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

(11) EP 1 839 873 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
03.10.2007 Bulletin 2007/40

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

(21) Application number: **06019207.7**

(22) Date of filing: **13.09.2006**

(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 LV MC NL PL PT RO SE SI SK TR

(30) Priority: **28.03.2006 JP 2006088204**

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

(72) Inventors:
- **Sasaki, Toyonori**
  Mizuho-ku,
  Nagoya-shi
  Aichi 467-8562 (JP)
- **Hattori, Shingo**
  Mizuho-ku,
  Nagoya-shi
  Aichi 467-8562 (JP)
- **Yokoe, Yoshinori**
  Mizuho-ku,
  Nagoya-shi
  Aichi 467-8562 (JP)
- **Momozaki, Motohiro**
  Mizuho-ku,
  Nagoya-shi
  Aichi 467-8562 (JP)

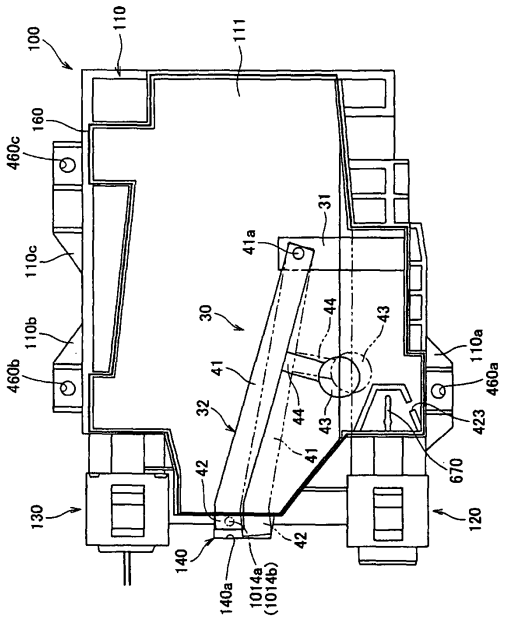
(74) Representative: **Hofer, Dorothea et al**
Prüfer & Partner GbR
Patentanwälte
Sohnckestrasse 12
81479 München (DE)

(54) Ink cartridge

(57) While stringently avoiding any increase in size of the ink cartridge and reducing the amount of ink that can be stored within the ink reservoir chamber, it is possible to detect that the ink within an ink reservoir chamber (111) has been reduced.

There is a light blocking part (42) formed near the edge of the left side of the arm part (41), which is supported such that it can oscillate by a support dais (31) in the fulcrum (41a) near the edge of the right side. The arm part (41) has a branched arm part (44), which is branched and extends downwards in the part between the light blocking part (41) and the fulcrum (41a), and there is a float part (43) at the edge of this. When there is sufficient ink remaining within the ink reservoir chamber (111), the light blocking part (42) will block the light emitted from an light emitting part (1014a) of an optical sensor (1014). When the ink within the ink reservoir chamber (111) is reduced, the light blocking part (42) will move downwards, and it will no longer block the light emitted by the light emitting part (1014a), so that a light receiving part (1014b) will receive this light.

FIG.3



EP 1 839 873 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to an ink cartridge that supplies ink to an ink-jet printer.

PRIOR ART

[0002] In ink cartridges that supply ink to a printer, there are those which are configured such that it is possible to detect when the amount of ink remaining in the ink cartridge has become low. For instance, in the ink cartridge as described in JP 2005-125 738 A, there is a shutter mechanism comprises a lever whose central part in the direction that the lever extends is supported such that it can rotate about the support dais provided at the bottom of the ink tank (ink reservoir). The shutter mechanism comprises a shutter (light-blocking part) at one end of the lever and a float at the other end of the lever. When there is a large amount of ink in the ink tank, the lever rotates due to an upwards movement of the float due to buoyancy, and the shutter is positioned near the bottom of the concave part of the ink tank and blocks the light that is emitted from the light emitting part of the optical sensor. As the amount of ink in the ink tank decreases, the float falls and the lever rotates, resulting in the shutter being positioned near the top part of the concave part, and stopping blockage of light emitted from the light emitting part. At this time, the light receiving part of the optical sensor receives this light, and it detects that the ink in the ink tank has run out.

[0003] However, in the ink cartridge disclosed in JP 2005-125 738 A, because the relatively large shutter mechanism with the shutter and float placed on both ends of the level which is supported by the support dais is placed within the ink tank, it is necessary to increase the size of the ink cartridge in order to house this type of shutter mechanism.

[0004] The object of the present invention is to provide an ink cartridge which can detect when there is little ink remaining while also preventing any increase in size of the ink cartridge as much as possible.

This object is solved by an ink cartridge according to claim 1.

[0005] According to the ink cartridge, because the float part is positioned at the end of the branched arm part which branches from the part of the arm part which is between the light blocking part and the pivot part, it is possible to shorten the arm part as there is no need to extend the arm part to the opposite side of the pivot part from the light blocking part. Therefore, it is possible to minimize the size of the rotating member, and it is possible to place the rotating member within the ink reservoir without needing to increase the size of the ink cartridge. Further, because the float part is positioned below the light blocking part when the ink cartridge is installed in the printer, it is possible to efficiently detect that the ink within the ink reservoir has run out. Also, because the float part is positioned at the end of the branched arm part, it is possible to easily position the float part below the light blocking part when the ink cartridge is installed in the printer.

[0006] Also, according to the ink cartridge claimed in claim 2, because it is possible to generate a sufficiently large buoyancy on the entirety of the rotating member when there is sufficient ink remaining, it is possible to reduce any possibility of mistakenly detecting that the amount of remaining ink becomes little due to oscillation of the rotating member such as when external oscillation is applied to the ink cartridge.

