording head 7 can be reduced, allowing stable discharging of the ink.

[0083] As should be appreciated, various modifications are available, for example, in the above-described embodiment, the check valve 60 is made in an umbrella shape formed from an umbrella portion and a shaft portion. However, a structure that fixes one side of a rectangular film and allows the other sides to open and close may be used as a check valve.

[0084] Moreover, the air introduction path of the instal-

lation part may project in a hollow cylindrical shape similar to the ink extraction tube 12 while the valve system 24 of the air communication side may have the same structure as the valve system 23 of the ink supply side. Furthermore, the ink extraction tube 12 may have a shape not projecting from the installation part, chile the valve system 23 on the ink supply side may have the same structure as the valve system 24 of the air communication side.

[0085] In addition, instead of the valve systems 23, 24, a rubber plug may be engaged to the communication chambers 30, 50, and hollow, needle-shaped ink supply pipe and air introduction pipe projecting form the installation part may be inserted through the rubber plug.

[0086] Next, a check valve 60 is further explained with reference to FIG. 7. FIG. 7 is a perspective view of the check valve 60. The check valve 60 is formed integrally with a resin material having elasticity and has a an umbrella shaped film part 60b facing the ink supply opening 21 and a shaft part 60c connected to the film part 60b. A protruding portion 60a is formed at the shaft part 60c. This shaft part 60c is inserted slidable to a shaft hole In formed adjacent to the ink supply opening 21. In the normal condition, the protruding portion 60a falls perpendicularly by engaging the top surface of the bottom wall 1e due to the weight of the check valve 60 itself, and a condition that the film part 60b leaves a space with the ink supply opening 21. Therefore, in the normal state, the ink in the ink chamber 1 can flow from the ink supply opening 21 to the communication chamber 30. On the other hand, when the flow from the communication chamber 30 to the ink chamber 16 occurs, the film part 60b is lifted with the shaft part 60c, and the film part 60b closely covers the ink supply opening 21 and prevents the reverse-flow.

[0087] Next, the ink cartridge 1 according to another embodiment of this disclosure will be described in detail.

[0088] As shown in FIGS. 8A-10, the ink cartridge 1 is equipped with a main body case 1a, a valve system 23, a valve system 24, a shadow mechanism 22 that blocks light emitted from a light emitting portion of a sensor 14 that detects the amount of remaining ink, and a cap member 1f that covers the lower end portion of the main body case 1a.

[0089] The main body case 1a is formed of a synthetic resin having permeability. As shown in FIG. 10, a bottom wall 1e extends horizontally in the main body case 1a and the bottom wall 1e partitions the inner space of the main body case 1a into the ink chamber 16 at the upper side and two communication chambers 30, 50 at the lower side. The respective ink is filled in the ink chamber 16, and the valve system 23 and the valve system 24 are respectively housed in the two communication chambers 30, 50. On the bottom surface of the ink chamber 16, four ink supply openings 70a-70d (see FIG. 13) for supplying the ink in the ink chamber 16 to the inkjet recording apparatus 2 through the valve system 23 are provided. The inner structure of the ink chamber 16 directing the ink into these four ink supply openings 70a-70d will be described later.

[0090] As shown in FIG. 10, a protruding portion 34 that protrudes slightly to the outside is formed at a substantially center position of the sidewall portion of the main body case 1a in the height direction thereof. A light blocking plate 59 of the later-described shadow mechanism 22 is positioned in the space inside the protruding portion 34. In addition, the protruding portion 34 is sandwiched between the light emitting portion and light receiving portion of the sensor 14 provided at the installation part 3 in a state when the ink cartridge 1 is installed in the installation part 3. Moreover, a top 1b is fused at the top end portion of the main body case 1a. Therefore, the ink chamber 16 in the main body case is sealed by the top 1b.

[0091] An injection hole 17, for injecting the ink in the ink chamber 16 of an empty ink cartridge 1, is formed between the two communication chambers 30, 50. In this injection hole 17, a synthetic rubber plug member 18 is press fit. In addition, the deep end of the injection hole 17 is connected to the ink chamber 16 in the main body case 1a. An injection needle (not shown) is inserted through the plug member 18 and into the injection hole 17 to fill the ink in the ink chamber 16 through the injection needle.

[0092] A cylindrical portion 38 for communicating with the ink chamber 16 and the communication chamber 30 is integrally formed at a portion of the bottom wall 1e. At the lower end of the cylindrical portion 38, a thin film portion 42 that closes the communication path formed in the cylindrical portion 38 is provided. On the other hand, two cylindrical portions 47 and 48 for communicating with the ink chamber 16 and the communication chamber 50 are integrally formed at a portion of the bottom wall 1e. At the lower end of the cylindrical, portion 48, a thin film portion 49 that closes a communication path formed in the cylindrical portions 47, 48 is provided. In addition, at the upper side of the cylindrical portion 47, a cylindrical member 25 extending to the upper end portion of the ink chamber 16 is provided.

[0093] As shown in FIGs. 10-11B, the valve system 23 is equipped with a support member 46 formed substantially in a cylindrical shape by a synthetic rubber and having elasticity, and a valve member 32 housed in the support member 46. The support member 46 is structured by integrally forming an urging part 46b, a valve seat part 46a and an attachment part 33a, which are positioned in order from the upper side (ink chamber 16 side) of the support member 46.

[0094] The lower surface of the valve member 32 is made to contact the upper surface of the valve seat part 46a (end surface on the ink chamber 16 side), and an opening 41 extending in the up/down direction is formed at a portion of the valve seat part 46a on the central axis side. An introduction path 40 communicating with the opening 41 and extending downwardly is formed in the attachment part 33a, and the introduction path 40 is

formed in a tapered shape in which the lower diameter widens. A ring shape groove 40a is formed around the introduction path 40. A wall portion forming the introduction path 40 is made to easily elastically deform in the direction in which the diameter of the introduction path 40 increases. Therefore, when the ink extraction tube 12 is inserted into the introduction path 40, the closeness of the introduction path 40 and the ink extraction tube 12 increases, and the leakage of ink is significantly prevented. In addition, even when the ink extraction tube 12 is inserted to the introduction path 40 in an inclined state or an offset state, the ink extraction tube 12 is accurately inserted into the introduction path 40 because the wall portion deforms in the direction in which the diameter of the introduction path 40 increases.

[0095] The urging part 46b has a cylindrical sidewall portion 36 raised from the circumference side portion of the valve seat part 46a towards the ink chamber 16 side, and a thrust portion 37 thrusting integrally from the upper end of the sidewall portion 36 towards the radially inner direction. The lower surface of the thrust portion 37 contacts the valve member 32. By the elastic force of the sidewall portion 36 and the thrust portion 37, the valve member 32 is urged downwardly. In addition, an opening 37a is formed inside the thrust portion 37, so that the integrally formed sidewall portion 36 and thrust portion 37 can be easily elastically deformed.

[0096] As shown in FIGs. 11A-12, the valve member 32 has a bottom portion 57 that contacts the valve seat part 46a, a cylindrical valve side wall portion 56 extending from the circumference side portion of the bottom portion 57 towards the ink chamber 16 side, and a breaking portion 52 protruding from the center portion of the bottom portion 57 towards the ink chamber 16 side further than the valve side wall portion 56.

[0097] A protruding member 39 that protrudes to the valve seat part 46a side is formed on the lower surface of the bottom portion 57. When the valve member 32 is urged to the valve seat part 46a side by the urging part 46b and when the protruding member 39 closely contacts the upper surface of the valve seat part 46a, the opening 41 of the valve seat part 46a is closed by the valve member 32 and the ink supply flow path is closed. Moreover, at equal distant locations in the circumferential direction at a portion of the bottom portion 57 outside the circumference of the protruding member 39 and inside the circumference of the valve side wall portion 56, a plurality of communication paths 53 that connect the spaces above and below the valve member 32.

[0098] As shown in FIGS. 11A-12, the breaking portion 52 is structured from four plate members 52a, 52b, 52c and 52d assembled in a cross shape in the plan view and provided upwardly at the substantially center portion of the bottom portion 57. In addition, grooves 54 extending in the up/down direction are respectively formed between the four plate members 52a-52d. Moreover, The breaking portion 52 projects upwardly through the opening 37a inside the valve seat portion 46b. As shown in FIG. 10, the front end of the breaking portion 52 is positioned slightly below the thin film portion 49. ink cartridge 1 is installed on the

[0099] When the ink cartridge 1 is installed on the installation part 3, the ink extraction tube 12 is inserted into the introduction path 40. Then, the valve member 32 is raised, against the urging force by the urging part 46b, by the front end of the ink supply extraction 12. The valve member 32 moves upwardly while deforming the urging part 46b, and the protruding member 39 of the valve member 32 is separated from the valve seat portion 46a. At this time, since the thin film portion 42 is broken by the front end of the breaking portion 52 of the valve member 32 that has moved upwardly, the ink in the ink chamber 16 flows into the communication chamber 30, as shown in FIGs . 10 and 11B, and the ink is supplied to the inkjet recording head 2 side from the ink extraction tube 12 through the communication path 53 of the valve member 32.

[0100] The valve system 24 is equipped with a support member 46 and a valve member 32 housed in the support member 46, and has the same structure as the valve system 23. That is, the valve member 32 is urged downwardly by the urging part 46b that is closely attached to the valve seat portion 46b of the support member 46, in order to close the opening 41. In addition, when the ink cartridge 1 is installed on the installation part 3, an a ir introduction tube 13 is inserted to the introduction path 40 formed at the support member 46, and similar to the valve system 23, the valve member 32 moves upwardly, causing the thin film portion 49 of the cylindrical portion 48 to be broken by the breaking portion 52. Then, the external air flows into the communication chamber 50 from the air introduction tube 13 through the communication path 53 of the valve member 32, and the air is introduced into the upper part of the ink chamber 16 through the internal path of the introduction path 40, the opening 41 and the cylindrical member 25.

[0101] As shown in FIG. 10, the shadow mechanism 22 is provided in the space at the lower part of the ink chamber 16. The shadow mechanism 22 is equipped with a light blocking plate 59 that does not transmit the light, a hollow float 61, a connecting member 62 that connects the light blocking plate 59 and the float 61, and a support table 64 that is provided on the upper side of the bottom wall 1e and pivotally supports the connecting member 62. The light blocking plate 59 and the float 61 are provided respectively at the ends of the connecting member 62. The connecting member 62 is arranged pivotally in the vertical plane perpendicular to the bottom wall le, about the pivot point of the support table 64.

[0102] The light blocking plate 59 is a thin plate member parallel with the vertical plane and having a predetermined area. When the ink cartridge 1 is installed on the installation part 3, the light emitting portion and the light receiving portion of the sensor 14 provided at the installation part 3 are positioned at the same height as the protruding portion 34 formed on the side wall portion

of the main body case 1a. The light blocking plate 59 is made to block the light transmitted from the light emitting portion of the sensor 14 through the wall portion of the main body case 1a and the ink in the ink chamber 16, when the light blocking plate 59 is positioned in a space inside the protruding portion 34. The float 61 is a cylindrical member filled with air inside thereof. The specific gravity of the entire float is made smaller than the specific gravity of the ink in the ink chamber 16.

[0103] Therefore, when the amount of ink remaining in the ink chamber 16 is large and when the entire float 61 provided at an end of the connecting member 62 is positioned in the ink, the float 61 floats by the buoyant, and the light blocking plate 59 provided at the other end blocks the light from the light emitting portion (position indicated by a solid line in FIG. 10). However, when the amount of the ink remaining in the ink chamber 16 becomes low, and a part of the float 61 is exposed from the surface of the ink, the buoyant applied to the float 61 decreases, and the float 61 is lowered. Then, the light blocking plate 59 moves above the protruding portion 34 and to a position at which the light blocking plate 59 does not block the light from the light emitting portion (position indicated by a chain line in FIG. 10). Therefore, the light from the light emitting portion is transmitted through the protruding portion 34 along a linear optical path and is received by the light received portion. As a result, a state that the amount of the ink remaining in the ink chamber 16 is low is detected by the sensor 14.

[0104] As shown in FIGS. 8A-10, the cap member 1f is fixed to the main body case 1a by a ultrasonic adhesion or the like in a matter covering the lower end of the main body case 1a. At positions on the bottom portion of the cap member If corresponding respectively to the valve system 23 and the valve system 24, two seal portions 63 protruding downwardly are respectively formed. The seal portions 63 make the ink around the entrance of the ink extraction tube 12 or the air introduction tube 13 difficult to adhere on the surface of a desk when the ink cartridge 1 is placed on the desk.

[0105] Next, an internal structure of the ink chamber 16 for directing the ink in the ink chamber 10 to the ink supply openings 70a-70d is described.

[0106] As shown in FIG. 13, a deep portion 72a, which is slightly lower than the surrounding, is formed on the upper surface of the bottom wall 1e forming the bottom surface of the ink chamber 16. In addition, a plate member 71 is provided substantially at the center position of the deep portion 72a in the plan view. Four ink supply openings 70a-70d for supplying the ink in the ink chamber 16 to the inkjet recording device 2 via the valve system 23 are formed on the plate member 71. Of these four ink supply openings 70a-70d, the ink supply opening 70a is circular in the plan view and is positioned substantially at the center portion of the plate member. 71, and the three ink supply openings 70b, 70c and 70d having a oblong shape in the plan view are positioned side by side in the circumferential direction around the circular ink supply opening 70a. The ink chamber 16 and the communication chamber 30 are communicated by these four ink suppl openings 70a-70d, to allow the ink discharged from the ink supply openings 70a-70d to be supplied to the inkjet recording device 2 via the valve system 23.

[0107] Because the four ink supply openings 70a-70d are formed on the plate member 71 provided at the deep portion 72a, the four ink supply openings 70a-70d are positioned at a location slightly higher than the deep portion 72a. Therefore, even if dust and the like generated when forming the main body case 1a remains in the ink chamber 16, such dust and the like remain at the deep portion 72a and is difficult to flow out from the ink supply openings 70a-70d positioned higher than the deep portion 72a. As a result, a filter for filtering the ink discharge from the ink supply openings 70a-70d is omitted.

[0108] On the bottom surface of the ink chamber 16, three projections 75 (ink leading portion) projecting from a bottom surface 72 and extending from the three side surfaces 73, 74 of the ink chamber 16 to the vicinity of the ink supply openings 70a-70d, respectively, are formed. The projections 75 are provided so as to be directed towards the ink supply openings 70a-70d from three directions around the ink supply openings 70a-70d. Therefore, even when the amount of ink remaining in the ink chamber 16 becomes, low, the ink near the side surfaces 73, 74 of the ink chamber 16 is led to the ink supply openings 70a-70d by the three projections 75. Moreover, ends of the projections 75 opposite from the ink supply openings 70a-70d are connected to the side surfaces 73, 74. As a result, the ink can be led to the ink supply openings 70a-70d accurately even from edges 77 between the bottom surface 72 and the side surfaces 73, 74, at which the ink easily remains, when there is substantially no ink in the ink chamber 16.

[0109] FIG. 14 is a cross-sectional view of a cross section VI in FIG. 13. FIG. 15 is a cross-sectional view of a cross section VII in FIG. 13. FIG. 16 is a cross sectional view of a cross section VIII in FIG. 13. FIG. 17 is a cross-sectional view of a cross section IV in FIG. 13. As shown in FIGs. 14-16, a curvature radius r1, r2 of the edges 76 between each projection 75 and the bottom surface 72 is smaller than the curvature radius R1 of the edge 77 between the side surfaces 73, 74 and the bottom surface 72. In other words, the curvature is large at the edge 76 near the ink supply openings 70a-70d, which makes the edge have an acute shape. In addition, as shown in FIGs. 14 and 16, at the edge 76 between the projection 75 and the bottom surface 72, the curvature radius r2 at a position 76b near the ink supply openings 70a-70d (position of the cross section VIII) is smaller than the curvature radius r1 at the position 76a remote from the ink supply openings 70a-70d (position of the cross section VI). That is, the curvature of the edge 76 between the projection 75 and the bottom surface 72 becomes larger approaching the ink supply openings 70a-70d, which makes the edge have an acute shape. Therefore, the capillary force applied from the edge near the ink supply openings 70a-

70d to the ink becomes larger than the capillary force by the edge at a position remote from the ink supply openings 76a-70d. Therefore, the ink on the bottom surface 72 is accurately led to the ink supply openings 70a-70d when the amount of the ink remaining in the ink chamber 16 becomes low. As a result, the ink is prevented from being attracted to the position remote from the ink supply openings 70a-70d, which causes the ink to be separated and remained at that position.

[0110] Furthermore, as shown in FIGs. 15 and 17, the curvature radius R1 of the edge 77 extending horizontally between the side surfaces 73, 74 and the bottom surface 72 is made smaller than the curvature radius R2 of the edge 78 extending upwardly and downwardly between the two side surfaces 73, 74. Thus, the curvature of the edge 77 near the ink supply openings 70a-70d is larger than the curvature of the edge 78 remote from the ink supply openings 70a-70d. In addition, the edge 78 extending upwardly and downwardly, the edge 77 extending horizontally and the edge 76 between the bottom surface 72 and each projection 75 are connected, and the curvature radiuses of these three edges 76-78 become smaller (curvatures become larger) approaching the ink supply openings 70a-70d (r1<R1<R2). Therefore, when the surface of the in the ink chamber 16 is lowered in accordance of the consumption of the ink, the ink is accurately led to the ink supply openings 70a-70d from the position higher than the ink supply openings 70a-70d by the edges 76-78 which changes the curvature. Therefore, the ink near the side surfaces 73, 74 of the ink chamber 16 is accurately led to the ink supply openings 70a-70d.

[0111] The edges between two surfaces forming the ink chamber 16, (the edge 77 between the side surfaces 73, 74 and the bottom surface 72, and the edge 78 between the two side surfaces 73, 74 are made so as not to vary the curvature within one edge 77, 78. The curvatures thus change for each combination of two surfaces. By changing the curvature of an edge between two surfaces for each combination of the two surfaces, the structure in which the curvature of the edges becomes larger approaching the ink supply openings 70a-70d can be easily realized. In addition, as shown in FIGs. 15 and 17, tangent planes 77A, 77B and 78A, 78B at the connecting portion of two surfaces at the edges 77, 78 between the two surfaces are made in parallel with the two surfaces, respectively. Therefore, the edges 77, 78 having a predetermined curvature can be easily formed between the two surfaces.

[0112] According to the ink cartridge explained above, the curvatures of the edges 76-78 being parts forming the ink chamber 16 are made larger when approaching the ink supply openings 70a-70d. Thugs, the shape of the edges has a moderate curvature to an acute curvature when approaching the ink supply openings 70a-70d, and the capillary force applied to the ink increases at the edge near the ink supply openings 70a-70d. Accordingly, the ink is prevented from being attracted to and separated at the ink supply openings 70a-70d.

[0113] Next, modifications in which various changes are incorporated to the above-describe embodiment will be explained. However, for elements having the same structure as those in the above-described embodiment, the same reference numbers are used to omit the description thereof.

1) The shape of the projections of the ink leading portion is not limited to the one in the above-described embodiment, but may be appropriately changed. For example, as shown in FIG. 18, projections 85 extending from the side surfaces 83, 84 of the ink chamber 81 towards the ink supply opening 80 may extend to the ink supply opening 80. In this case, the ink on the bottom surface 82 of the ink chamber 81 is accurately led to the ink supply opening 80 via the projections 85. In addition, the number of the projections and the shape of the ink chamber may also be appropriately changed.

2) The ink leading portion that leads the ink to the ink supply openings is not limited to the protrusion in the above-described embodiment. For example, as shown in FIG. 19, the ink leading portion may be structured by a groove 89 formed on the bottom surface 88 of the ink chamber 87. Here, FIG. 20A is a cross-sectional view of the cross section X in Fizz. 19 and FIG. 20B is a cross-sectional view of the cross section XI in FIG. 18. The edge 90 between the bottom surface 89a and the side surfaces 89b of the groove 89 is made such that the curvature at the position 90b (FIG. 20B) near the ink supply opening 90 is made larger than the curvature at the position 90a (FIG. 20A) remote from the ink supply opening 86, and thus the edge 90 is made in an acute shape. Therefore, the ink on the bottom surface 88 is more accurately led to the ink supply openings 86 by the groove 89.

3) Edges forming the internal shape of the ink chamber other than the edge between the surfaces forming the ink chamber and edges between the ink leading portion, such as the projections, and the bottom surface, may be structured such that the curvature becomes larger towards the ink supply openings. For example, an edge may be formed by providing other projections or grooves to increase the curvature of the edge that is closer to the ink supply opening.

[0114] Next, the structure of an ink cartridge 1 according to another embodiment of this disclosure will be described in detail. FIG. 21 is a sectional diagram of the ink cartridge 1, and FIG. 22 is a bottom view of a main body case 1a.

[0115] The ink cartridge 1 has a ink chamber 16 therein that forms a space for reserving the ink. The ink cartridge 1 is structured from the main body case 1a that has a bottom wall 1e and side walls 1c forming the ink chamber 16, a top 1b that covers the open top surface of the main body case 1a, and a cap member 1f that covers the bot-

tom wall 1e of the main body case 1a. Two exposing holes 1fa, 1fb that expose the later-described valve systems 23, 24 to the installation part 3 are formed at the cap member If. The ink cartridge 1 is formed by adhering the top 1b and the cap member 1f to the main body case 1a. The top 1b, the main body case 1a and the cap member 1f is structured by a resin material.

[0116] On one end of the cap member 1f (right side in FIG. 21), a plate-shape cap protruding portion 1d that projects to the main body case 1a side is formed, and an insertion portion 1g, to which the cap protruding portion 1d is inserted, is formed on the main body case 1a. Therefore, because such a structure provides an orientation for the mounting of the main body case 1a and the cap member 1f, mismounting can be prevented, and a generation of defective products can be reduced.

[0117] A plurality of ink supply openings 21 are formed in the bottom wall 1e. The plurality of ink supply openings 21 are in direct communication with a communication chamber 30 for supplying the ink in the ink chamber 16. The communication chamber 30 is formed inside a cylindrical wall 30a integrally and protrudingly formed from the lower surface of the bottom wall 1e (one side of the ink chamber 16). In addition, an air introduction opening 26 is formed in the bottom wall 1e. The air introduction opening 26 is in direct communication with a communication chamber 50 for introducing the air into the ink chamber 16. The communication chamber 50 is formed inside a cylindrical wall 50a integrally and protrudingly formed from the lower surface of the bottom wall 1e (one side of the ink chamber 16). When the ink cartridge 1 is installed on the installation part 3, the ink extraction tube 12 and the air introduction tube 13 are inserted into the communication chamber 30 and the communication chamber 50, respectively.

[0118] In the communication chamber 30, a valve system 23 is provided to block the communication between the inside and outside of the ink cartridge 1. In the communication chamber 50, a valve system 24 is provided to block the communication between the inside and outside of the ink cartridge 1. Details of the valve systems 23, 24 will be described later.

[0119] The plurality of ink supply openings 21 allow communication between the communication chamber 30 and the ink chamber 16. The plurality of the ink supply openings 21 are formed by three oblongs, each of which is arrange to substantially form a triangle (see FIG. 22). Moreover a shaft hole In is formed at a center position of the ink supply opening 21. A check valve 60 formed substantially in an umbrella shape is inserted through the shaft hole 1n. The check valve 60 is structured from an elastic resin material having elasticity.

[0120] As shown in FIG. 21, the check valve 60 faces the lower surface of the ink supply openings 21 and is structured from an elastic umbrella shaped film part 60b and a film part 60c extending substantially from the center position of the film part 60b to the ink chamber 16 through the shaft hole 1n. The shaft part 61c has a substantially spherical protruding part 60a having a diameter larger than the inner diameter of the shaft hole In and is supported by the shaft hole In slidably in the up/down direction between the film part 60b and the protruding art 60a.

[0121] On the bottom wall 1e, a hollow cylindrical member 25 in a hollow cylindrical shape is formed integrally with the bottom wall 1e and extends in a direction toward the open top surface of the main body case 1a (hereinafter referred to as "first direction") from the bottom wall 1e. The upper end opening 25a of the hollow cylindrical member 25 is open above the surface of the ink in the ink chamber 16. The hollow cylindrical member 25 is formed in a taper shape where both the outer shape and the inner diameter of an internal flow path 25b are gradually narrowed towards the upper side (direction distant from a later-described blocking member 100). A connecting portion 25c of the hollow cylindrical portion 25 connecting with the bottom wall 1e is formed in a shape that expands towards the bottom wall 1e from the hollow cylindrical member 25. In addition, the cylindrical wall 50a of the communication chamber 50 is formed in a cylindrical shape integrally with the hollow cylindrical member 25 from the lower end of the connecting portion 25c and across the bottom wall 1e. As a result, the communication chamber 50 and the internal flow path 25b of the hollow cylindrical member 25 are connected smoothly via the air introduction opening 26 and the tapered internal surface of the connecting portion 25c. That is, one end of the hollow cylindrical member 25 communicates with the air introduction opening 26, and the other end communicates with the ink chamber 16. Therefore, the internal flow path 25b forms a flow path for introducing the air.

[0122] The opening 25a slopes with respect to the first direction and inclines in a direction from the center axis of the ink cartridge 1 towards the side wall 1e and towards the bottom wall 1e side. Therefore, the opening 25a has a substantial plane surface in an oval shape and have an area larger than the cross-sectional area of the internal flow path 25b perpendicular to the first direction.

[0123] The valve systems 23, 24 provided at the communication chambers 30, 50 are explained.

[0124] The valve system 23 is equipped with a support member 46 produced integrally with a rubber elastic member and a valve member 32 made with a resin material and structured contactably and separatably with the valve seat part 46a. The support member 46 has a substantially cylindrical outer shape and is structure by forming integrally the valve seat part 46a at the substantially intermediate portion in the center axis direction thereof, an urging part 46b closer to the ink chamber 16 side than the valve seat part 46a, a cylindrical portion 45 extending from the valve seat part 46a to the side opposite from the urging part 46b, and a circumferential portion 45a extending in parallel with the circumference of the cylindrical portion 45 with a space therebetween. The valve member 32 is urged by the urging part 46b in a direction to contact the valve seat part 46a and the valve member 32 is housed in the urging part 46b.

[0125] The circumferential portion 45a has an attachment part 33a projecting radially. The communication chamber 30 has a stepped surface 44 in which the diameter increases outside for housing the attachment part 33a. Moreover, a protrusion 43 projecting and formed annularly is formed on the surface of the attachment part 33a that contacts the stepped surface 44. The main body case 1a and the cap member 1f are adhered in a state that the attachment part 33a is pressed and held tight between the stepped surface 44 and the cap member 1f, thereby preventing the ink from leaking between the main body case 1a and the valve system 23.

[0126] The valve seat part 46a has an opening 41 at the center thereof and formed through the center axis direction. The cylindrical portion 45 has an introduction path 40 to which the ink extraction tube 12 is inserted when the ink cartridge 1 is installed on the installation part 3 and is integrally connected from the valve seat part 46a in a manner that the introduction path 40 is communicated with the opening 41. The inner diameter of the introduction path 40 is formed smaller than the outer diameter of the ink extraction tube 12 so as to closely attach the circumferential wall 45 with the inserted ink extraction tube 12. The opening 41 is formed larger than the inner diameter of the introduction path 40 and the outer diameter of the ink extraction tube 12. The end of the introduction path 40 to which the ink extraction tube 12 is inserted is formed in a taper shape expanding outwardly.

[0127] An annular groove 69 separates the cylindrical portion 45 and the circumferential portion 45a and makes the cylindrical portion 45 deformable with respect to the circumferential portion 45a in a plane in which the cylindrical portion 45 is orthogonal with the center axis direction of the introduction path 40. As a result, expansion of the diameter of the cylindrical portion 45 in accordance with the insertion of the ink extraction tube 12 into the introduction path 40 becomes easy, and the closeness of the introduction path 40 and the ink extraction tube 12 is increased, resulting in the prevention of ink leakage. Moreover, even if the ink extraction tube 12 is inserted with inclination or offset to the introduction path 40, the insertion of the ink extraction tube 12 into the introduction path 40 becomes possible by the deformation of the cylindrical portion 45.

[0128] The urging part 46b is formed of a side wall portion 36 upstanding in a cylindrical shape from the circumference of the valve seat part 46a on the ink chamber 16 side, a thrust portion 37 connecting to the side wall portion and thrusting inside so as to contact the valve member 32 on the ink chamber 16 side, and an opening 37a at the center of the thrust portion 37. The urging part 46b urges the valve member 32 by the elastic force of the side wall portion 36 and the thrust portion 37 in the direction to contact the valve member 32 against the valve seat part 46a. In the normal state, the valve member 32 and the valve seat part 46a are attached. Moreover, because the ink extraction tube 12 is inserted into the introduction path 40 and pushes up the valve member 32. Thus, the side wall portion 36 stretches and inclines the thrust portion 37, to form a space between the valve member 32 and the valve seat part 46a for flowing ink.

[0129] The valve member 32 is equipped with a bottom portion 57 that contacts with the valve seat part 46a of the support member 46, and a valve side wall portion 51 extending cylindrically closer to the ink chamber 16 than the circumference of the bottom portion 57. The bottom portion 57 has a protruding member 39 formed protrudingly and annularly to the valve seat part 46a side at more inside than the later-described communication path 58 and more outside than the opening 41. The valve side wall portion 51 is pressed by the lower surface of the thrust portion 37 of the urging part 46b in a state that the valve member 32 is housed in the support member 46, and the protruding member 39 is closely attached to the upper surface of the valve seat part 46a by elastically deforming the valve seat part 46a due to the pressure. Therefore, the occurrence of ink leakage via the opening 41 and the introduction path 40 is prevented while the valve member 32 is housed, in the support member 46.

[0130] From a position outside the protruding member 39 of the bottom portion 57 to the valve side wall portion 51, formed are a plurality of communication paths 58 that allow communication between the ink chamber 16 side and the valve seat part 46a side of the valve member 32, with intervals in the circumferential direction.

[0131] The valve system 24 has a structure similar to that of the valve system 23. Therefore, the same symbols are used for the same parts, and thus their descriptions are omitted. In the valve system 24, the valve member 79 is equipped with a bottom portion 96, a valve side wall portion 97, a valve member protrusion 98, and communication paths 99, which are in the same shape as those of the valve member 32. In addition, a blocking member 100 that protrudes more to the ink chamber 16 side than the valve side wall portion 97 is further equipped at the substantially center portion of the upper surface of the bottom portion 96. The blocking member 100 has an outer diameter smaller than the inner diameter of the opening 37a of the urging portion 37 and passes through the opening 37a with a space therebetween. Moreover, for the blocking member 100, the outer diameter D1 at an upper end 100a opposite from the bottom portion 96 of the valve member 79 is formed slightly smaller than the inner diameter D2 on the lower end side of the internal flow path 25b of the hollow cylindrical portion 25, and larger than the inner diameter D3 at the upper portion side of the internal flow path 25b (see FIG. 23A). The internal flow path 25b is formed to slightly taper from the inner diameter D2 at the lower end to the inner diameter D3 at the upper part. Therefore, when the upper end 100a of the blocking member 100 engages, the upper end 100a is frictionally connected to the inner side of the inner flow path 41, and is in a "biting" state. This state is not released by the elastic force of the urging part 46b that urges the valve member 79. The upper end 100a of the blocking member 94 substantially tightly closes the internal flow

path 25b and blocks the flow of air. The upper end 100a of the blocking member 100 is formed in a taper shape in which the outer diameter is decreased in a direction of the internal flow path 25b.

[0132] When the ink cartridge 1 is installed on the installation part 3, the ink extraction tube 12 and the air introduction tube 13 are inserted into the respective introduction paths 40, while expanding the diameter of the cylindrical portions 45, and contact the respective valve members 32, 79 at the bottom portions 57, 96. Thereafter, when the ink cartridge 1 is further pushed, each of the valve members 32, 79 is pressed in the direction toward the ink chamber 16 and is separated from the valve seat part 46a. As a result, an introduction path for introducing the air inside the ink cartridge as well as a supply path for supplying the ink outside from the ink cartridge 1 are formed. Because the ink cartridge 1 is under a reduced pressure when packaged, a flow is created from both of the ink extraction tube 12 and the introduction tube 13 towards the ink chamber 16. However, a reverse-flow of the ink remaining in the flow path between the ink extraction tube 12 and the recording head 7 is prevented by the check valve 60, and therefore, the air is rapidly flown into the upper part of the ink chamber 16 from the air introduction tube 13 through the hollow cylindrical member 25. Thus, even if the ink enters into the hollow cylindrical member 25 or the communication chamber 50 because the ink cartridge 1 falls during transportation, the ink is returned to the ink chamber 16. At this time, because the communication chamber 50 is smoothly connected to the internal flow path 25b of the hollow cylindrical member 25 via the tapered internal surface of the connecting portion 25c, the ink quickly flows.

[0133] Assuming that the valve member 32 on the ink supply side opens earlier than the valve member 79 on the air introduction side due to the inclination of the ink cartridge 1 when installing the ink cartridge 1 on the installation part 3, a rapid reverse-flow of ink occurs from the ink extraction tube 12 to the ink chamber 16. However, the check valve 60 closes the ink supply opening 21 by this flow, and thus the flow is prevented. Preferably, by appropriately setting the length of the ink extraction tube 12 and the air introduction tube 13, the valve system 24 on the air introduction side can be accurately opened earlier than the valve system 23 on the ink supply side, and therefore, the rapid reverse-flow of ink from the ink extraction tube 12 is prevented.

[0134] In the normal circumstance, the film part 60b of the check valve 60 falls by its own weight to a position remote from the ink supply opening 21. In accordance with the flow of the ink from the ink chamber 16, the air is supplied from the air introduction tube 14 to the upper part of the ink chamber 16.

[0135] The operation of the valve system 79 is explained with reference to FIGS. 23A and 23B. FIG. 23A is a diagram showing a state in which the ink cartridge 1 is correctly installed on the installation part 3. The valve member 79 is pushed up by the air introduction tube 13, and as described above, the introduction path for introducing the air is formed. At this time, the distance that the valve member 79 is separated from the valve seat part 46a (amount of movement) is substantially constant. In addition, the valve member 79 is positioned such that a predetermined space exists between the front end 100a of the blocking member 100 and the internal flow path 25b in order to secure a path for the air.

[0136] FIG. 23B shows a case in which the valve member 79 is accidentally pushed by a stick member A and moves more than the distance that the valve member 79 moves when the ink cartridge 1 is correctly installed (state shown in FIG. 23A). In this state, the front end 100a of the blocking member 100 of the valve member 79 enters the internal flow path 25b and closes the flow path of the interval flow path 25b, and the blocking member 100 is held in the internal flow path 25b under the above described frictional connection.

[0137] As explained above, in the above-described ink cartridge 1, the blocking member 100 closes the internal flow path 25b when the valve member 79 accidentally moves more than the distance it moves when the ink cartridge 1 is correctly installed. Therefore, even if the communication chamber 50 opens, air pressure does not act on the ink, and the chance that the ink leaks from the communication chamber 50 is suppressed at minimum.

[0138] In addition, if the valve member 79 is pushed further than the predetermined distance as described above, the amount of extension of the urging part 46b of the support member 46 is larger compared to when the ink cartridge 1 is correctly installed (see FIG. 23B). Therefore, the urging part 46b may be damaged, or the valve member 79 may be ejected from the inside of the urging part 46b. However, since the amount of the movement by the blocking member 100 is limited by the internal flow path 25b, damage to the urging part 46b or having the valve member 79 ejected from the inside of the urging part 46b can be accurately prevented.

[0139] Moreover, the internal flow path 25b is formed in a tapered shape in which the inner diameter thereof becomes narrower towards the upper side of the ink cartridge. The front end 100a of the blocking member 100 is also formed in the tapered shape in which the outer diameter thereof becomes narrower towards the internal flow path 25b. Therefore, even if inclination occurs in the direction that the valve member 79 is pushed, the blocking member 100 is accurately inserted in the internal flow path 25b.

[0140] Next, the structure of an ink cartridge 1 according to another embodiment of this disclosure will be described in detail. FIG. 24 is a sectional diagram of the ink cartridge 1. The same symbols are used for the same parts as those in previous embodiments, and thus the explanations therefore are omitted.

[0141] Unlike the embodiment of FIG. 21, the support member 46 is not equipped with an annular groove between the cylindrical portion 45 and the circumferential portion 45a. However, each of other parts has the func-

tions similar to those in the embodiment of FIG. 21 in conjunction with the valve member 32 and the ink extraction tube 12. Therefore, their detailed explanations are omitted.

[0142] In this embodiment, a seal portion 101 is formed annularly around the opening 40 at a position closer to the installation part 3 side than the circumferential wall 45a side. The valve member 79 is further equipped an operation member 102 in a substantial shaft shape extending to the installation part 3 side through the opening 40 formed in the bottom portion 96.

[0143] The installation part 3, similar to the embodiment of FIG. 2A, is structured from the base portion 3a and the guide portions 3b upstanding from the both sides of the base portion 3a and is provided with the ink extraction tube 12 protruding therefrom. A cave-in portion 103 is formed at a part of the base portion 3a that is attached with the ink extraction tube 12. In the cave-in portion 103, a porous member 104 that can absorb the ink and have flexibility is provided. The size of the porous member 104 is made larger than the size of an exposing hole 1fa of the cap member 1f. In addition, an air introduction path 105 that communicates with the atmosphere is formed instead of the air introduction tube 13. In the circumferential part thereof, a cave-in portion 106 made larger than the size of an exposing hole 1fb of the cap member 1f.

[0144] Similar to the embodiment of FIG. 2A, when the ink cartridge 1 is installed on the installation part 3, the ink extraction tube 12 enters into the introduction path 40 while expanding the cylindrical portion 45 and pushes the valve member 32 of the valve system 23 up towards the ink chamber 16 to form the ink supply path. When the installation of the ink cartridge 1 on the installation, part 3 is completed, the protruding portions around the exposing hole 1fa contacts the porous member 104. As a result, even if the ink leaks form the valve system 23 or the ink adhered in the ink extraction tube 12 drips off when repeating the attachment and detachment of the ink cartridge 1, for example, the ink can be absorbed by the porous member 104. Therefore, the chance for staining by the ink can be kept at a minimum.

[0145] Furthermore, on the air introduction side, the seal portion 101 closely contacts the cave-in portion 106 of the base portion 3a by being contacted and elastically deformed. As a result, the inside of the seal portion 101 is sealed from the outside. At this time, the operation member 102 contacts the bottom of the cave-in portion 106 at a position offset from the air introduction path 105. When the installation of the ink cartridge 1 progresses further, the valve member 79 is pushed towards the ink chamber 16 to form the air introduction path similarly to the embodiment of FIG. 2A.

[0146] In the ink cartridge 1 according to this embodiment, the structure of the blocking member 100 is in the same shape as that for the ink cartridge 1 in the embodiment of FIG. 21, effects similar to those in the first embodiment can be provided.

[0147] As should be appreciated, various modifications are available. For example, in the above-described embodiments, the blocking member 100 and the valve member 79 are made integrally, respectively. However, the valve member and the blocking member may be a separate body, or may have a structure that connects them or links their operations.

[0148] In addition, the hollow cylindrical member 25 rises in the first direction from the bottom wall 1e and is formed integrally with the bottom wall 1e. The upper end opening 25a of the hollow cylindrical member 25 opens above the surface of the ink in the ink chamber 16, and the opposite end of the internal flow path 25b is connected to the communication chamber 50.

[0149] The contact portion 25c between the hollow cylindrical member 25 and the bottom wall 1e is formed in a shape expanding towards the bottom wall 1e from the hollow cylindrical member 25. The contact portion between the hollow cylindrical member 25 and the communication chamber 50 is smoothly formed without any stepped surfaces.

[0150] The upper end opening 25a slopes with respect to the first direction and inclines in a direction from the center axis of the ink cartridge 1 towards the side wall 1c and towards the bottom wall 1e. Therefore, because the upper end opening 25a has a substantially oval plane surface, the area of the upper end opening 25a is larger than the cross-section area of the internal flow path 25b in a direction perpendicular to the first direction.

[0151] A circumferential wall 27 of the hollow cylindrical member 25, a topmost end surface 25d is a substantially plane surface substantially parallel with the bottom wall 1e. The end surface of the circumferential wall 27, except the topmost end surface 25d, is formed in an inclination along the circumference of the upper end opening 25a.

[0152] The diameter of the upper end opening 25a in the inclination direction, that is the major axis, is approximately 1 mm and preferably 2 mm or greater. This is because, since the surface tension of the ink used in this embodiment is 30 mN/m - 45 mN/m at 25 °C, meniscus is hard to generate even if the ink adheres on the upper end opening 25a and, even if formed, easily breaks in accordance with the introduction of air.

[0153] The inner diameter of the internal flow path 25b is preferably approximately 0.8 mm or greater. This is because meniscus may be formed by the ink in the direction to close the internal flow path 25b if the inner diameter of the internal flow path 25b is less than 0.8 mm. If the inner diameter of the internal flow path 25b is approximately 0.8 mm or greater, the meniscus is difficult to form, and even if formed, easily breaks in accordance with the introduction of air. Moreover, even if the ink adheres along the inner surface of the internal flow path 25b, a flow path having a sufficient cross-sectional area is secured without significantly increasing the resistance for the introduction of air.

[0154] Because the above-described hollow cylindri-

cal member 25 is formed integrally with' the main body case 1a whose top surface is open, the main body case 1a can be easily produced by tool molding, resulting in the reduction of production costs. In addition, assembly procedures can be omitted, and thus the operation effectiveness increases. Moreover, adverse effects that the air is not correctly introduced due to the flow of ink in the internal flow path 25b from the connecting portion 25c, can be prevented.

[0155] The ink may adhere at the open end of the hollow cylindrical member 25, or the ink may enter inside thereof, as the ink cartridge 1 is inclined or fallen before the user installs the ink cartridge 1 to the ink jet recording apparatus 2 after production. The majority of ink in the hollow cylindrical member 25 returns to the ink chamber 16 due to the air that rapidly flows into the ink cartridge 1 under the reduced pressure as described above. However, if the ink remains in the hollow cylindrical member 25 at this time or if the user removes the ink cartridge 1 from the installation part 3 thereafter and inclines or drops the ink cartridge 1, the internal flow path of the hollow cylindrical member 25 may be blocked. However, the upper end opening 25a of the hollow cylindrical member 25 is formed with an inclination with respect to the first direction and has an area larger than the cross-sectional area in a direction orthogonal to the first direction of the internal flow path 25b. Therefore, the chance that the meniscus is formed by the ink in the upper end opening 25a can be reduced. Moreover, even if the meniscus is formed, it can break easily in accordance with the introduction of air. Furthermore, the inner diameter of the internal flow path 25b has a size wherein the meniscus is not formed in the direction to block the internal flow path 25b. Therefore, the introduction of air is performed correctly without causing the fluctuation, and the supply of ink to the recording head 7 can be smoothly accomplished, allowing the discharge of the ink to be maintained uniformly.

[0156] Next modified examples of the upper end opening 25a of the hollow cylindrical member 25 are explained with reference to FIGS. 25A-26B.

[0157] As shown in FIGS. 25A and 25B, the upper end portion of the hollow cylindrical member 25 may be formed in a stepped shape. The upper end opening 25a may be structured from semicircular planes 25aa, 25ac, which are substantially parallel with the bottom wall and at a different height, and a rectangular plane 25ab, which is substantially perpendicular to the bottom wall 1e, and have a non-circular circumference.

[0158] As shown in FIGS. 26A and 26B, the upper end opening 25a of the air introduction member 25 may be formed with an inclination with respect to the first direction, and a protruding portion 244a may protrude in the first direction from one side of the front end opening 25a. Therefore, the front end opening 25a is formed substantially in an oval shape and the circumference is structured from a plane 245a, which is the upper end of the protruding portion 244a, a plane 245b including the majority of the front end opening 25a, and a vertical plane 241a connecting the planes 245a, 245b.

[0159] The inner diameter for the internal flow path 25b of the air introduction member 25 in the above described modified examples, is made 0.8mm or greater. The air introduction member 25 is formed such not only that the area of the opening 25a is larger than the cross-sectional area of the internal flow paths in the direction perpendicular to the first direction, but also that surfaces forming the circumference of the opening are formed by three mutually different planes. Therefore, formation of the meniscus by the ink in the upper end opening 25a can be reduced, and thus, effects similar to those in the above-describe embodiment can be provided.

[0160] As should be appreciated, various embodiments are available. For example, the opening of the hollow cylindrical member 25 in the above-described embodiment may be formed by two planes diagonally intersecting at an angle different with respect to the first direction, or may be formed in a non-circular shape such as a circle that is partially cut out.

[0161] In addition, a hollow cylindrical member 25, which is formed integrally with the bottom wall 1e and rises from the bottom wall 1e in the first direction toward the open top surface of the main body case 1a, is formed on the bottom wall 1e. The front end opening 25a of the air introduction member opens above the surface of the ink in the ink chamber 16. The outer shape and the internal flow path 25b of the hollow cylindrical member 25 is formed in a tapered shape in which the diameter narrows gradually towards the upper side. The connecting portion of the hollow cylindrical member 25 with the bottom wall 1e is formed in a shape to expand from the top of the hollow cylindrical member 25 towards the bottom wall 1e. Moreover, a cylindrical wall 50a of the communication chamber 50 is formed integrally in a cylindrical shape in a sequence with the hollow cylindrical member 25, from the low end of the connecting portion 25c across the bottom wall 1e. As a result, the communication chamber 50 and the internal flow path 25b of the hollow cylindrical member 25 are formed smoothly continuously via the tapered inner surface of the connecting portion 25c. Furthermore, by the connecting portion 25c, the strength of the connecting point of the hollow cylindrical member 25 to the bottom wall 1e is increased, and deformation of the hollow cylindrical member 25 at the time of molding or due to effects from environmental changes can be prevented.

[0162] As described above, the main body case 1a of the above-described ink cartridge 1 has a shape in which the top surface is open. The hollow cylindrical member 25 is formed integrally with the bottom wall 1e and in a shape expanding from the front end opening 25a towards the bottom wall 1e. Therefore, the main body case 1a can be manufactured easily by tool molding, and thus the manufacturing cost can be reduced. Moreover, because the hollow cylindrical member 25 and the main body case 1a are formed integrally, assembly processes

can be omitted, and the operation efficiency can be increased. Furthermore, adverse effects that air is not correctly introduced, because ink enters into the internal flow path 25b of the hollow cylindrical member 25 from the connecting portion 25c between the hollow cylindrical member 25 and the main body case 1a, can be prevented.

[0163] According to an exemplary aspect of the disclosure, there is no need to provide a protrusion for opening the opening of the valve member at the installation part of the inkjet recording apparatus. Therefore, there is an effect that positioning the ink cartridge and the installation part when installing the ink cartridge to the installation part becomes easy.

[0164] According to an exemplary aspect of the disclosure, when the ink cartridge is removed from the inkjet recording apparatus, the valve member contacts the valve seat portion by the urging portion, and the ink is prevented from leaving or evaporating through the opening. Moreover, when the ink cartridge is installed on the inkjet recording apparatus, the valve can be opened by uniformly raising the valve member by the operation member and separating the valve member from the valve seat portion.

[0165] According to an exemplary aspect of the disclosure, a complex operational procedure to attach the urging device that urges the valve member in an area in which the valve member is positioned becomes unnecessary. Accordingly, there is an effect to reduce the manufacturing cost of the ink cartridge.

[0166] According to an exemplary aspect of the disclosure, the ink is prevented from leaving or evaporating through the opening.

[0167] According to an exemplary aspect of the disclosure, the ink supply opening and the air introduction opening can be opened when the ink cartridge is installed on the installation part and thus can introduce the air in the cartridge at the same time when the ink is supplied to the recording apparatus. In addition, at least one of the first and second valve systems comprise a valve seat portion and a valve member movable with respect to the valve seat portion. The valve member has an operation member protruding outside the ink cartridge and is structured such that the operation member contacts the installation part when the ink cartridge is installed on the installation part so as to separate the valve member from the valve seat portion. When providing the installation part with the operation member that protrudes in correspondence with the first and second valve system, it must be sealed to prevent the ink from leaking and manufactured to accurately maintain the mutual positional relationships between two protruding operation members and the mutual positional relationships between the ink supply opening and the air introduction opening. However, there is an effect that the ink cartridge can be easily installed to the installation part while easily manufacturing without requiring high accuracy in the positional relationships.

[0168] According to an exemplary aspect of the disclosure, the two valve systems can be opened by moving the ink cartridge simply in the direction of the installation part, providing better operability.

[0169] According to an exemplary aspect of the disclosure, when installing the ink cartridge on the installation part, it is necessary to accurately position the second valve system at a position of the hollow member provided in the installation part. However, the position of the first valve system does not have to accurately positioned, and thus there is an effect that the ink cartridge can be easily manufactured, and the installation of the ink cartridge to the installation part becomes easy.

[0170] According to an exemplary aspect of the disclosure, a complex operational procedure to attach the urging device that urges the valve member in an area in which the valve member is positioned becomes unnecessary. Accordingly, there is an effect to reduce the manufacturing cost of the ink cartridge.

[0171] According to an exemplary aspect of the disclosure, there is an effect that by operating the operation member, the valve is raised uniformly and the valve is opened by separating the valve portion from the valve seat portion.

[0172] According to an exemplary aspect of the disclosure, there is an effect to prevent the fluid flowing to the valve system from leaking outside or evaporating.

[0173] According to an exemplary aspect of the disclosure, there is an effect that the ink cartridge can be easily manufactured without requiring high accuracy in the mutual positional relationship between the ink supply opening and the air introduction opening of the ink cartridge or the mutual positional relationship between the extraction portion and the air supply portion of the installation part, and thus the installation of the ink cartridge on the installation part can be easily achieved.

[0174] In an inkjet recording apparatus, in Japanese Laid Open Patent Application No. H9-85963, that is structured to allow attachment and detachment of an ink container (hereinafter referred to as an ink cartridge), two rooms are provided to a holder for holding the ink cartridge. Each room is filled with a porous material, and projection portions that project upwardly from the upper end are formed. An end of one of the porous material is connected to an air introduction opening, and the lower surface of the other porous material is connected to an ink supply opening.

[0175] The ink cartridge is provided with a through hole that allows insertion of each of the projection portions at the bottom portion. A film valve that can open a valve extends from the projection portions. By installing the ink cartridge to the holder, the two rooms and the inside of the ink cartridge are communicated.

[0176] However, the inside of the cartridge is generally in a negative pressure in a package. When installing the ink cartridge, if a valve for the ink supply opening opens before a valve for the air introduction opening, the ink reserved on the recording apparatus side reverse-flows

into the ink cartridge. The ink in the ink cartridge is maintained in a deaeration state, and the state cannot be maintained if the ink that has been discharged is brought back. Moreover, the meniscus of the ink formed inside nozzles of a recording head is destroyed as the ink is pulled towards the ink cartridge. As a result, there has been a problem that excellent ink cannot be discharged.

[0177] Embodiments of the disclosure of this invention, in consideration of the above-described problem, provide an ink cartridge that can prevent the reverse-flow of the ink to the ink cartridge when installing the ink cartridge and maintaining the ink in the normal condition as well as maintaining the excellent discharge of the ink to the recording head.

[0178] An ink cartridge according to an exemplary aspect of the disclosure has an ink chamber for reserving ink and installed attachably and detachably to a recording apparatus main body and is in a reduced pressure state prior to the installation. The ink cartridge comprises an air introduction opening formed in communication with the ink chamber and being open for introducing air inside the ink chamber, a first sealing means that seals the air introduction opening before the ink cartridge is installed to the recording apparatus main body, an ink supply opening formed in communication with the ink chamber and being opened for supplying the ink inside the ink chamber outside, a second sealing means that seals the ink supply opening before the ink cartridge is installed to the recording apparatus main body, and a check valve provided between the second sealing means and the ink chamber, the check valve blocking a flow of the ink from the outside of the ink supply opening towards the inside of the ink chamber.

[0179] In an ink cartridge according to an exemplary aspect of the disclosure, the air introduction opening and the ink supply opening are formed side by side on one side of the ink chamber and the first and second sealing means are opened in accordance with the installation of the ink cartridge to the recording apparatus main body.

[0180] In an ink cartridge according to an exemplary aspect of the disclosure, the check valve leaves the ink supply open in a normal state and only when the flow from the outside of the ink supply opening towards the ink chamber occurs, blocks the flow in a direction thereof.

[0181] In an ink cartridge according to an exemplary aspect of the disclosure, the air introduction opening is formed inside a first cylindrical wall formed outwardly from one side of the ink chamber. The ink supply opening is formed inside a second cylindrical wall formed outwardly from one side of the ink chamber. The first sealing means is provided inside the first cylindrical wall to cover the air introduction opening, and the second sealing means is provided inside the second cylindrical wall to cover the ink supply opening.

[0182] In an ink cartridge according to an exemplary aspect of the disclosure, the check valve is structured from a shaft portion and a film umbrella portion. The umbrella portion is positioned to face the ink supply opening, and a space is formed between the ink supply opening and the umbrella portion to allow the flow of the ink from the ink supply opening. When the flow from the outside of the ink supply opening towards the ink chamber occurs, the umbrella closely contacts and blocks the ink supply opening.

[0183] An ink cartridge according to an exemplary aspect of the disclosure, the first sealing means and the second sealing means are a valve means comprising a valve seat portion and a valve member movable with respect to the valve seat portion. The valve member moves from the valve seat portion in accordance with the installation of the ink cartridge to the recording apparatus main body, to open a valve.

[0184] According to the ink cartridge of an exemplary aspect of the disclosure, a check valve that prevents the ink from flowing from the outside of the ink supply opening into the ink chamber is provided between a sealing means on the side for supplying the ink and the ink chamber. Therefore, when the sealing means on the side for introducing air and the sealing means on the side for supplying the ink open while installing the ink cartridge to the recording apparatus main body, the ink is prevented from reverse-flowing from the ink supply opening to the ink chamber, which is in a reduced pressure state. In addition, the deaeration state of the ink is prevented from deteriorating due to mixture of the ink on the recording apparatus side into the deaerated ink in the ink cartridge. Moreover, the ink meniscus inside the nozzles of the recording head is prevented from being damaged, and thus defective discharge of ink from the recording head is reduced. As such, there is an effect that the excellent recording quality is maintained.

[0185] According to the ink cartridge according to an exemplary aspect of the disclosure, the air introduction opening and the ink supply opening are formed side by side on one side of the ink chamber, and the first and second sealing means are opened in accordance with the installation of the ink cartridge to the recording apparatus main body. Therefore, because two sealing means can be opened by installing the ink cartridge from one direction, the installation of the ink cartridge to the recording apparatus main body becomes easy. In addition, there is an effect that the ink is prevented from reverse-flowing as described above, even if either sealing means is opened first due to inclination of the ink cartridge at that time during the installation and the like.

[0186] According to the ink cartridge according to an exemplary aspect of the disclosure, the check valve leaves the ink supply open in a normal state and only when the flow from the outside of the ink supply opening towards the ink chamber occurs, blocks the flow in a direction thereof. Therefore, there are effects that a small amount of the reverse-flow is tolerated, and thus the pressure on the recording head side is prevented from significantly changing. That is, with a structure to close the valve in the normal state and opens only when supplying the ink, when the pressure on the recording side changes

and increases due to the movement by the carriage and the like, there is no place for the ink to escape, and the pressure on the recording side increases, which prevents normal discharge of ink. Therefore, by opening the valve in the normal state, a small reverse-flow to the ink chamber is tolerated, and thus such a phenomenon is prevented.

[0187] According to the ink cartridge of an exemplary aspect of the disclosure, the air introduction opening is formed inside a first cylindrical wall formed outwardly from one side of the ink chamber. The ink supply opening is formed inside a second cylindrical wall formed outwardly from one side of the ink chamber. The first sealing means is provided inside the first cylindrical wall to cover the air introduction opening, and the second sealing means is provided inside the second cylindrical wall to cover the ink supply opening. Therefore, the air to be introduced and the ink to be supplied are completely separated, and thus there is an effect that the air is not mixed into the ink to be supplied.

[0188] According to the ink cartridge of an exemplary aspect of the disclosure, the check valve is structured from a shaft portion and a film umbrella portion. The umbrella portion being positioned to face the ink supply opening, and a space is formed between the ink supply opening and the umbrella portion to allow the flow of the ink from the ink supply opening. When the flow from the outside of the ink supply opening towards the ink chamber occurs, the umbrella closely contacts and blocks the ink supply opening. Therefore, there are effects that the check valve can be formed simply and at low cost, that the pressure at the recording head side is prevented from fluctuating as described above, and that the reverse-flow can be accurately prevented when it occurs.

[0189] According to the ink cartridge of an exemplary aspect of the disclosure, the first sealing means and the second sealing means are a valve means comprising a valve seat portion and a valve member movable with respect to the valve seat portion, and the valve member move from the valve seat portion in accordance with the installation of the ink cartridge to the recording apparatus main body, to open a valve. Therefore, there are effects that the sealing means can be formed with a simple structure and that the installation of the ink cartridge to the recording apparatus main body becomes easy.

[0190] An ink cartridge has an ink chamber in which ink is filled. When the ink cartridge is installed in a recording apparatus, such as an inkjet printer, the ink is supplied from the ink chamber to the recording apparatus. Depending on a condition, such as an internal formation of the ink chamber and viscosity of the ink, the ink remains partially inside the ink chamber. Therefore, as an ink cartridge that can prevent such remaining of the ink, an ink cartridge provided with grooves for discharging the ink around a prism for detecting the amount of remaining ink, for example, has been proposed in Japanese Laid-Open Patent Application No. 2000-71471. In such an ink cartridge, by progressing the discharging of the ink around the prism using the grooves to make the ink to be difficult to remain on the surface of the prism, misdetection of the ink can be prevented when there is only a small amount of ink in the chamber.

[0191] However, in the above-described ink cartridge, if the curvature of the grooves formed in the ink chamber for discharging the ink is constant, the size of the capillary force applied to the ink from the grooves becomes substantially the same at the position near an ink supply portion for supplying the ink to the recording apparatus and the position distant from the ink supply portion. Accordingly, when the amount of the ink remaining in the ink chamber becomes low, the ink splits by being pulled to the position away from the ink supply portion, causing the ink to remain in the ink chamber. As such, the ink in the ink chamber cannot be used completely.

[0192] Embodiments of the disclosure of this invention provide an ink cartridge that can prevent more accurately the remaining of the ink in the ink chamber.

[0193] An ink cartridge of an exemplary aspect of the disclosure is an ink cartridge including an ink chamber and ink supply openings for supplying ink in the ink chamber to a recording apparatus, wherein curvature of at least a part of a plurality of edges forming an internal shape of the ink chamber is made larger as closer to the ink supply openings.

[0194] In this cartridge, the ink in the ink chamber is supplied to the recording apparatus from the ink supply openings. Curvature of at least a part of a plurality of edges forming an internal shape of the ink chamber (e.g., an edge between surfaces forming the ink chamber, and edges at a portion formed in projecting or cave-in shapes in the ink chamber) becomes larger as closer to the ink supply openings. That is, the shape of the edges becomes from a moderate shape to an acute shape as it becomes closer to the ink supply openings. Therefore, at a position near the ink supply openings, the capillary force applied to the ink from the edges becomes larger. Accordingly, the ink is led to the ink supply openings by a part of the edges which curvature changes. As a result, because an occasion that the ink remains at a remote from the ink supply openings, at which the capillary force applied to the ink from the edges is relatively small, due to being attracted at the position and separated, can be prevented, the ink in the ink chamber can be completely used.

[0195] An ink cartridge of an exemplary aspect of the disclosure is that, the at least a part of the plurality of edges continues from an edge at a position higher than the ink supply openings to an edge at the ink supply openings. Therefore, even when the ink surface is lowered in accordance with the consumption of the ink, the ink is accurately led to the ink supply openings by the edges that continues to the ink supply openings form the position higher than the ink supply openings and that have the larger curvatures as closer to the ink supply openings. Therefore, the ink is prevented form remaining at a vicinity of the side surfaces of the ink chamber that are remote

from the ink supply openings.

[0196] An ink cartridge of an exemplary aspect of the disclosure is that the at least a part of the plurality of edges is formed between a predetermined two surfaces of the surfaces forming the ink chamber, and curvature of the edge is different in each conjunction of the predetermined two surfaces. With the structure that the curvature of the edge between two surfaces forming the ink chamber is different in each conjunction of the two surfaces, the structure in which the curvature of the edge is larger as closer to the ink supply openings can be easily realized.

[0197] An ink cartridge of an exemplary aspect of the disclosure is tangent surfaces at a connecting part of the predetermined two surfaces at the edge are parallel respectively with the predetermined two surfaces. Therefore, edges having predetermined curvature can be easily formed between the two surfaces.

[0198] An ink cartridge of an exemplary aspect of the disclosure includes a cartridge main body forming an ink chamber; ink supply openings formed on a bottom surface of the ink chamber and for supplying ink to a recording apparatus; and ink leading portions provided on the bottom surface of the ink chamber and extending from side surfaces of the ink chamber towards the ink supply openings. Curvature of an edge between the ink leading portion and the bottom surface is larger than curvature of an edge between the side surfaces and the bottom surface of the ink chamber.

[0199] In this ink cartridge, the ink in the ink chamber formed in the cartridge main body is supplied to the recording apparatus from the ink supply opening via the ink leading portions extending from the side surfaces of the ink chamber towards the ink supply openings. The curvature of the edge between the ink leading portion and the bottom surface of the ink chamber is made greater than the curvature of the edge between the side surfaces and the wall surface of the ink chamber. That is, the capillary force applied to the ink at the edge between the ink leading portion neat the ink supply openings and the bottom surface of the ink chamber becomes greater than the capillary force at the position near the side surfaces of the ink chamber that is remote from the ink supply openings. Accordingly, because an occasion that the ink remains at a remote from the ink supply openings, at which the capillary force applied to the ink from the edges is relatively small, due to being attracted at the position and separated, can be prevented, the ink in the ink chamber can be completely used.

[0200] An ink cartridge of an exemplary aspect of the disclosure is that the curvature of the edge between the ink leading portion and the bottom surface is larger as closer to the ink supply openings. Therefore, the capillary force applied to the ink becomes greater as closer to the ink supply openings even at the edges between the ink leading portion and the bottom surface of the ink chamber. Thus, the ink is accurately prevented from remaining at a position remote from the ink supply openings.

[0201] An ink cartridge of an exemplary aspect of the disclosure is that the ink leading portion extends to the ink supply openings. Therefore, the ink on the bottom surface of the ink chamber is accurately led to the ink supply openings via the ink leading portions.

[0202] The ink leading portion may be a projection projecting form the bottom surface (the eighth invention) or a groove formed on the bottom surface (the ninth invention).

[0203] An ink cartridge of an exemplary aspect of the disclosure is that a plurality of the ink leading portions are provided to gather to the ink supply openings from the surrounding of the ink supply openings. Because a plurality of ink leading portions is provided to gather from the surrounding thereof, the ink on the bottom surface of the ink chamber is further accurately led to the ink supply openings.

[0204] An ink cartridge of an exemplary aspect of the disclosure is that an edge of the ink leading portion opposite from the ink supply portion continues to side surfaces of the ink chamber. Therefore, the ink near the side surfaces of the ink chamber can be accurately led to the ink supply openings via the ink leading portions.

[0205] There exists, in Japanese Laid-Open Patent Application No. H09-85963, an ink container (hereinafter referred to as "an ink cartridge") that reserves ink inside and is provided with an opening on a bottom portion. An elastic film valve is provided at the opening of the ink cartridge. This ink cartridge is structured freely attachable to and detachable from to a holder. To the holder, a protruding portion to open the valve is formed at a position facing the opening. A through hole for flowing the ink in the ink cartridge out to the outside is provided at the protruding portion. When the ink cartridge is correctly installed to the holder, the valve is pushed and opened in the upward direction by the protruding portion of the holder, and the ink in the ink cartridge flows outside via the through hole and the opening.

[0206] However, the above-described ink cartridge has a structure that the communication between the inside and outside of the ink cartridge is normally blocked by the valve and is permitted by the protruding portion to push up the valve when the ink cartridge is correctly installed to the holder. However, there is a problem that the ink leaks through the opening if the valve is accidentally pushed up before the ink cartridge is installed to the holder.

[0207] Embodiments of the disclosure of this invention, in consideration of the above-described problem, provide an ink cartridge that suppresses the ink leakage at minimum even if misoperated before the ink cartridge is installed to the holder.

[0208] An ink cartridge according to an exemplary aspect of the disclosure is attachablly and detachably installed to a recording apparatus main body and equipped with a reservoir chamber that reserves the ink. The ink cartridge includes a communication opening that is formed in a cylindrical wall formed on one side of the

reservoir chamber and communicates with the outside of the ink cartridge, a flow path, one end of which communicates with the communication opening and other end of which communicates with the reservoir chamber, a valve means having a valve seat portion provided, in the communication opening and a valve member structured connectably and separatably with respect t the valve seat portion, the valve means sealing communication between the inside and outside of the reservoir chamber when the valve member contacts the valve seat portion, and allowing communication between the inside and outside of the reservoir chamber when the valve member is separated from the valve member for a predetermined distance upon the correct installation of the ink cartridge to the recording apparatus main body, and a blocking member that blocks the communication between the inside and outside of the reservoir chamber by closing the flow path when the valve member moves more than the predetermined distance.

[0209] In an ink cartridge according to an exemplary aspect of the disclosure, the flow path is formed inside a hollow cylindrical member formed from the bottom wall upstanding towards upper part of the ink cartridge. The blocking member is formed by projecting towards the flow path side and projecting in a substantially cylindrical shape having an outer diameter being substantially equal to an inner diameter of the low path. At least a front end of the blocking member fits by closely contacting inside the flow path when the valve member moves more than the predetermined distance.

[0210] In an ink cartridge according to an exemplary aspect of the disclosure, the blocking means is held under the close contact and fitting state.

[0211] In an ink cartridge according to an exemplary aspect of the disclosure, the valve member and the blocking member are formed integrally with a resin material.

[0212] In an ink cartridge according to an exemplary aspect of the disclosure, the flow path is an air introduction path for introducing air into the ink cartridge.

[0213] An ink cartridge according to an exemplary aspect of the disclosure is installed attachablly and detachably to a recording apparatus main body and equipped with a reservoir chamber that reserves ink. The ink cartridge includes a communication opening formed at one side of the ink cartridge to open outside, a flow path that communicating the communication opening to the reservoir chamber, a blocking member arranged movably in a direction to approach the flow path in accordance with the correct installation of the ink cartridge to the recording apparatus, the blocking member positioning with a space with the flow path when correctly installed, and closing the flow path when moved more than an amount of movement for the correct installation.

[0214] An ink cartridge according to an exemplary aspect of the disclosure further includes a sealing means positioned in the communication opening and more externally than the blocking member, wherein the sealing means is opened when correctly installed.

[0215] In an ink cartridge according to an exemplary aspect of the disclosure, the sealing means is formed from a valve seat portion and a valve member contactable and separatable with respect to the valve seat portion, and the blocking member is connected to the valve member.

[0216] An ink cartridge according to an exemplary aspect of the disclosure further includes an ink supply opening that is formed on one side of the ink cartridge and open outside and supplies the ink in the reservoir chamber to the recording apparatus main body. The communication opening is an air introduction opening for introducing air into the reservoir chamber.

[0217] In an ink cartridge according to an exemplary aspect of the disclosure, the front end of the blocking member is structured that the outer diameter becomes smaller towards the flow path.

[0218] In the ink cartridge according to an exemplary aspect of the, disclosure, the flow path is structured that the inner diameter thereof becomes smaller from an end surface being the blocking member side in a direction departing from the blocking member.

[0219] According to the ink cartridge according to an exemplary aspect of the disclosure, the valve member is separated for the predetermined distance from the valve seat portion when the ink cartridge is correctly installed to the recording apparatus main body, so that the ink reservoir chamber can be communicated to the outside. In addition, the blocking member closes the flow path when the valve member is accidentally moved more than the predetermined distance. Therefore, the chance that the ink leaks outside is suppressed at minimum.

[0220] According to the ink cartridge according to an exemplary aspect of the disclosure, the flow path is formed inside a hollow cylindrical member formed from the bottom wall upstanding towards upper part of the ink cartridge. The blocking member is formed by projecting towards the flow path side and projecting in a substantially cylindrical shape having an outer diameter being substantially equal to an inner diameter of the low path. At least a front end of the blocking member fits by closely contacting inside the flow path when the valve member moves more than the predetermined distance. Therefore, there is an effect that the ink leakage is accurately suppressed.

[0221] According to the ink cartridge according to an exemplary aspect of the disclosure, the blocking means is held under the close contact and fitting state. Therefore, there is an effect that the ink is prevented from leaking continuously.

[0222] According to the ink cartridge according to an exemplary aspect of the disclosure, because the valve member and the blocking member are formed integrally with a resin material, there is an effect to reduce the number of parts and thus reduce the manufacturing cost.

[0223] According to the ink cartridge according to an exemplary aspect of the disclosure, the flow path is an air introduction path for introducing air into the ink car-

tridge. Therefore, the air introduction path is blocked by the blocking member when the valve member moves more than the predetermined distance, and even if the ink supply opening opens at this time, the air pressure is not applied in the ink cartridge. Therefore, there is an effect to suppress the ink leakage.

[0224] According to the ink cartridge according to an exemplary aspect of the disclosure, the communication opening is formed at one side of the ink cartridge to open outside and communicates with the reservoir chamber by the flow path. The blocking member is arranged in the communication opening, movably in a direction to approach the flow path in accordance with the correct installation of the ink cartridge to the recording apparatus. The blocking member is positioned with a space with the flow path when the ink cartridge is correctly installed to the recording apparatus main body, and closing the flow path when accidentally, moved more than the predetermined amount. Therefore, the chance that the ink leaks outside is suppressed at minimum.

[0225] The ink cartridge according to an exemplary aspect of the disclosure further includes a sealing means positioned in the communication opening and more externally than the blocking member. the sealing means is opened when correctly installed. Therefore, the communication between the inside and outside of the ink cartridge is accurately sealed by the sealing means when the ink cartridge is not installed to the recording apparatus main body. In addition, the flow path to the outside is accurately formed when the ink cartridge is correctly installed to the recording apparatus main body.

[0226] According to the ink cartridge according to an exemplary aspect of the disclosure, the sealing means is formed from a valve seat portion and a valve member contactable and separatable with respect to the valve seat portion, and the blocking member is connected to the valve member. Therefore, compared to the case in which the blocking member and the valve member are separate units, forming in the ink cartridge a complicated structure to arrange the blocking member and the valve member becomes unnecessary. Therefore, there is an effect that the structure of the ink cartridge can be simplified.

[0227] According to the ink cartridge according to an exemplary aspect of the disclosure, the ink cartridge further includes an ink supply opening that is formed on one side of the ink cartridge and open outside and supplies the ink in the reservoir chamber to the recording apparatus main body. The communication opening is an air introduction opening for introducing air into the reservoir chamber. Therefore, the flow path through which the air is introduced is blocked when the blocking member moves more than the predetermined amount of movement, and the air pressure does not apply in the ink cartridge even if the ink supply opening is opened at this time. Therefore, there is an effect that the ink leakage is suppressed.

[0228] According to the ink cartridge according to an exemplary aspect of the disclosure, because the front end of the blocking member is structured that the outer diameter becomes smaller towards the flow path, the front end of the blocking member can be easily inserted into the flow path. Therefore, there is an effect for an accurate blocking operation.

[0229] According to the ink cartridge according to an exemplary aspect of the disclosure, because the flow path is structured that the inner diameter thereof becomes smaller from an end surface being the blocking member side in a direction departing from the blocking member, the blocking member can be more easily inserted into the flow path. Therefore, there is an effect for an accurate blocking operation.

[0230] There exists, in Japanese Laid-Open Patent Application No. H06-64182, an ink cartridge which is equipped with an air pipe (hereinafter referred to as "air introduction member") for introducing the air inside a main case of the ink cartridge, a thin film blocking member adhered on the upper end of the air introduction member, and a cooperating member provided inside the air introduction member. For the introduction of air into the ink cartridge, an air introduction needle is inserted through a rubber member provided on a bottom wall of the ink cartridge. The film breaking member is broken by pushing the cooperating member to form an introduction path for the air that passes a narrow hole made by the cooperating member. The narrow hole of the cooperating member extends in a direction substantially perpendicular to the bottom wall of the ink cartridge and is formed in a substantially linear form from a front end opening to the rubber member.

[0231] The air introduction member of the ink cartridge introduces in the ink cartridge the air of an amount corresponding to the amount of ink supplied from the ink cartridge to a recording head, to maintain the pressure for the ink to be supplied to the recording head constant. Therefore, it is preferable that the air introduction member is not closed by, for example, the ink entered thereto. However, it is unavoidable that the ink cartridge be inclined or fallen before the user installs the ink cartridge to a recording apparatus main body after production or after the user removes the ink cartridge from the recording apparatus main body once. Therefore, there is a chance that the ink adheres at the open end of the air introduction member or that the ink enters inside the air introduction member.

[0232] The ink often closes the air introduction member by forming meniscus at the open end of the air introduction member at a reservoir chamber side or by forming the meniscus inside an introduction path in the air introduction member when the introduction path is narrow. If the ink is supplied under this circumstance, it is repeated that the pressure in the reservoir chamber sealed by the meniscus is reduced; the air breaks the meniscus and flows into the reservoir chamber; the pressure is reduced by the meniscus formed with the remaining ink; and the air breaks the meniscus and flows into the reservoir

chamber. That is, ink supply pressure for the recording head fluctuates, and the ink is ununiformly discharged from the recording head. Therefore, there is a problem that recording qualities may be lowered.

[0233] Embodiments of the disclosure of this invention is made with consideration of the above-described problems and provide an ink cartridge that prevents the fluctuation of the ink supply pressure for the recording head by correctly introducing the air in the ink cartridge and to maintain the ink discharge from the recording head uniform.

[0234] An ink cartridge according to an exemplary aspect of the disclosure is equipped with a reservoir chamber that reserves ink and includes an air introduction opening formed on a bottom wall being a bottom portion of the reservoir chamber, the air introduction opening introducing air into the reservoir chamber, an ink supply opening that supplies the ink in ,the reservoir chamber outside, and an air introduction member in a hollow cylindrical shape raised from the bottom wall towards an upper part of the reservoir chamber, a lower end of an inner flow path of the air introduction member communicating with the air introduction opening, the upper end of the air introduction member being open in the upper part of the reservoir chamber. The air introduction member is structured such that at least a part of the upper end opening is formed diagonally with respect to the first direction, and thereby an area of the upper end opening is larger than a cross-sectional area of the inner flow in a direction orthogonal to the first direction.

[0235] An ink cartridge according to an exemplary aspect of the disclosure is equipped with a reservoir chamber that reserves ink and includes an air introduction opening formed on a bottom wall being a bottom portion of the reservoir chamber, the air introduction opening introducing air into the reservoir chamber, an ink supply opening that supplies the ink in the reservoir chamber outside, and an air introduction member in a hollow cylindrical shape raised from the bottom wall towards an upper part of the reservoir chamber, a lower end of an inner flow path of the air introduction member communicating with the air introduction opening, the upper end of the air introduction member being open in the upper part of the reservoir chamber. An upper end opening of the air introduction member is formed on two or more mutually different planes.

[0236] An ink cartridge according to an exemplary aspect of the disclosure is equipped with a reservoir chamber that reserves ink and includes an air introduction opening formed on a bottom wall being a bottom portion of the reservoir chamber, the air introduction opening introducing air into the reservoir chamber, an ink supply opening that supplies the ink in the reservoir chamber outside, and an air introduction member in a hollow cylindrical shape raised from the bottom wall towards an upper part of the reservoir chamber, a lower end of an inner flow path of the air introduction member communicating with the air introduction opening, the upper end of the air introduction member being open in the upper part of the reservoir chamber. The upper end opening of the air introduction member is formed in a non-circular shape.

[0237] An ink cartridge according to an exemplary aspect of the disclosure is equipped with a reservoir chamber that reserves ink and includes an air introduction opening formed on a bottom wall being a bottom portion of the reservoir chamber, the air introduction opening introducing air into the reservoir chamber, an ink supply opening that supplies the ink in the reservoir chamber outside, and an air introduction member in a hollow cylindrical shape raised from the bottom wall towards an upper part of the reservoir chamber, a lower end of an inner flow path of the air introduction member communicating with the air introduction opening, the upper end of the air introduction member being open in the upper part of the reservoir chamber. The inner diameter of an inner flow path of the air introduction member is formed in a size by which a meniscus in a direction for the ink to block the inner flow path is not formed. ,

[0238] In an ink cartridge according to an exemplary aspect of the disclosure, the inner diameter of the inner flow path of the air introduction member is equal to or more than approximately 0.8 mm.

[0239] An ink cartridge according to an exemplary aspect of the disclosure further includes a side walls extending from a circumference of the bottom wall in the first direction and being a periphery of the reservoir chamber, a main case structure by the bottom wall and side walls, a top surface of the main case being open, and a cover member the covers the open top surface of the main body case. The air introduction member is formed integrally with the bottom wall.

[0240] According to the ink cartridge of an exemplary aspect of the disclosure, an air introduction opening is formed on a bottom wall being a bottom portion of the reservoir chamber and introduces air into the reservoir chamber. A lower end of an inner flow path of the air introduction member communicating with the air introduction opening. The air introduction member rises from the bottom wall towards the upper part of the reservoir chamber and has an opening open in the upper part of the reservoir chamber. The air introduction member is structured such that at least a part of the upper end opening is formed diagonally with respect to the first direction, and thereby an area of the upper end opening is larger than a cross-sectional area of the inner flow in a direction orthogonal to the first direction. The upper end opening may also be formed by two or more planes that are mutually different from each other. The upper end opening may also be formed in a non-circular shape. Therefore, the meniscus becomes difficult to be formed even if the ink adheres on the opening, and even if the meniscus is formed, it easily breaks in accordance with the introduction of air. Therefore, because the fluctuation of air introduction that occurs when the meniscus is formed at the opening can be suppressed, there are effects that the

fluctuation in the ink supply to the recording head is reduced, and the ink discharge from the recording head can be maintained uniformly.

[0241] According to the ink cartridge of an exemplary aspect of the disclosure, an air introduction opening is formed on a bottom wall being a bottom portion of the reservoir chamber and introduces air into the reservoir chamber. A lower end of an inner flow path of the air introduction member communicating with the air introduction opening. The air introduction member rises from the bottom wall towards the upper part of the reservoir chamber and has an opening open in the upper part of the reservoir chamber. Because the inner diameter of an inner flow path of the air introduction member is formed in a size by which a meniscus in a direction for the ink to block the inner flow path is not formed, the inner flow path is not blocked by a film of ink, that is, meniscus even if the ink remains in the inner flow path. In addition, the air is correctly introduced in the reservoir chamber. Accordingly, there is an effect that the uniform discharge of ink from the recording head is maintained as described above.

[0242] According to the ink cartridge of an exemplary aspect of the disclosure, the effect can be easily achieved by setting the inner diameter of the inner flow path of the air introduction member equal to or more than approximately 0.8 mm.

[0243] According to the ink cartridge of an exemplary aspect of the disclosure, the main case is structured by a top surface made open by the bottom wall and side walls. In addition, the air introduction member is formed integrally with the bottom wall. Therefore, because the main body case to which the air introduction member is integrally provided can be easily formed by tool molding, the production cost can be reduced, and the ink flow form the connecting ports of the air introduction member and the bottom wall to the inner flow path can be prevented. Accordingly, there is an effect that the air is correctly introduced in the reservoir chamber.

[0244] There exists, in Japanese Laid-Open Patent Application No. 6-64182, an ink cartridge that is equipped with an air pipe (herein referred to as "air introduction member") for introducing the air inside a main case of the ink cartridge is known. The ink cartridge has on a bottom portion a rubber member through which an ink supply needle and an air introduction needle are inserted. Above the rubber member, an air introduction member, the air introduction member is mounted by adhering to the main case. In addition, the upper end of the air introduction member is formed with a flat surface portion having a diameter larger than the outer diameter of the air introduction member, to adhere a think film blocking member for preventing the entrance of flow. A cooperating member that breaks the think film blocking member is arranged inside the air introduction member. To introduce the air inside the ink cartridge, the air introduction needle is inserted through the rubber member and pushes up the cooperating member, such that the cooperating member breaks the think film blocking member to allow the air to be introduced inside the ink cartridge.

[0245] However, because the main body case and the air introduction member are structured as separate bodies in the above-described ink cartridge, a process to assemble the air introduction member to the main body case becomes necessary, and the operation efficiency is lowered, resulting the increase in manufacturing cost. Moreover, because there is a chance that the air enters into the inner flow path of the air introduction member from the connection point between the ink cartridge and the air introduction member. Therefore, there is a problem that the air is not correctly introduced.

[0246] Furthermore, for manufacturing an ink cartridge in which the main body case and the air introduction member are integral to improve the operation efficiency, because the upper end of the air introduction member is formed with a flat surface having a diameter larger than the outer diameter of the air introduction member, there are also problems that the production with the tool molding becomes complicated, and thus the manufacturing cost is increase.

[0247] Embodiments of the disclosure of this invention, in consideration of the above problems, provide an ink cartridge that can reduce the manufacturing cost of the ink cartridge as well as allowing the air to be correctly introduced into the ink cartridge.

[0248] An ink cartridge according to an exemplary aspect of the disclosure has a reservoir that reserves ink and includes a main body case having a bottom wall and side walls forming the reservoir chamber, the top surface of the main body case being open, an air introduction opening formed on the bottom wall of the main body case for introducing air in the reservoir chamber, an ink supply opening formed on the main body case for supplying the ink in the reservoir chamber outside, and a hollow cylindrical air introduction member of which an internal flow path communicates with the air introduction opening, the hollow cylindrical air introduction member formed integrally with and rising from the bottom wall of the main body case towards the open upper surface in the first direction, an upper end of the air introduction member being open above a surface of the ink in the reservoir chamber.

[0249] In an ink cartridge according to an exemplary aspect of the disclosure, a connecting portion of the air introduction member to the bottom wall is formed in a shape expanding from the air introduction member towards the bottom wall.

[0250] In an ink cartridge according to an exemplary aspect of the disclosure, the air introduction opening is formed in a first cylindrical wall protruding and formed integrally from a lower surface of the bottom wall. The ink supply opening is formed in a second cylindrical wall protruding and formed integrally form the lower surface of the bottom wall, and the air introduction opening and the ink supply opening are sealed by sealing means provided in the first cylindrical all and the second cylindrical

wall.

[0251] In an ink cartridge according to an exemplary aspect of the disclosure, the first cylindrical wall and the air introduction member are formed integrally in a continuously cylindrical shape across the bottom wall.

[0252] In an ink cartridge according to an exemplary aspect of the disclosure, the sealing means is a valve means equipped with a valve seat portion and a valve member movable with respect to the valve seat portion, and the valve means moves in a direction that the valve member leaves away from the valve seat portion in accordance with the installation of the ink cartridge to the inkjet recording apparatus.

[0253] According to the ink cartridge according to an exemplary aspect of the disclosure, the ink cartridge has a reservoir that reserves ink, and is structured from a main body case having a bottom wall and side walls forming the reservoir chamber, the top surface of the main body case being open, and a cover member that covers the open top surface of the main case. An air introduction opening is formed on the bottom wall of the main body case for introducing air in the reservoir chamber. In addition, a hollow cylindrical air introduction member of which an internal flow path communicates with the air introduction opening, the hollow cylindrical air introduction member formed integrally with and rising from the bottom wall of the main body case towards the open upper surface in the first direction, an upper end of the air introduction member being open above a surface of the ink in the reservoir chamber. The inner flow path of the air introduction member communicates with the air introduction opening, and the air can be introduced in the reservoir chamber through the air introduction opening and the air introduction member. Thus, because the upper surface of the main body is open, and because the air introduction member is formed by integrally rising from the bottom wall towards the open surface, the main body and the air introduction member can be resin-molded easily by tooling or the like. Therefore, because the number of parts is reduced and because the assembly of the main body case and the air introduction member becomes unnecessary, the operation efficiency is improved, and the manufacturing cost is reduced.

[0254] Moreover, because the main body case and the air introduction member are formed integrally, the ink is prevented flowing into the inner flow path of the air introduction member from the connecting portion between the main body case and the air introduction member. Therefore, there is an effect that the air is correctly introduced in the reservoir chamber.

[0255] According to the ink cartridge of an exemplary aspect of the disclosure, because a connecting portion of the air introduction member to the bottom wall is formed in a shape expanding from the air introduction member towards the bottom wall, there are effects that the strength at the connecting point increases and that deformation of the air introduction member at the time of molding or due to effects by environmental changes thereafter can be prevented.

[0256] According to the ink cartridge of an exemplary aspect of the disclosure, the air introduction opening is formed in a first cylindrical wall protruding and formed integrally from a lower surface of the bottom wall, the ink supply opening is formed in a second cylindrical wall protruding and formed integrally form the lower surface of the bottom wall, and the air introduction opening and the ink supply opening are sealed by sealing means provided in the first cylindrical all and the second cylindrical wall. Therefore, the inside of the ink cartridge can be in a sealed state by arranging the sealing means at the first cylindrical wall and the second cylindrical wall if the first cylindrical wall and the second cylindrical wall are molded integrally to the main body case by tooling or the like. Accordingly, there is an effect that the operation efficiency for the assembly can be further improved.

[0257] According to the ink cartridge of an exemplary aspect of the disclosure, the first cylindrical wall and the air introduction member are formed integrally in a continuously cylindrical shape across the bottom wall. Therefore, even if the ink flows into the inner flow path of the air introduction member during transportation of the ink cartridge, the ink in the inner flow path can be flown smoothly into the reservoir chamber when the air introduction opening is opened by the installation of the ink cartridge. Accordingly, since the ink in the inner flow path of the air introduction member is prevented from blocking the introduction of air, there is an effect that the air is correctly introduced.

[0258] According to the ink cartridge of an exemplary aspect of the disclosure, the sealing means is a valve means equipped with a valve seat portion and a valve member movable with respect to the valve seat portion, and the valve means moves in a direction that the valve member leaves away from the valve seat portion in accordance with the installation of the ink cartridge to the inkjet recording apparatus. There are effects that occurrence of ink leakage is prevented when the ink cartridge is not installed to the inkjet recording apparatus, and the air introduction path and the ink supply path are accurately formed by the valve member of the valve means to move in a direction to leave away from the valve seat portion when the ink cartridge is installed to the inkjet recording apparatus.

[0259] While this disclosure has been described in conjunction with the exemplary embodiments and examples outlined above, various alternatives, modifications, variations, improvements and/or substantial equivalents, whether known or that are or may be presently unforeseen, may become apparent to those having at least ordinary skill in the art. Accordingly, the exemplary embodiments of the disclosure, as set forth above, are intended to be illustrative, not limiting. Various changes may be made without departing from the scope of the disclosure as defined by the claims.

Industrial Applicability

[0260] The ink cartridge of the present invention are widely used for home and office uses.

Claims

1. An ink cartridge (1) configured to be removably installed in an installation part (3) of an inkjet recording apparatus (2), comprising:

a case (1a);
an ink chamber (16);
an air communication chamber (50) provided within the case (1a) and that is capable of communicating with the ink chamber (16) and an outside of the case (1a);
a first valve system (24) disposed within the air communication chamber (50);
an ink communication chamber (30) provided within the case (1a) and that is capable of communicating with the ink chamber (16) and an outside of the case (1a); and
a second valve system (23) disposed within the ink communication chamber (30),
wherein the first valve system (24) comprises a first valve seat (46a), a first valve (65) that is capable of moving relative to the first valve seat (46a), and an operation member (67) that extends from the first valve (65) to the outside of the case (1a);
the operation member (67) is capable of moving the first valve (65) from a first position where the first valve (65) contacts the first valve seat (46a) to a second position where the first valve (65) is separated from the first valve seat (46a);
the second valve system (23) comprises a second valve seat (46a) and a second valve (32);
when the ink cartridge (1) is installed in the installation part (3) of the inkjet recording apparatus (2), the operation member (67) is capable of moving the first valve (65) from the first position to the second position when the operation member (67) contacts the installation part (3), and the second valve (32) is capable of being moved from a third position where the second valve (32) contacts the second valve seat (46a) to a fourth position where the second valve (32) is separated from the second valve seat (46a) when an extraction tube (12) provided in the installation part (3) enters into the case (1a) and the second valve (32) is pushed by the extraction tube (12).

2. The ink cartridge (1) according to claim 1, wherein the first valve (65) and the operation member (67) are formed as a one-piece member.

3. The ink cartridge (1) according to claim 1, wherein the air communication chamber (50) and the ink communication chamber (30) are formed on one side of the case (1a).

4. The ink cartridge (1) according to claim 3, further comprising a cap member (1f) covering the one side of the case (1a).

5. The ink cartridge (1) according to claim 1, wherein:

the first valve (65) has a first surface and a second surface opposite the first surface,
an opening (41) is formed at a substantial l y center of the first valve seat (46a) in order to expose the second surface of the first valve (65),
the first valve system (24) comprises an urging device (46b) that extends from the first valve seat (46a), surrounds the first valve (65) and urges the first surface of the first valve (65) toward the first valve seat (46a) such that the first valve seat (46a) contacts the second surface of the first valve (65) outside of the opening (41),
the operation member (67) protrudes from the first valve (65) through the opening, and
the urging device (46b) is formed integrally with the first valve seat (46a) so as to urge the first surface of the first valve (65) toward the first valve seat (46a).

6. The ink cartridge (1) according to claim 5, wherein the operation member (67) is located on the second surface of the first valve (65).

7. The ink cartridge (1) according to claim 1, further comprising a sealing member (63) that surrounds the operation member (67).

8. The ink cartridge (1) according to claim 7, wherein the operation member (67) that has an outer end opposite the first valve (65), the sealing member (63) has an outer end opposite the opening (41), and air communication chamber (50) has an outer end opposite the ink chamber (16), the outer end of the operation member (67) being located between the outer end of the air communication chamber (50) and the outer end of the sealing member (63), when viewed in a direction of installation of the ink cartridge (1).

9. The ink cartridge (1) according to claim 8, wherein the sealing member (63) extends from the first valve seat (46a) on a side opposite the first valve (65) and is formed integrally with the first valve seat (46a).

10. The ink cartridge (1) according to claim 5, further comprising a sealing member (63) that surrounds the operation member (67) wherein when the ink car-

tridge (1) is installed in the installation part (3) of the inkjet recording apparatus (2), the sealing member (63) contacts the installation part (3) and forms a path from a flow path in the installation part (3) to the ink chamber (16).

11. The ink cartridge (1) according to claim 7, wherein the first valve seat (46a), the urging device (46b) and the sealing member (63) are integrally formed of a rubber-like material.

12. An inkjet recording apparatus (2), comprising:

an ink jet head (7); and
an installation part (3) that is capable of receiving the ink cartridge (1) according to any one of claims 1 to 11, the installation part (3) including a flow path through which air is introduced to the ink cartridge (1) and the extraction tube (12) through which ink is supplied to the ink jet head (7).

Patentansprüche

1. Eine Tintenpatrone (1), die eingerichtet ist, entfernbar in einem Installationsteil (3) eines Tintenstrahlaufzeichnungsgeräts (2) installiert zu werden, umfassend:

ein Gehäuse (1a);
eine Tintenkammer (16);
eine Luftverbindungskammer (50), die innerhalb des Gehäuses (1a) vorgesehen und in der Lage ist, mit der Tintenkammer (16) und mit einem Äußeren des Gehäuses (1a) in Verbindung zu stehen;
ein erstes Ventilsystem (24), das innerhalb der Luftverbindungskammer (50) angeordnet ist;
eine Tintenverbindungskammer (30), die innerhalb des Gehäuses (1a) vorgesehen und in der Lage ist, mit der Tintenkammer (16) und einem Äußeren des Gehäuses (1a) in Verbindung zu stehen; und
ein zweites Ventilsystem (23), das innerhalb der Tintenverbindungskammer (30) angeordnet ist, wobei das erste Ventilsystem (24) einen ersten Ventilsitz (46a), ein erstes Ventil (65), das in der Lage ist, sich relativ zu dem ersten Ventilsitz (46a) zu bewegen, und ein Betätigungselement (67) umfasst, das sich von dem ersten Ventil (65) zu dem Äußeren des Gehäuses (1a) erstreckt;
das Betätigungselement (67) in der Lage ist, das erste Ventil (65) von einer ersten Position, in welcher das erste Ventil (65) den ersten Ventilsitz (46a) kontaktiert, zu einer zweiten Position, in welcher das erste Ventil (65) von dem ersten Ventilsitz (46a) getrennt ist, zu bewegen;
das zweite Ventilsystem (23) einen zweiten Ventilsitz (46a) und ein zweites Ventil (32) umfasst;
wenn die Tintenpatrone (1) in dem Installationsteil (3) des Tintenstrahlaufzeichnungsgeräts (2) eingesetzt ist, das Betätigungselement (67) in der Lage ist, das erste Ventil (65) von der ersten Position zu der zweiten Position zu bewegen, wenn das Betätigungselement (67) das Installationsteil (3) kontaktiert, und das zweite Ventil (32) in der Lage ist, von einer dritten Position, in welcher das zweite Ventil (32) den zweiten Ventilsitz (46a) kontaktiert, zu einer vierten Position bewegt zu werden, in welcher das zweite Ventil (32) von dem zweiten Ventilsitz (46a) getrennt ist, wenn eine in dem Installationsteil (3) vorgesehene Extraktionsleitung (12) in das Gehäuse (1a) eintritt und das zweite Ventil (32) durch die Extraktionsleitung (12) gedrückt wird.

2. Die Tintenpatrone (1) gemäß Anspruch 1, wobei das erste Ventil (65) und das Betätigungselement (67) einstückig ausgebildet sind.

3. Die Tintenpatrone (1) gemäß Anspruch 1, wobei die Luftverbindungskammer (50) und die Tintenverbindungskammer (30) auf genau einer Seite des Gehäuses (1a) ausgebildet sind.

4. Die Tintenpatrone (1) gemäß Anspruch 3, ferner umfassend ein Kappenelement (1f), welches die eine Seite des Gehäuses (1a) abdeckt.

5. Die Tintenpatrone (1) gemäß Anspruch 1, wobei:

das erste Ventil (65) eine erste Oberfläche und eine der ersten Oberfläche entgegen gesetzte zweite Oberfläche besitzt,
eine Öffnung (41) im Wesentlichen in der Mitte des ersten Ventilsitzes (46a) ausgebildet ist, um die zweite Oberfläche des ersten Ventils (65) freizulegen,
das erste Ventilsystem (24) eine Spannvorrichtung (46b) umfasst, die sich von dem ersten Ventilsitz (46a) erstreckt, das erste Ventil (65) umgibt und die erste Oberfläche des ersten Ventils (65) hin zu dem ersten Ventilsitz (46a) vorspannt, so dass der erste Ventilsitz (46a) die zweite Oberfläche des ersten Ventils (65) außerhalb der Öffnung (41) kontaktiert,
das Betätigungselement (67) von dem ersten Ventil (65) durch die Öffnung hervorsteht, und
die Spannvorrichtung (46b) integral mit dem ersten Ventilsitz (46a) ausgebildet ist, um die erste Oberfläche des ersten Ventils (65) in Richtung auf den ersten Ventilsitz (46a) vorzuspannen.

6. Die Tintenpatrone (1) gemäß Anspruch 5, wobei das Betätigungselement (67) auf der zweiten Oberfläche des ersten Ventils (65) positioniert ist.

7. Die Tintenpatrone (1) gemäß Anspruch 1, ferner umfassend ein Dichtelement (63), welches das Betätigungselement (67) umgibt.

8. Die Tintenpatrone (1) gemäß Anspruch 7, wobei das Betätigungselement (67) ein äußeres Ende besitzt, das dem ersten Ventil (65) entgegengesetzt liegt, das Dichtelement (63) ein äußeres Ende besitzt, das der Öffnung (41) entgegengesetzt liegt, und die Luftverbindungskammer (50) ein äußeres Ende besitzt, das der Tintenkammer (16) entgegengesetzt liegt, wobei das äußere Ende des Betätigungselements (67) zwischen dem äußeren Ende der Luftverbindungskammer (50) und dem äußeren Ende des Dichtelements (63) positioniert ist, wenn dies in einer Richtung des Einsetzens der Tintenpatrone (1) betrachtet wird.

9. Die Tintenpatrone (1) gemäß Anspruch 8, wobei sich das Dichtelement (63) von dem ersten Ventilsitz (46a) auf einer zu dem ersten Ventil (65) entgegen gesetzten Seite erstreckt und integral mit dem ersten Ventilsitz (46a) ausgebildet ist.

10. Die Tintenpatrone (1) gemäß Anspruch 5, ferner umfassend ein Dichtelement (63), welches das Betätigungselement (67) umgibt, wobei, wenn die Tintenpatrone (1) in dem Installationsteil (3) des Tintenstrahlaufzeichnungsgeräts (2) installiert ist, das Dichtelement (63) das Installationsteil (3) kontaktiert und einen Weg von einem Fließweg in dem Installationsteil (3) hin zu der Tintenkammer (16) bildet.

11. Die Tintenpatrone (1) gemäß Anspruch 7, wobei der erste Ventilsitz (46a), die Spannvorrichtung (46b) und das Dichtelement (63) integral aus einem gummiähnlichen Material gebildet sind.

12. Ein Tintenstrahlaufzeichnungsgerät (2), umfassend:

einen Tintenstrahlkopf (7); und
ein Installationsteil (3), das in der Lage ist, die Tintenpatrone (1) gemäß einem der Ansprüche 1 bis 11 aufzunehmen, wobei das Installationsteil (3) einen Fließweg aufweist, durch welchen Luft in die Tintenpatrone (1) eingeführt wird, und die Extraktionsleitung (12) aufweist, durch welche Tinte dem Tintenstrahlkopf (7) zugeführt wird.

Revendications

1. Cartouche d'encre (1) configurée pour être installée de manière amovible dans une partie d'installation (3) d'un appareil d'enregistrement à jet d'encre (2), comprenant :

un boîtier (1a) ;
une chambre d'encre (16) ;
une chambre de communication d'air (50) prévue à l'intérieur du boîtier (1a) et qui peut communiquer avec la chambre d'encre (16) et un extérieur du boîtier (1a) ;
un premier système de soupape (24) disposé à l'intérieur de la chambre de communication d'air (50) ;
une chambre de communication d'encre (30) prévue à l'intérieur du boîtier (1a) et qui peut communiquer avec la chambre d'encre (16) et un extérieur du boîtier (1a) ; et
un deuxième système de soupape (23) disposé à l'intérieur de la chambre de communication d'encre (30),
dans laquelle le premier système de soupape (24) comprend un premier siège de soupape (46a), une première soupape (65) qui peut se déplacer par rapport au premier siège de soupape (46a), et un élément de commande (67) qui s'étend à partir de la première soupape (65) jusqu'à l'extérieur du boîtier (1a) ;
l'élément de commande (67) peut faire passer la première soupape (65) d'une première position dans laquelle la première soupape (65) est en contact avec le premier siège de soupape (46a) à une deuxième position dans laquelle la première soupape (65) est séparée du premier siège de soupape (46a) ;
le deuxième système de soupape (23) comprend un deuxième siège de soupape (46a) et une deuxième soupape (32) ;
lorsque la cartouche d'encre (1) est installée dans la partie d'installation (3) de l'appareil d'enregistrement d'encre (2), l'élément de commande (67) peut faire passer la première soupape (65) de la première position à la deuxième position lorsque l'élément de commande (67) est en contact avec la partie d'installation (3), et la deuxième soupape (32) peut passer d'une troisième position dans laquelle la deuxième soupape (32) est en contact avec le deuxième siège de soupape (46a) à une quatrième position dans laquelle la deuxième soupape (32) est séparée du deuxième siège de soupape (46a) lorsqu'un tube d'extraction (12) prévu dans la partie d'installation (3) pénètre dans le boîtier (1a) et que la deuxième soupape (32) est poussée par le tube d'extraction (12).

2. Cartouche d'encre (1) selon la revendication 1, dans laquelle la première soupape (65) et l'élément de commande (67) sont formés comme un élément d'un

seul tenant.

3. Cartouche d'encre (1) selon la revendication 1, dans laquelle la chambre de communication d'air (50) et la chambre de communication d'encre (30) sont formées d'un côté du boîtier (1a).

4. Cartouche d'encre (1) selon la revendication 3, comprenant en outre un élément de capuchon (1f) recouvrant le premier côté du boîtier (1a).

5. Cartouche d'encre (1) selon la revendication 1, dans laquelle :

la première soupape (65) a une première surface et une deuxième surface opposée à la première surface,
une ouverture (41) est formée sensiblement au centre du premier siège de soupape (46a) afin d'exposer la deuxième surface de la première soupape (65),
le premier système de soupape (24) comprend un dispositif de poussée (46b) qui s'étend du premier siège de soupape (46a), entoure la première soupape (65) et pousse la première surface de la première soupape (65) vers le premier siège de soupape (46a) de sorte que le premier siège de soupape (46a) est en contact avec la deuxième surface de la première soupape (65) à l'extérieur de l'ouverture (41),
l'élément de commande (67) fait saillie de la première soupape (65) par l'ouverture, et
l'élément de poussée (46b) est formé de manière solidaire avec le premier siège de soupape (46a) afin de pousser la première surface de la première soupape (65) vers le premier siège de soupape (46a).

6. Cartouche d'encre (1) selon la revendication 5, dans laquelle l'élément de commande (67) est positionné sur la deuxième surface de la première soupape (65).

7. Cartouche d'encre (1) selon la revendication 1, comprenant en outre un élément d'étanchéité (63) qui entoure l'élément de commande (67).

8. Cartouche d'encre (1) selon la revendication 7, dans laquelle l'élément de commande (67) a une extrémité externe opposée à la première soupape (65), l'élément d'étanchéité (63) a une extrémité externe opposée à l'ouverture (41), et la chambre de communication d'air (50) a une extrémité externe opposée à la chambre d'encre (16), l'extrémité externe de l'élément de commande (67) étant positionnée entre l'extrémité externe de la chambre de communication d'air (50) et l'extrémité externe de l'élément d'étanchéité (63), lorsqu'elle est observée dans une direction d'installation de la cartouche d'encre (1).

9. Cartouche d'encre (1) selon la revendication 8, dans laquelle l'élément d'étanchéité (63) s'étend à partir du premier siège de soupape (46a) sur un côté opposé à la première soupape (65) et est formé de manière solidaire avec le premier siège de soupape (46a).

10. Cartouche d'encre (1) selon la revendication 5, comprenant en outre un élément d'étanchéité (63) qui entoure l'élément de commande (67) dans laquelle, lorsque la cartouche d'encre (1) est installée dans la partie d'installation (3) de l'appareil d'enregistrement à jet d'encre (2), l'élément d'étanchéité (63) est en contact avec la partie d'installation (3) et forme une trajectoire à partir d'une trajectoire d'écoulement dans la partie d'installation (3) jusqu'à la chambre d'encre (16).

11. Cartouche d'encre (1) selon la revendication 7, dans laquelle le premier siège de soupape (46a), le dispositif de poussée (46b) et l'élément d'étanchéité (63) sont formés de manière solidaire à partir d'un matériau de type caoutchouc.

12. Appareil d'enregistrement à jet d'encre (2) comprenant :

une tête de jet d'encre (7) ; et
une partie d'installation (3) qui peut recevoir la cartouche d'encre (1) selon l'une quelconque des revendications 1 à 11, la partie d'installation (3) comprenant une trajectoire d'écoulement à travers laquelle on introduit de l'air dans la cartouche d'encre (1) et le tube d'extraction (12) à travers lequel l'encre est amenée à la tête de jet d'encre (7).

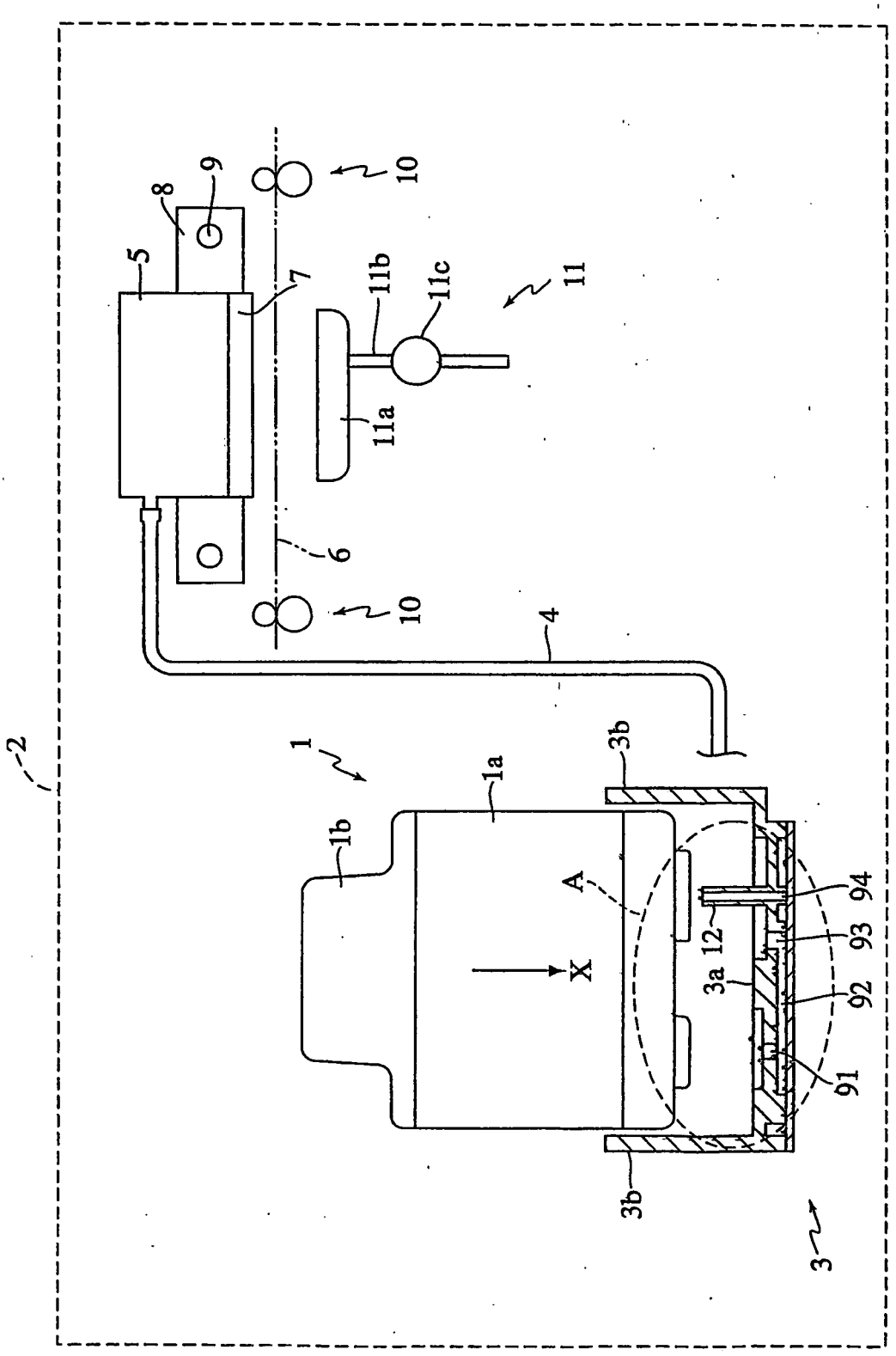


FIG. 1

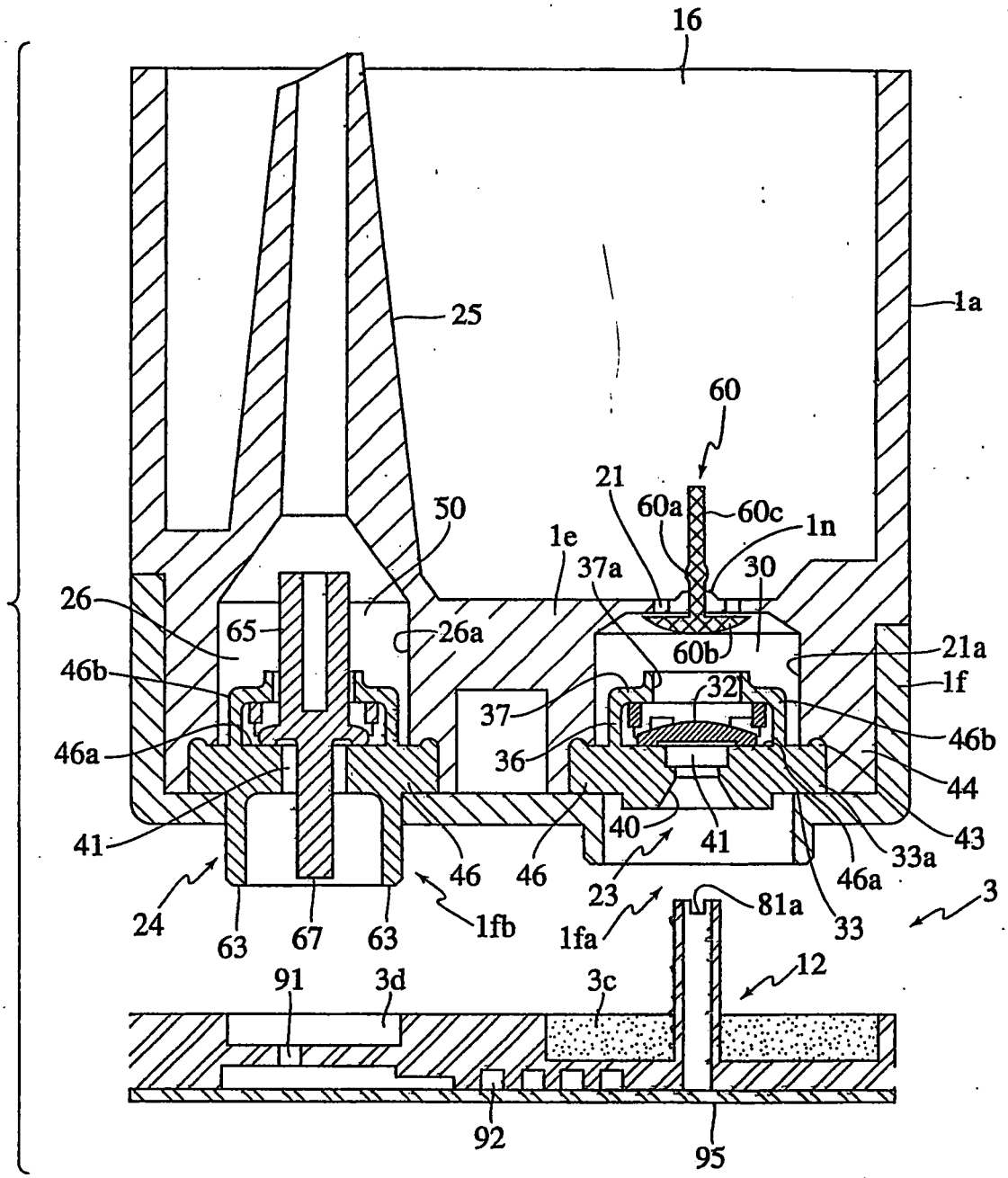

16
25
1a
60
21
60a
60c
1n
50
1e
37a
30
26
65
26a
60b
21a
46b
32
1f
37
46b
46a
36
44
40
41
43
41
46
46
33a
46a
23
81a
3
24
63
67
63
1fb
1fa
33
12
91
3d
3c
92
95

FIG. 2A

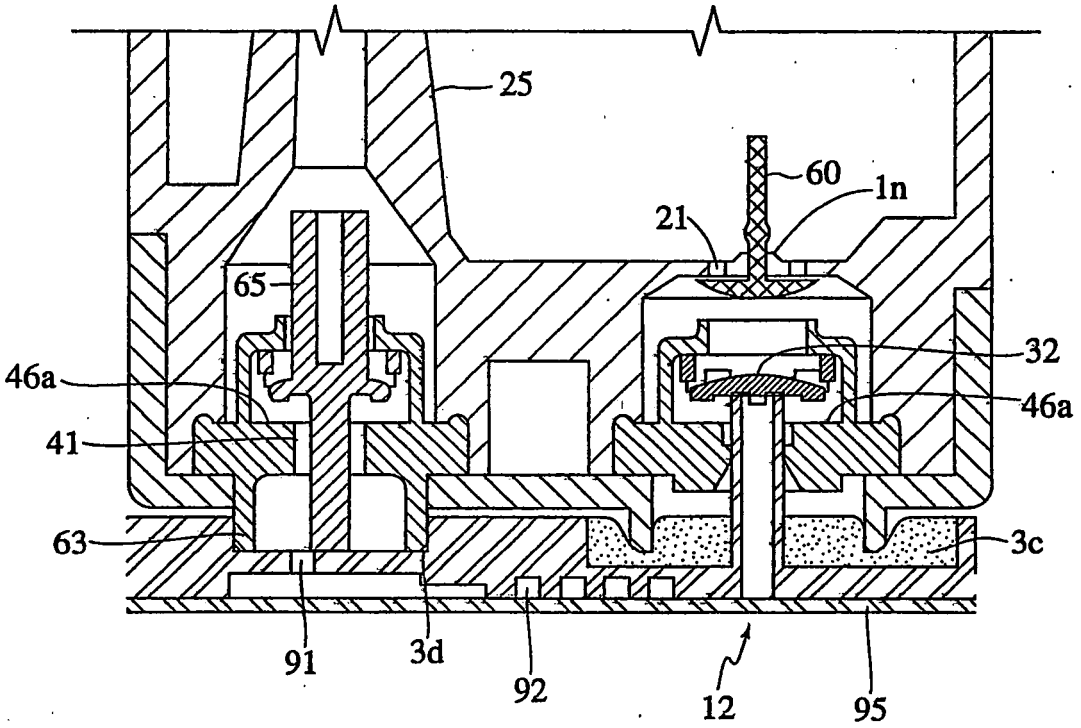


FIG. 2B

FIG. 3A

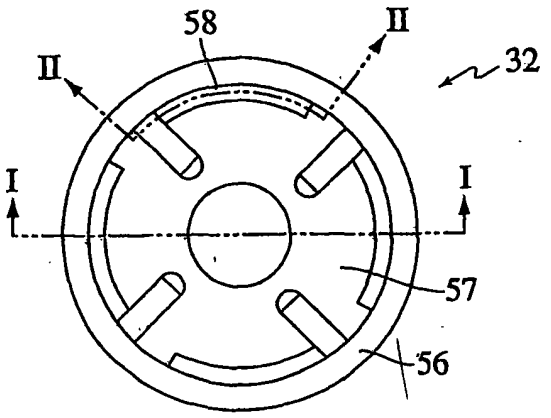


FIG. 3B

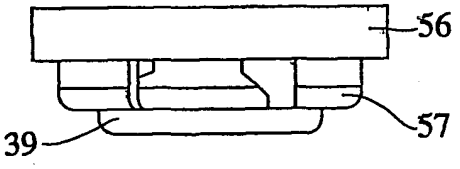


FIG. 3C

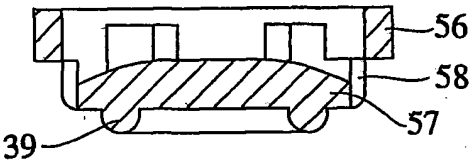


FIG. 3D

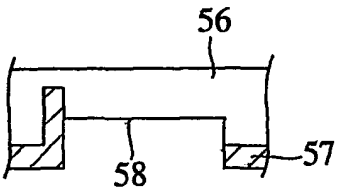


FIG. 3E

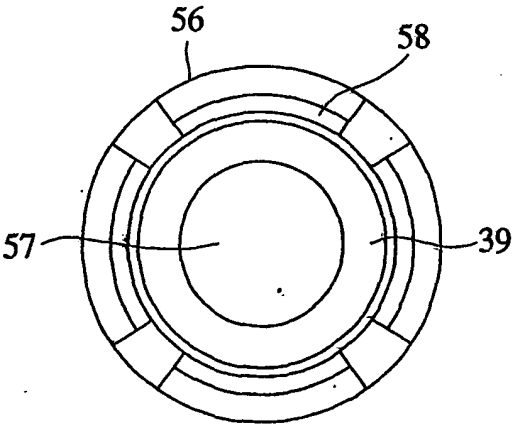


FIG. 4A

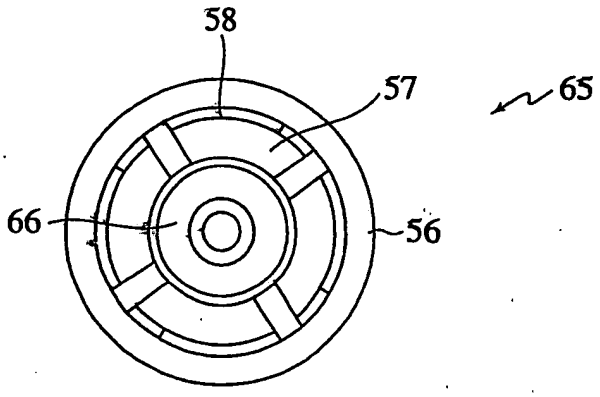


FIG. 4B

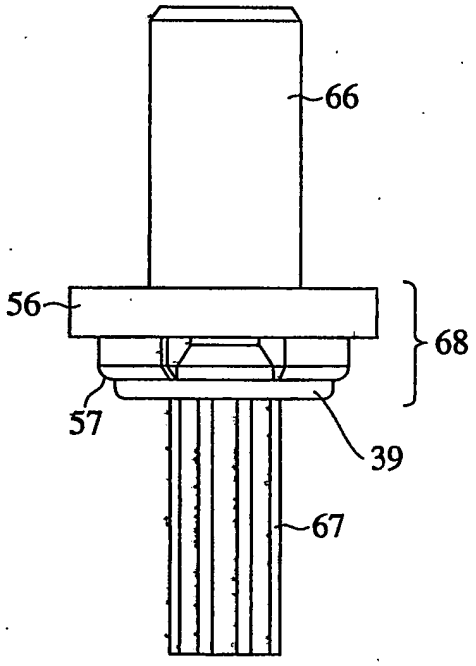
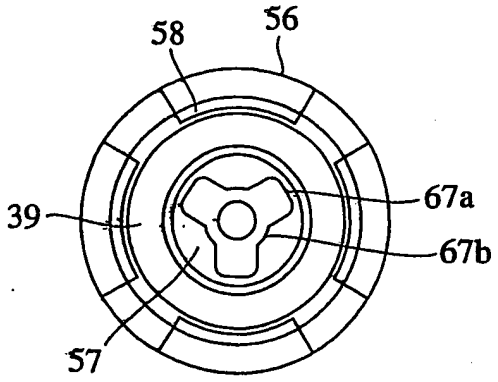


FIG. 4C



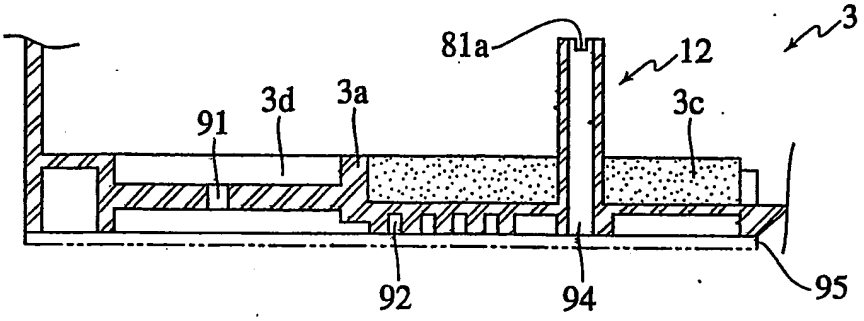

81a
12
3
3d
3a
91
3c
92
94
95

FIG. 5A

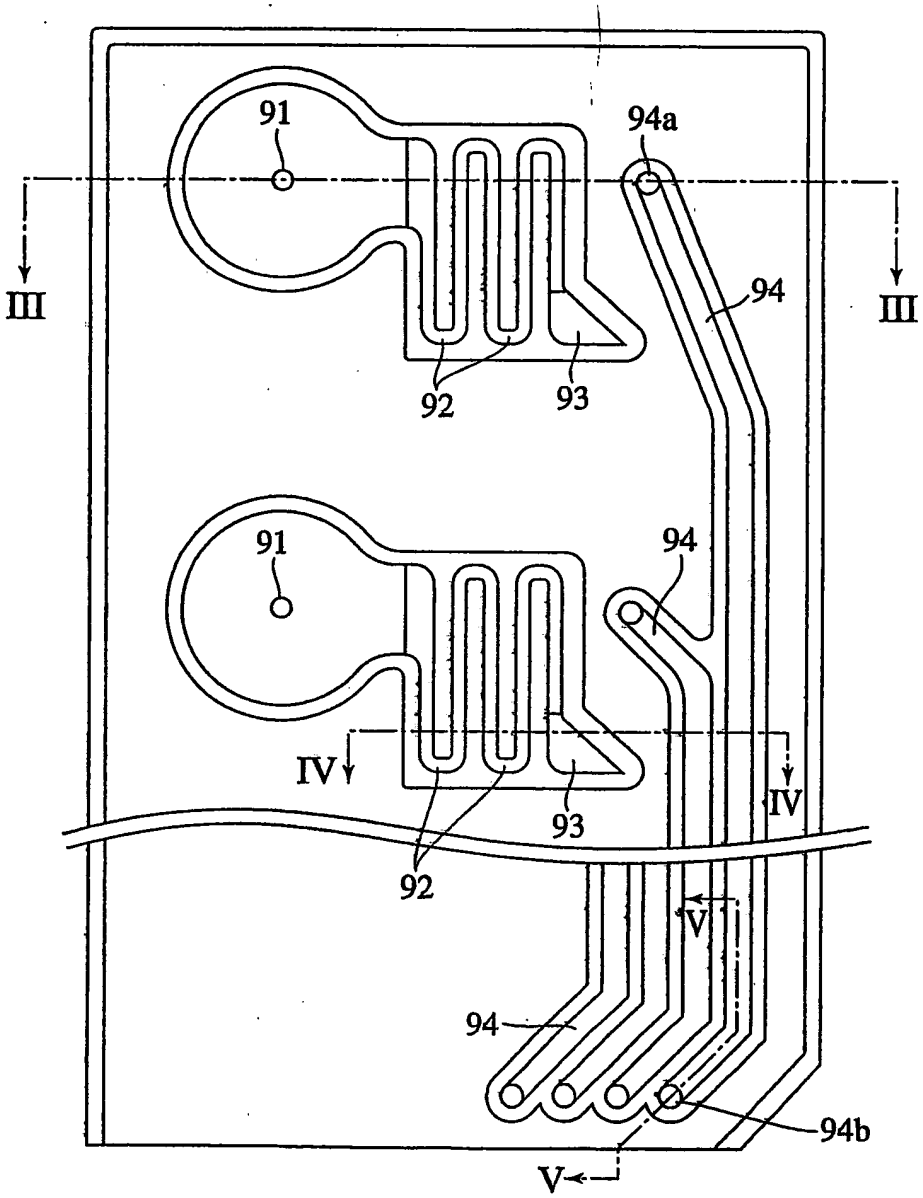

91
94a
III
III
94
92
93
91
94
IV
IV
93
92
V
94
94b
V

FIG. 5B

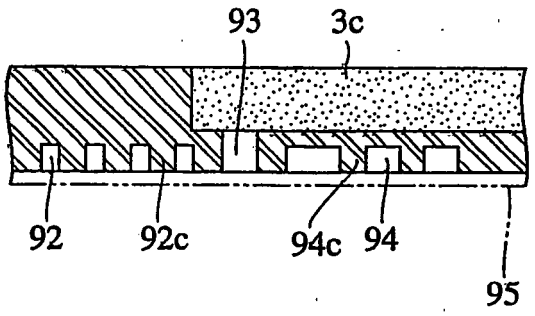


FIG. 6A

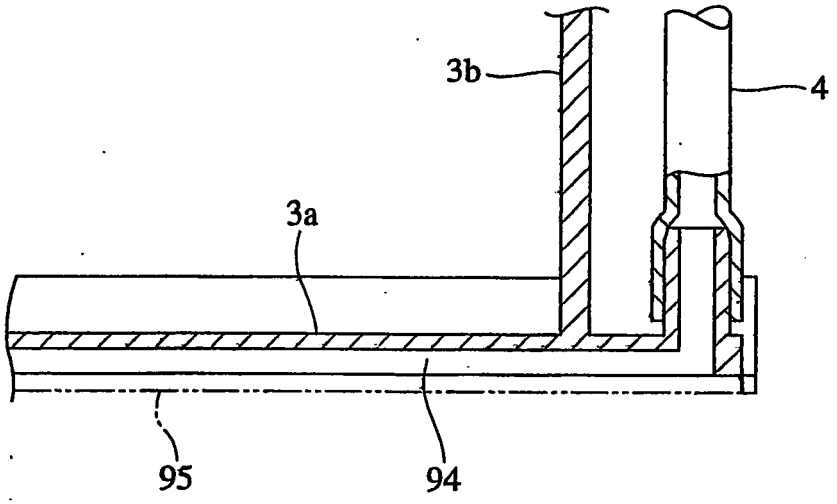


FIG. 6B

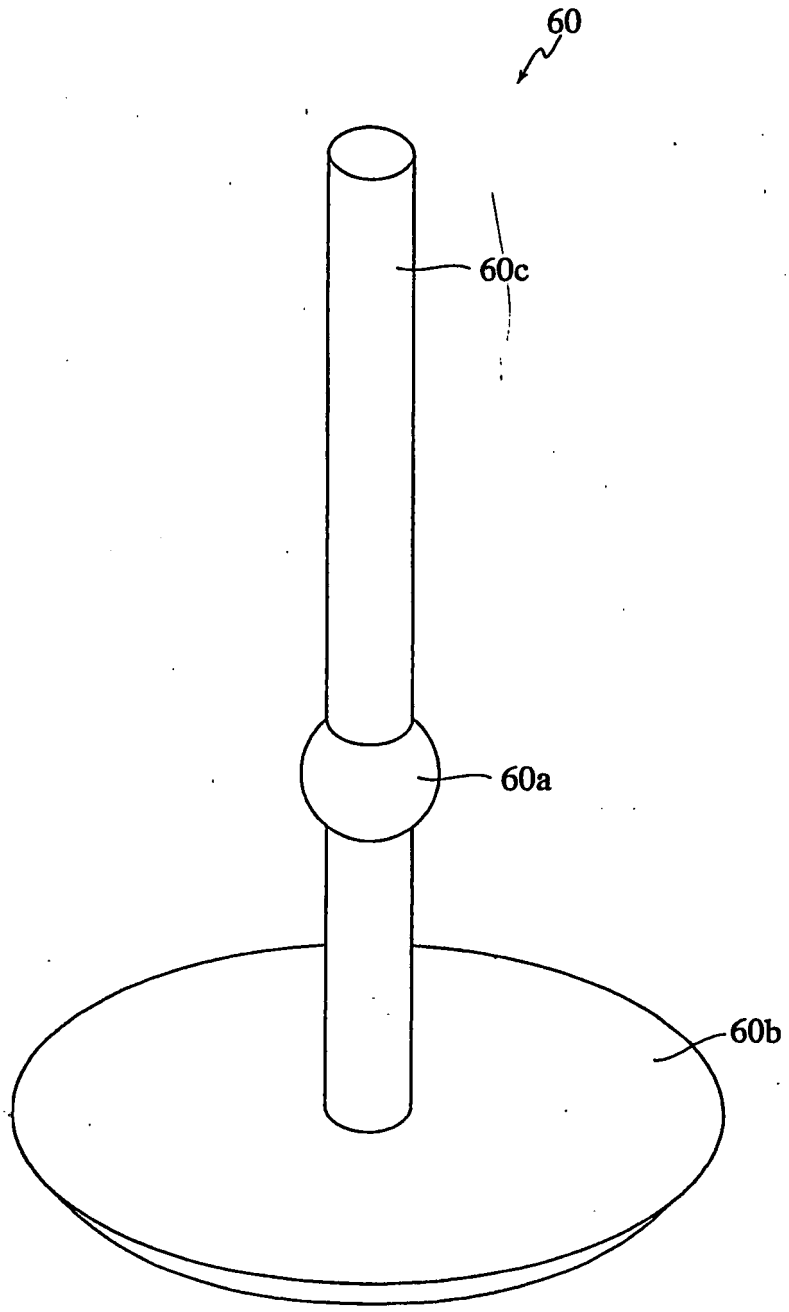


FIG. 7

FIG. 8A

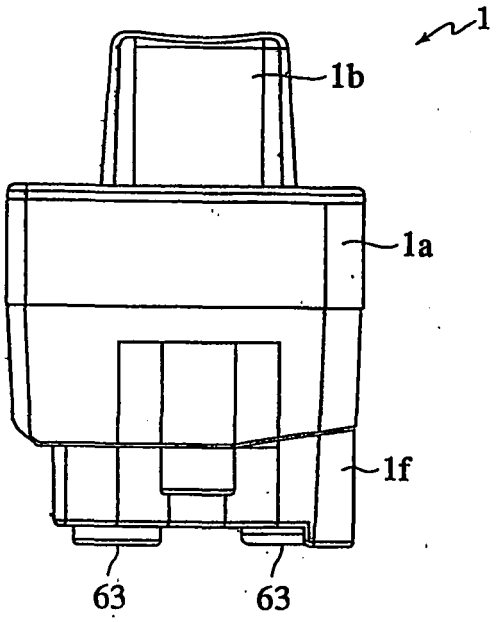


FIG. 8B

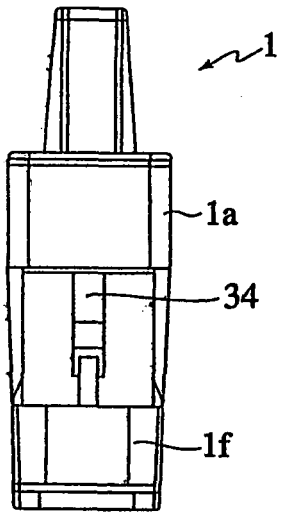
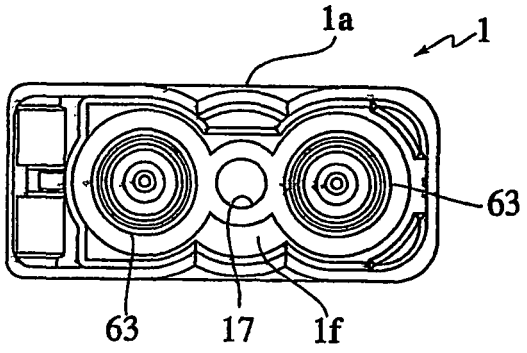


FIG. 8C



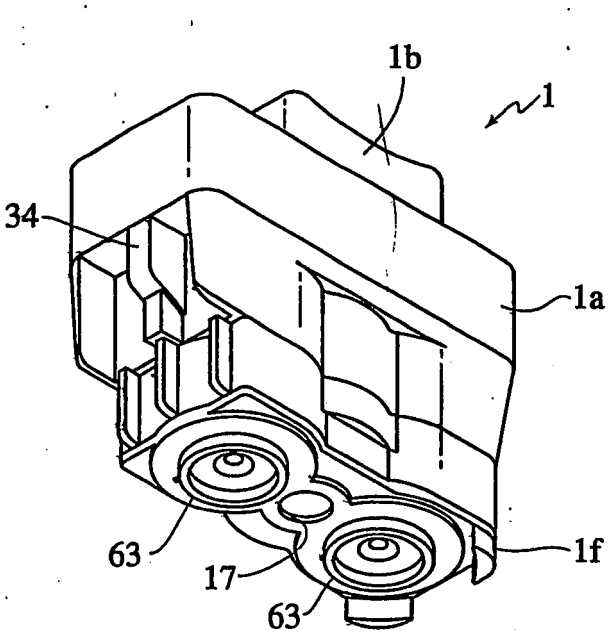


FIG. 9

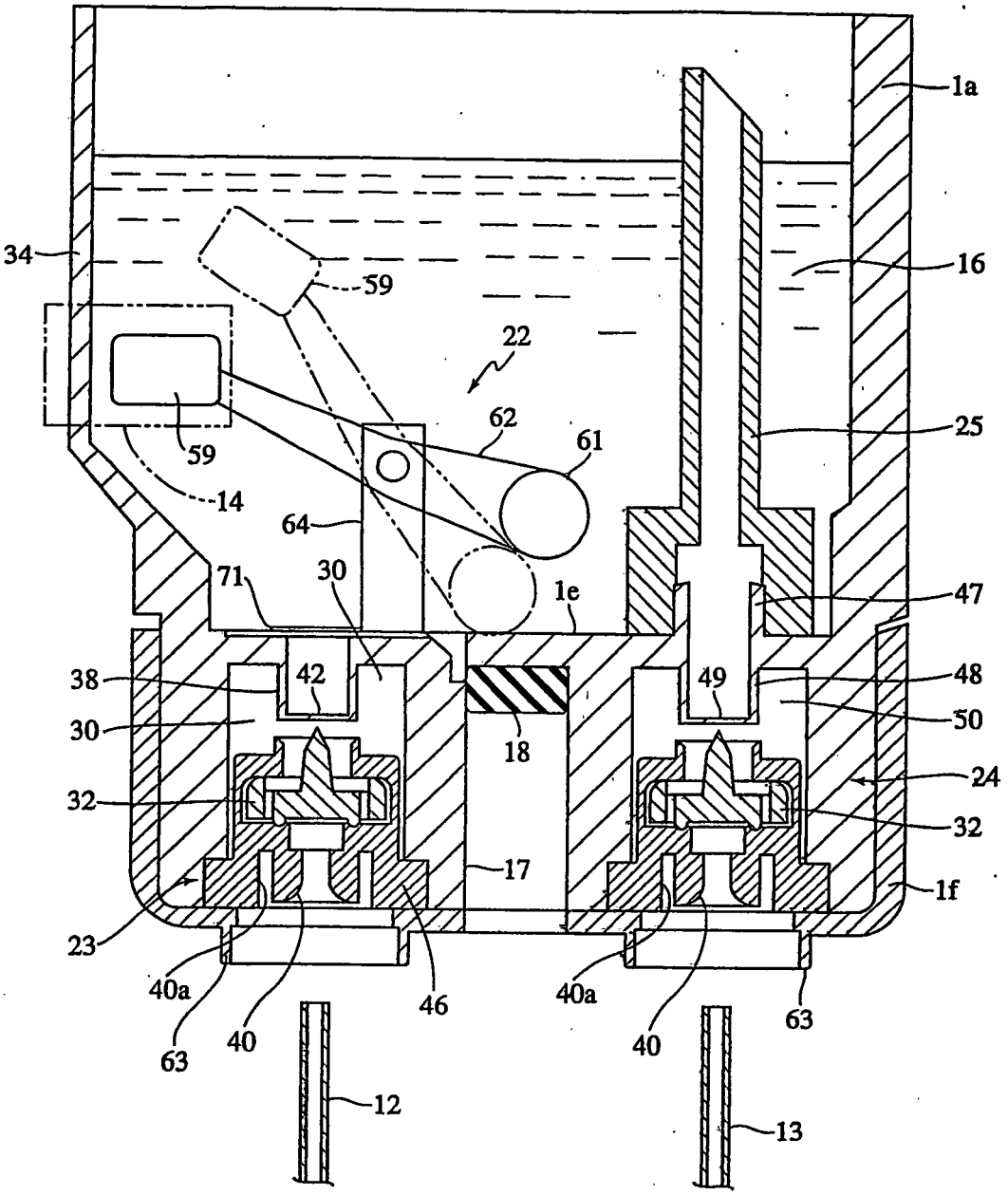

1a
34
59
16
22
62
61
25
59
14
64
71
30
1e
47
38
42
49
48
30
18
50
24
32
32
17
1f
23
40a
46
40a
63
40
40
63
12
13

FIG. 10

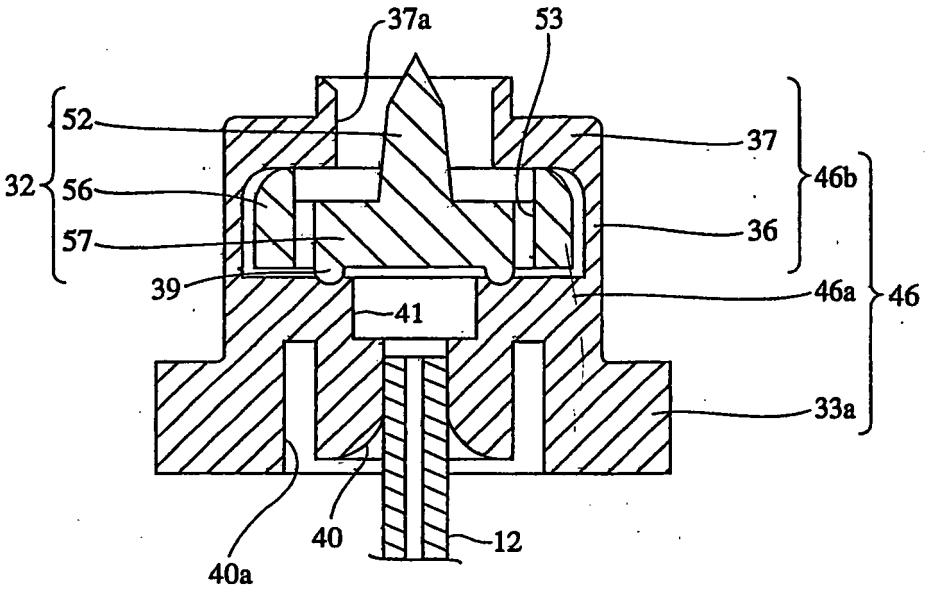


FIG. 11A

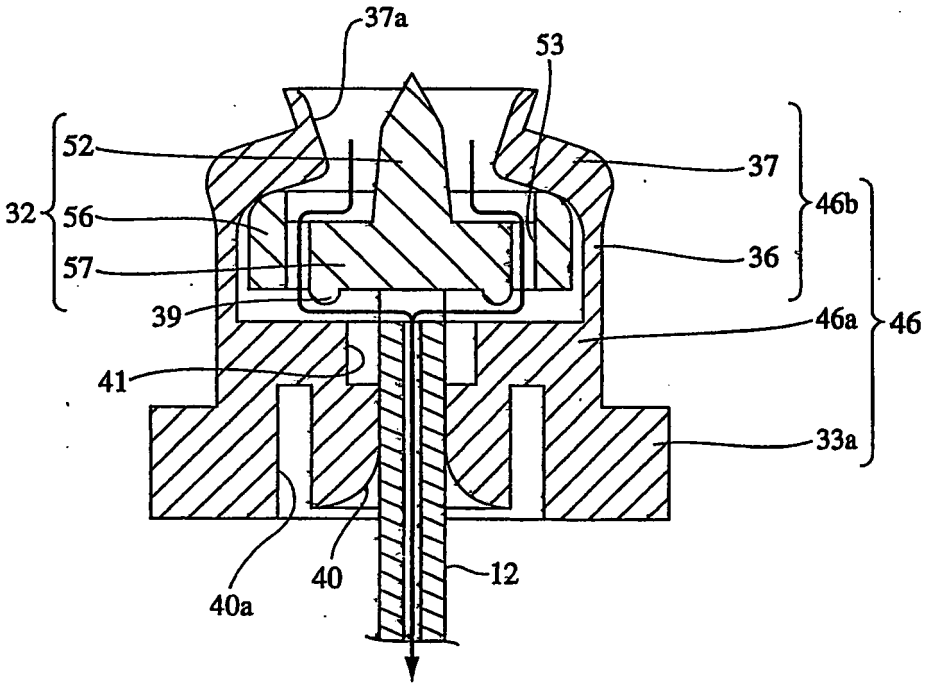


FIG. 11B

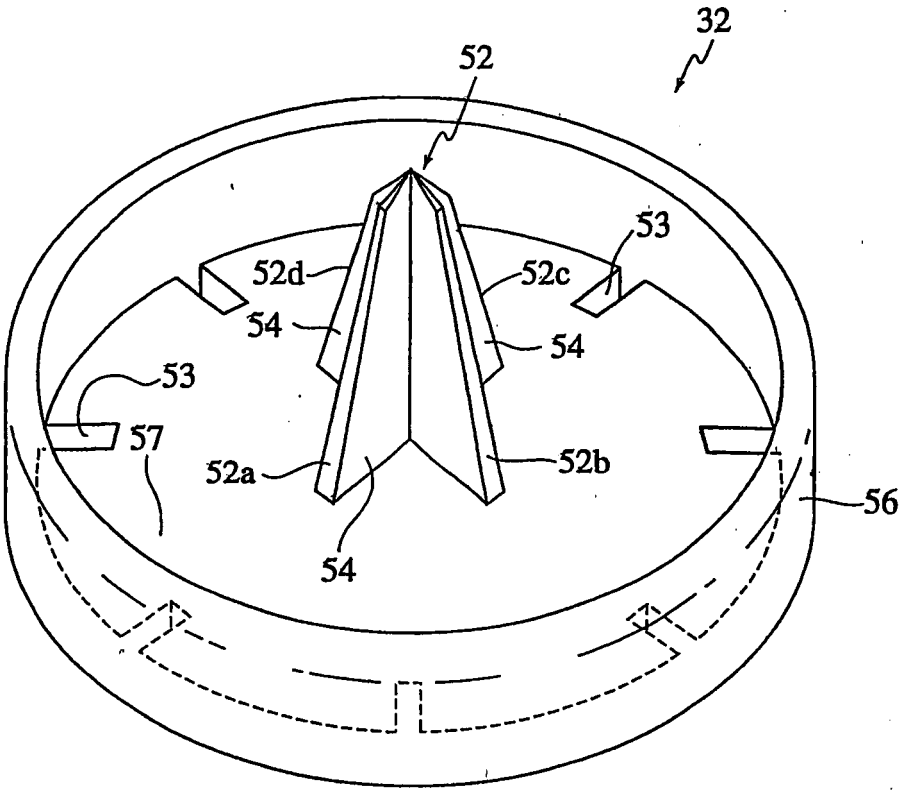


FIG. 12

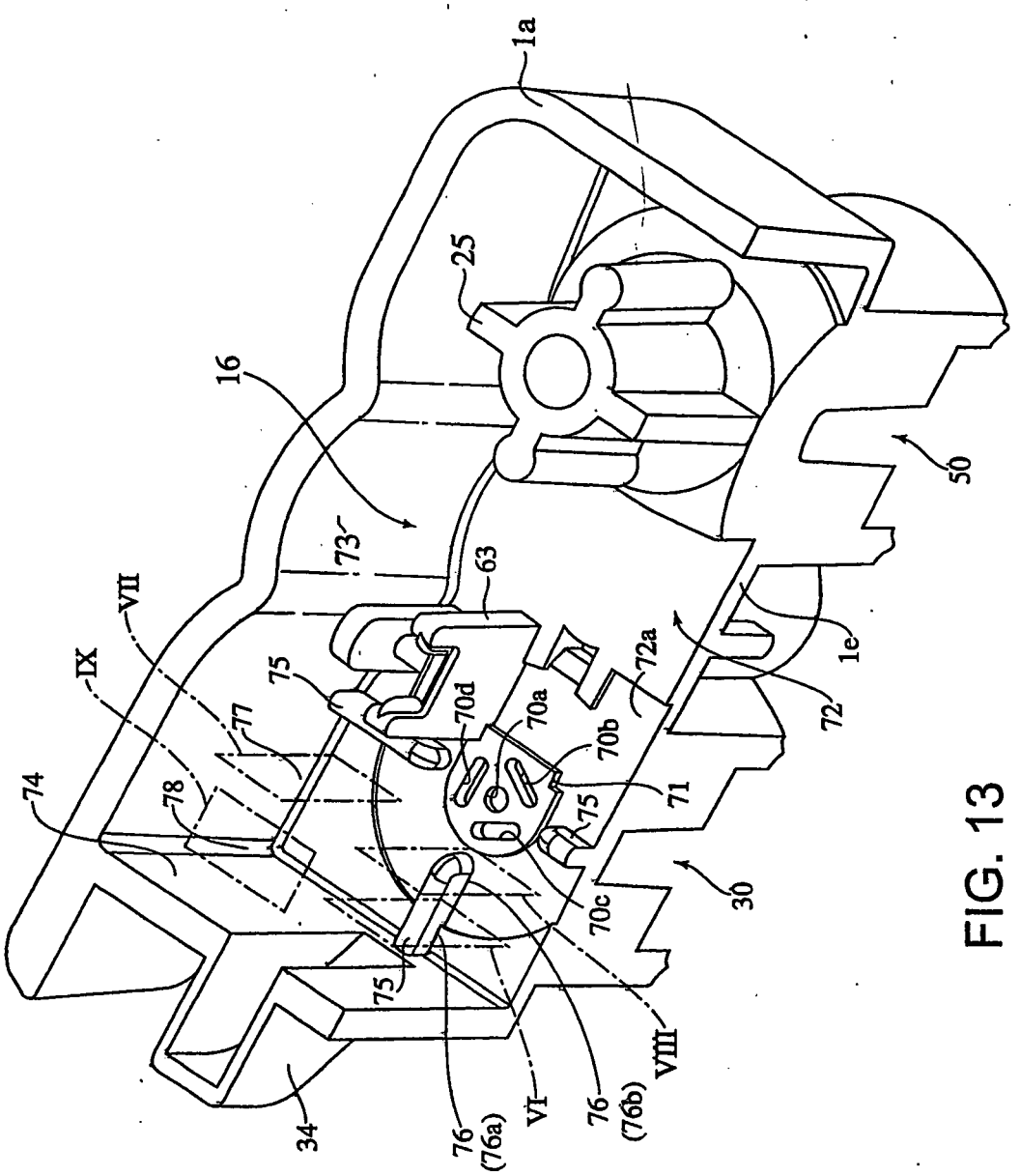

1a
25
16
73
63
VII
IX
75
77
74
78
70d
70a
70b
72a
72
1e
50
71
75
30
70c
75
VIII
VI
34
76
(76a)
76
(76b)

FIG. 13

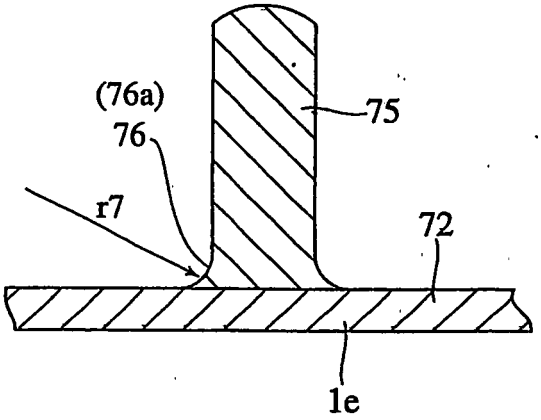


FIG. 14

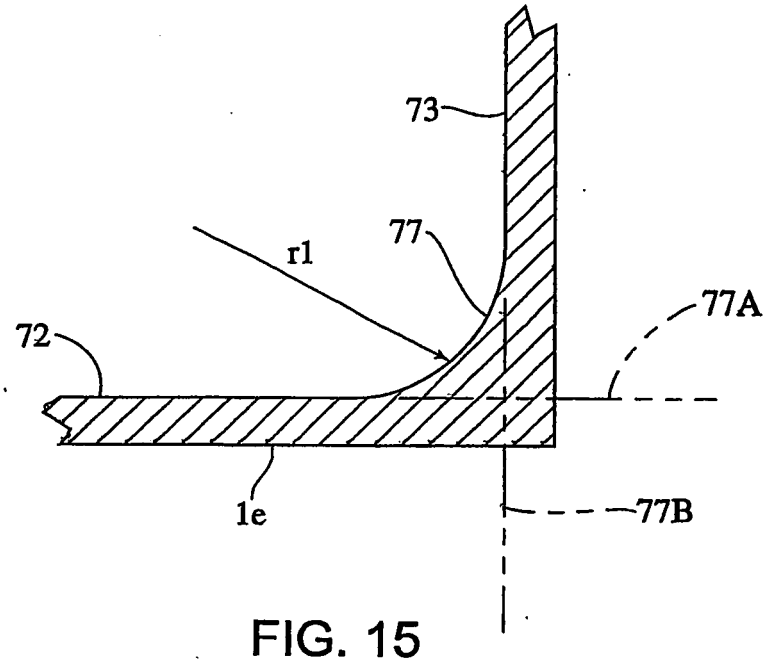


FIG. 15

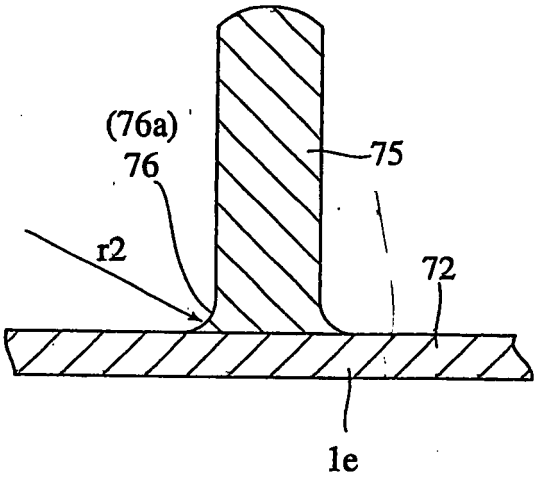


FIG. 16

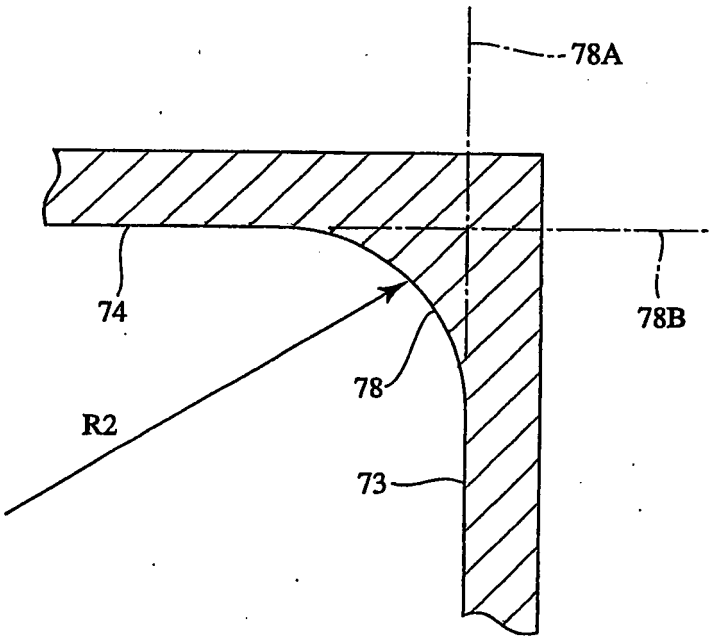


FIG. 17

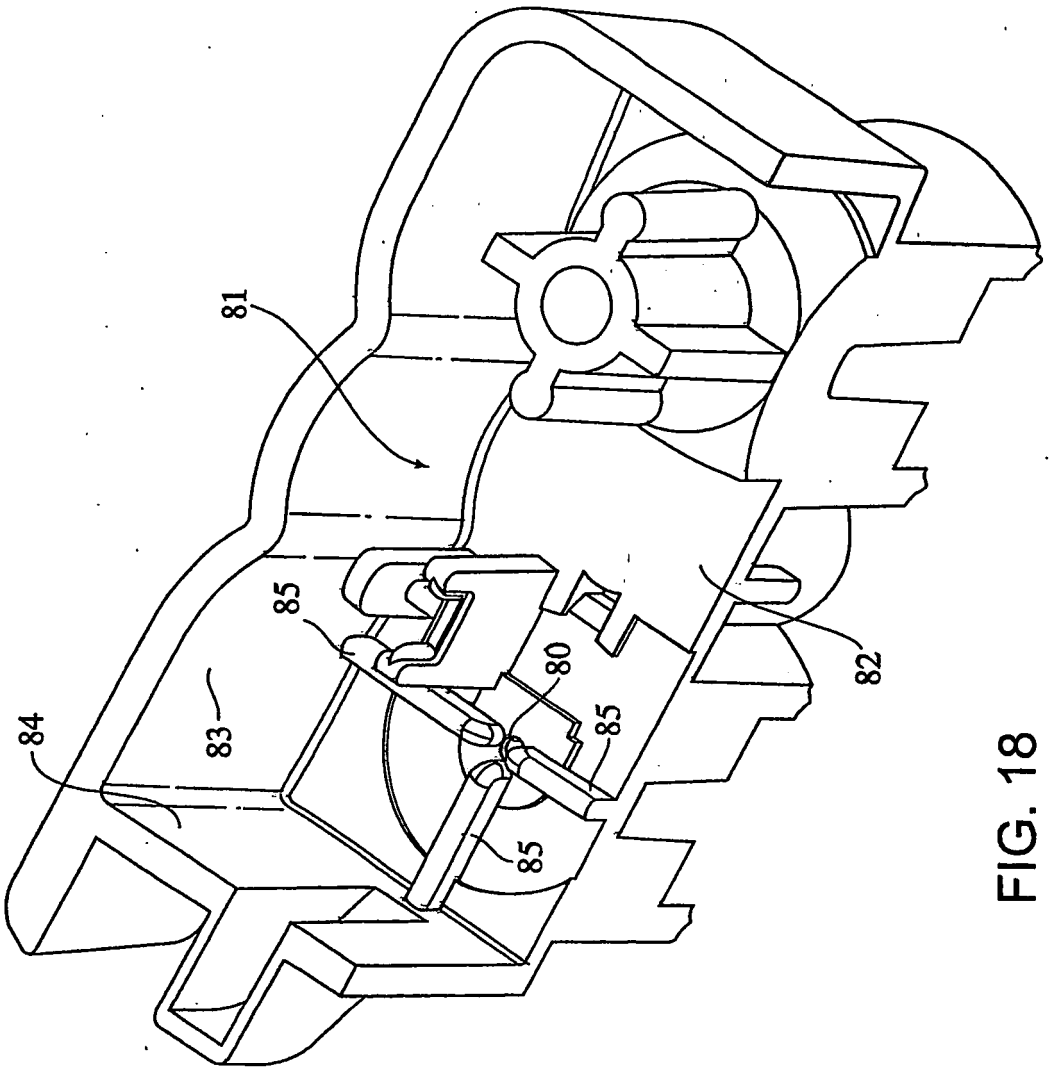


FIG. 18

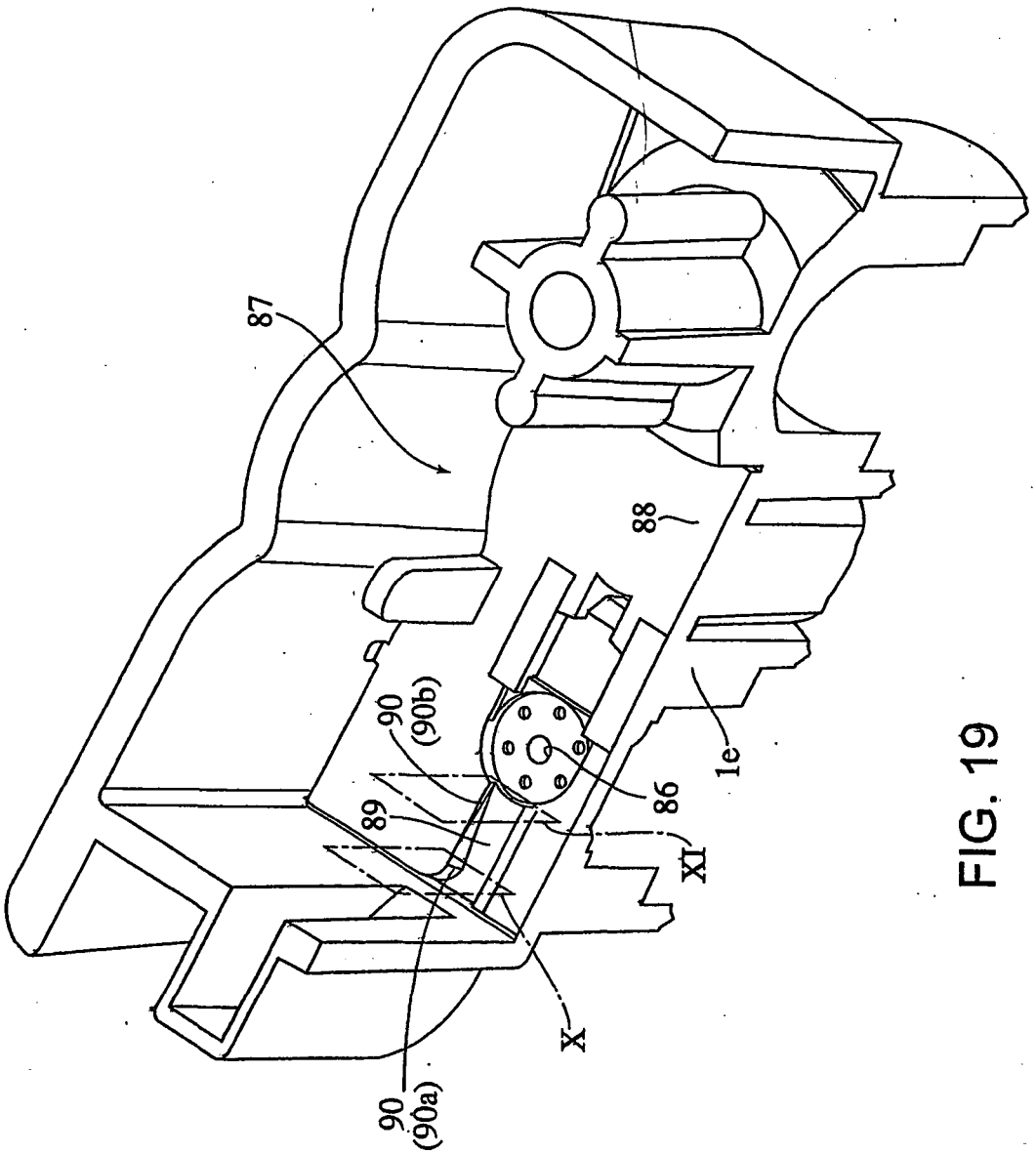


FIG. 19

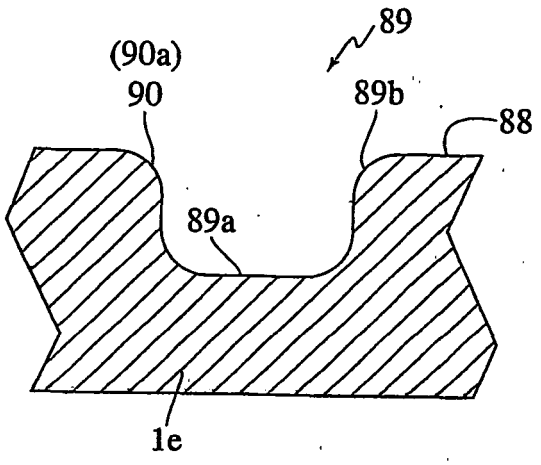


FIG. 20A

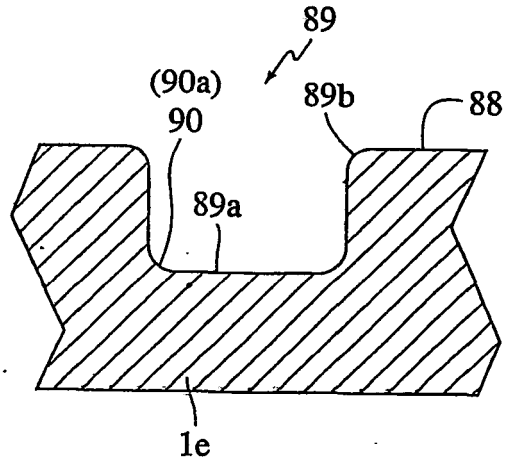


FIG. 20B

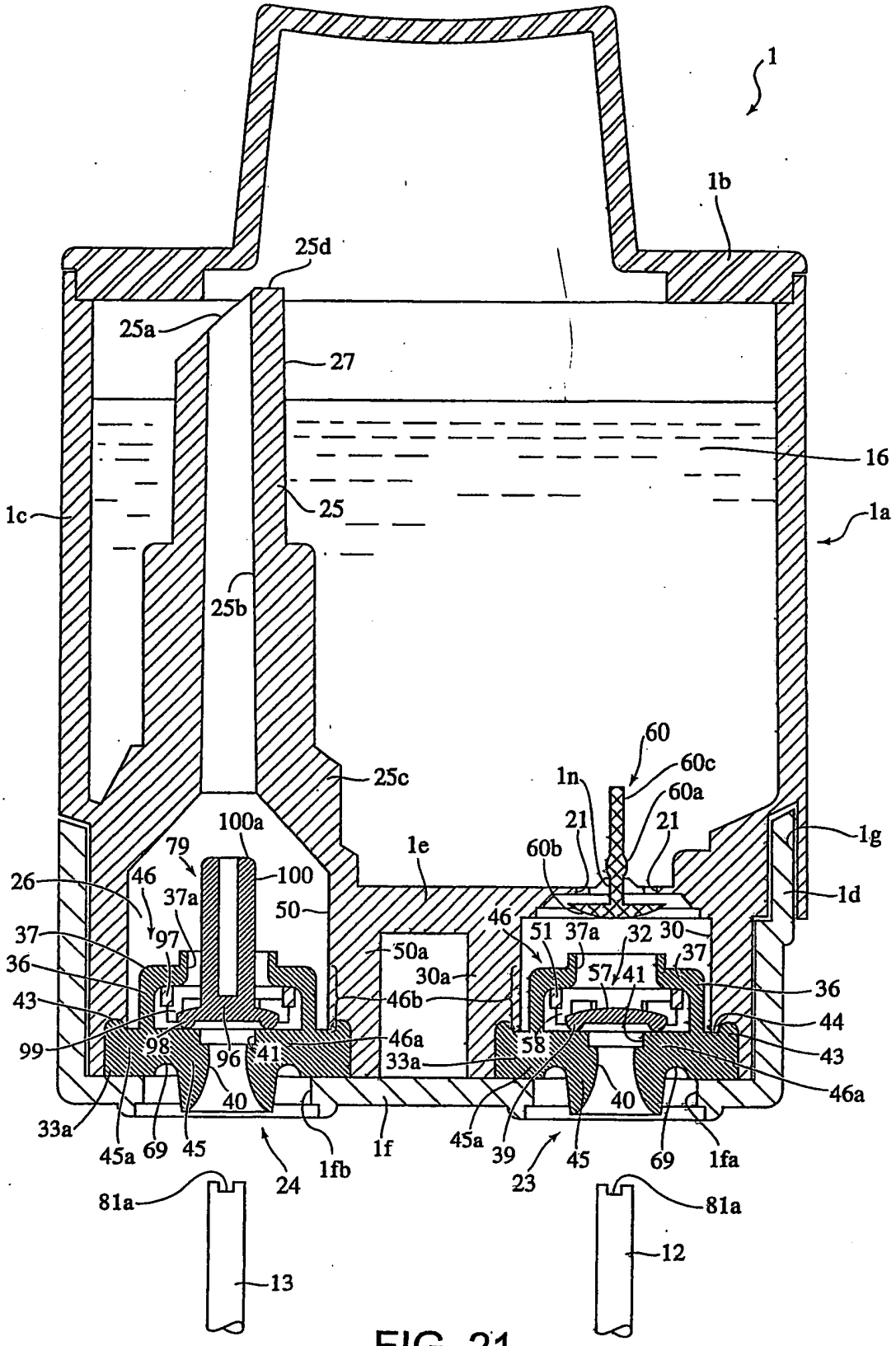

1
1b
25d
25a
27
16
1c
25
1a
25b
60
60c
1n
60a
25c
21
21
1g
100a
79
1e
60b
26
46
100
37a
1d
50
46
51
37a
32
30
37
97
50a
37
30a
57
41
36
36
46b
43
44
46a
58
99
98
96
41
33a
43
46a
40
40
33a
45a
69
45
24
1fb
1f
45a
39
23
45
69
1fa
81a
81a
13
12

FIG. 21

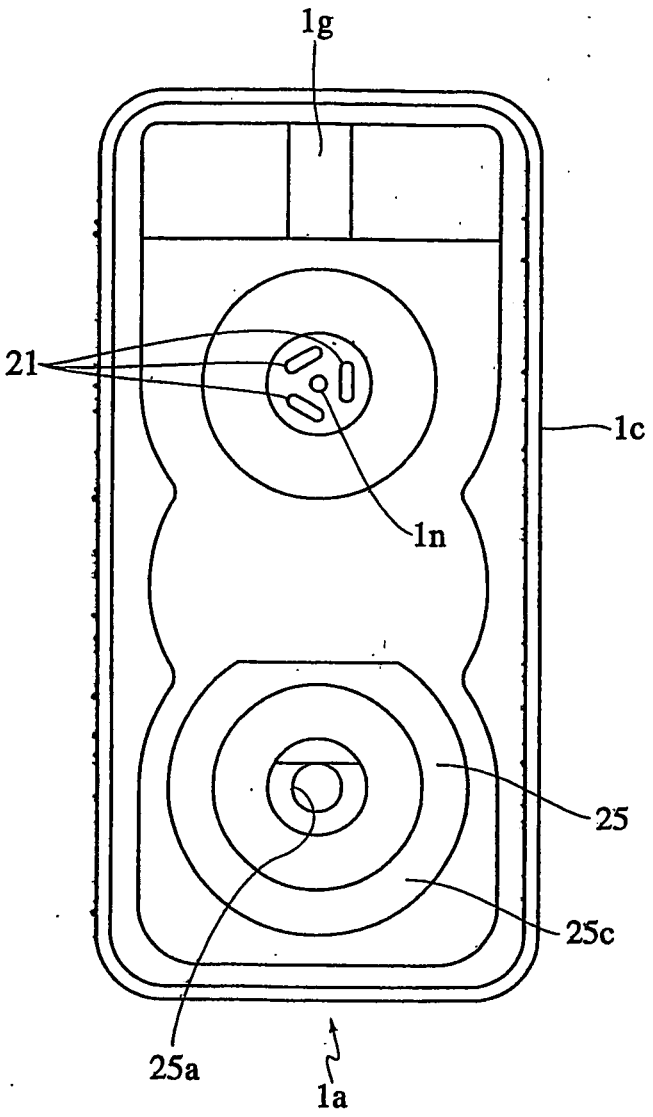
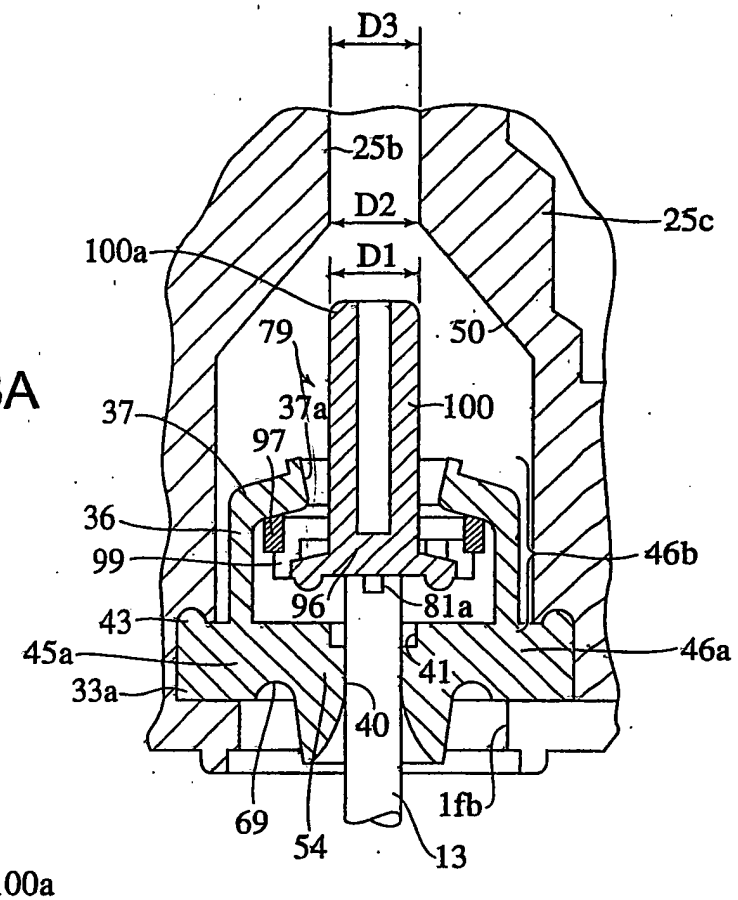


FIG. 22

FIG. 23A



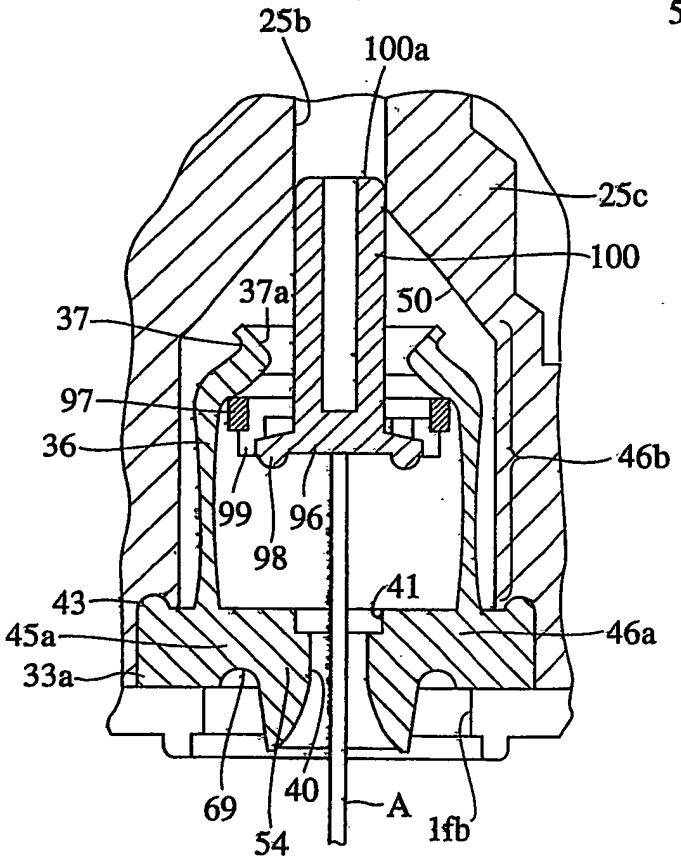
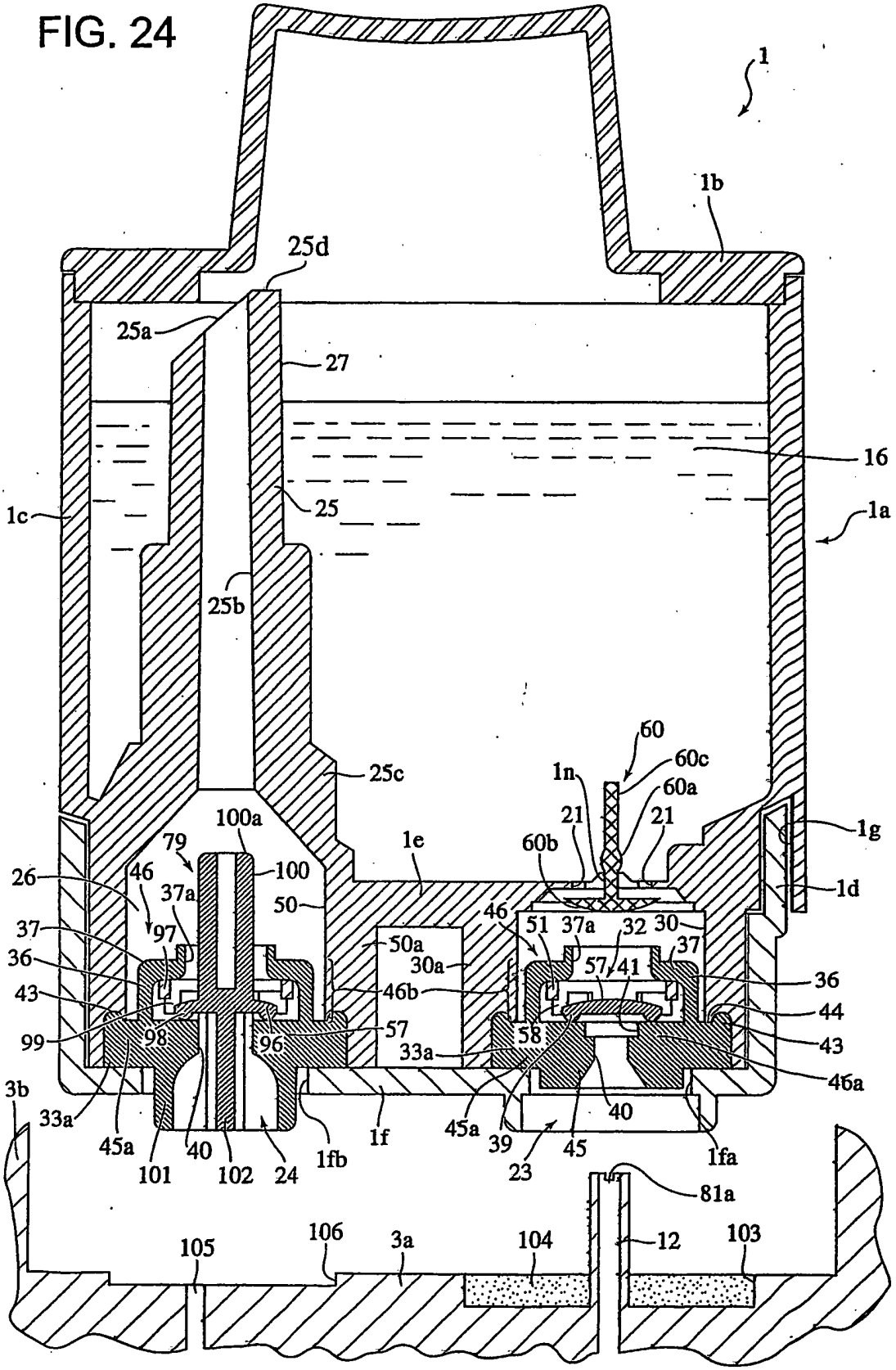


FIG. 23B

FIG. 24


1
1b
25d
25a
27
16
1c
25
1a
25b
60
60c
1n
60a
25c
21
21
1g
100a
79
1e
60b
26
46
100
37a
1d
50
46
51
37a
32
30
37
97
50a
57
41
37
36
30a
36
43
46b
44
99
98
96
57
58
33a
43
46a
3b
33a
40
45a
45a
39
45
40
1fa
101
102
24
1fb
1f
23
81a
105
106
3a
104
12
103

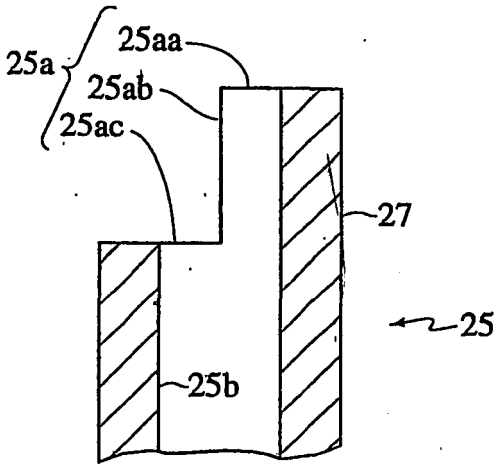


FIG. 25A

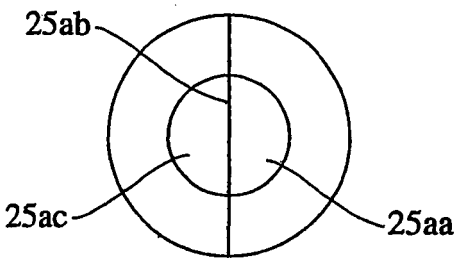


FIG. 25B

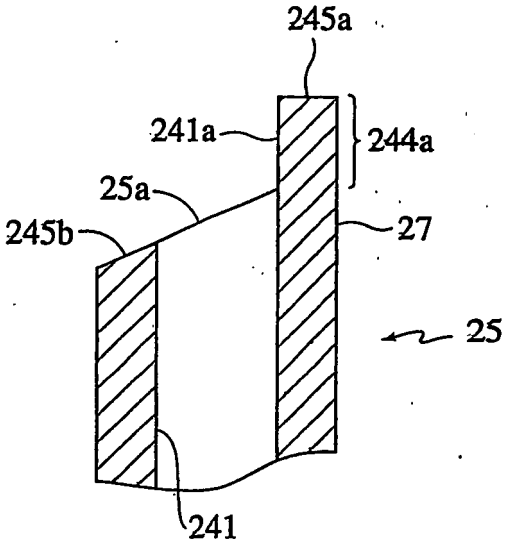


FIG. 26A

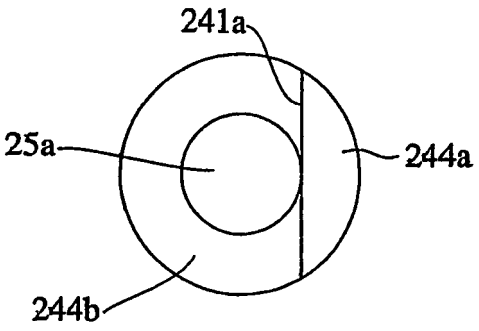


FIG. 26B

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- JP H985963 B **[0002] [0004] [0174]**
- JP 2000071471 A **[0190]**
- JP H0985963 B **[0205]**
- JP H0664182 B **[0230]**
- JP 6064182 A **[0244]**