[0007] Also, according to the ink cartridge claimed in claim 3, because the float part is positioned below the pivot part, it is possible to detect that the ink within the ink reservoir has run out when the ink level within the ink reservoir reaches a much lower position.

[0008] Also, according to the ink cartridge claimed in claim 4, the ink outlet and the protrusion part are positioned on the same side of the case close to each other, it is possible to minimize the size of the printer because it is possible to put all of the required optical sensors and ink supply pipes in the printer on the same surface close to each other. Also, because the surface that bounds the inner space can be used as the rotation control means, there is no need to have a separate rotation control means, making it possible to simplify the ink cartridge construction.

[0009] According to the ink cartridge claimed in claim 5, when the ink cartridge is installed in the printer, because the light emitting part and light receiving part of the optical sensor sandwich the protrusion part, it is possible to easily detect when the ink within the ink reservoir has run out based on whether or not the light emitted by the light emitting part is received by the light receiving part.

(BRIEF DESCRIPTION OF THE DRAWINGS)

[0010]

Figure 1 is a perspective view of the ink cartridge according to the embodiment of the present invention.
Figure 2 is an exploded perspective view of Figure 1.
Figure 3 is a side view of the ink reservoir unit in Figure 2.
Figure 4 is a partial exploded diagram of Figure 3.
Figure 5 (a) is a diagram showing a schematic of the oscillating component of Figure 3, and (b) is a diagram showing a schematic of a conventional oscillating component.
Figure 6 is a diagram showing the method to install the ink cartridge in Figure 1 into a printer.

(BEST EMBODIMENTS OF THE INVENTION)

[0011] Below, the optimal embodiment of the present invention will be describe while referring to the drawings. Figure 1 is a perspective view showing the outside of an ink cartridge 1 according to the embodiment of the present invention. Figure 2 is an exploded perspective view of Figure 1. Side wall 160, which will be described later, is translucent(transparent), and it is possible to view the inside of the ink reservoir 100, which will be described later. However the inside of the ink reservoir 100 is omitted in Figure 2.

[0012] As shown in Figures 1 and 2, the ink cartridge 1 comprises an ink reservoir 100 to store the light-permeable ink, an outer case 200 that covers the entirety of the ink reservoir 100, and a protector 300 attached to the outer case 200 to protect the ink reservoir 100 when the ink cartridge 1 is transported. In the present embodiment, the ink reservoir 100, outer case 200, and protector 300 are formed from a resin material such as nylon, polyethylene, or polypropylene.

[0013] The outer case 200 is constructed of two case components 210 and 220 which sandwich the ink reservoir 100 from the top and bottom (top and bottom of Figure 2). The first case component 210 is a component that covers the lower side of ink reservoir 100 in Figure 2, and the second case component 220 is a component that covers the upper side of the ink reservoir 100 in Figure 2. The first and second case components 210 and 220 are made of a resin material, and are manufactured through injection molding.

[0014] In the first case component 210, there are two case cut-out parts 211 and 212 in order to expose the ink supply part 120 and the air intake part 130 to the outside of the outer case 200. The case cut-out parts 211 and 212 are formed in semi-circular shapes. The case cut-out part 211 at the right front side of Figure 2 is a cut-out corresponding to the ink supply part 120, and the case cut-out part 212 at the left back side of Figure 2 is a cut-out corresponding to the air intake part 130. Also, between the case cut-out part 211 and the case cut-out part 212, there is a case cut-out part 213 formed in a rectangular shape, and this is a cut-out for receiving an optical sensor 1014 (see Figure 6) so that the optical sensor 1014 sandwiches a protrusion part 140. Also, on the inner side surface that is connected with the case cut-out part 211 of the first case component 210, there is a contact groove 211a that is in contact with ink supply part 120, and on the inner side surface that is connected with the case cut-out part 212 of the first case component 210, there is a contact groove 212a that is in contact with the air intake part 130. By using these contact grooves 211a and 212a, it is easy to align the ink reservoir 100 with respect to the first case component 210.

[0015] Also, in the first case component 210, there are two case protrusion parts 214a and 214b that protrude toward the protector 300 (the left front direction in Figure 2) from the surface where the case cut-out parts 211-213 are formed. The case protrusion parts 214a and 214b are formed on both sides (the right front side edge of Figure 2 and the left front side edge of Figure 2) of the first case component 210 such that the case cut-out parts 211-213 are positioned between them, and the one positioned on the ink supply part 120 side (right front side of Figure 2) is the case protrusion part 214a, and the one positioned on the air intake part 130 side (left front side of Figure 2) is the case protrusion part 214b. Also, the case protrusion part 214a has a sloped surface 214a2 from a part connected to a side wall of the first case component 210 to an end of the case protrusion part 214a. When the ink cartridge 1 is installed into a printer 1000 (see Figure 6), the installation is made with the case protrusion part 214a on the lower side. Therefore, when the ink cartridge 1 is installed, if the sloped surface 214a2 is in contact with the lower part of the printer 1000, the ink cartridge 1 is smoothly induced into a certain mount position due to the slope.

[0016] Further, in the case protrusion part 214b, there is a case protrusion cut-out part 214b1 that is cut in a rectangular shape and which is formed on the inner side surface on the case cut-out part 211-213 side. In addition, in the case protrusion part 214b, there is a case mating groove 214b2 that can mate with the mating rod 1016b1 (see Figure 6) when the ink cartridge 1 is installed into the printer 1000.

[0017] Also, in the first case component 210, there is a rod component 215a which protrudes toward the second case component 220 (upper side of Figure 2) near the side wall of the first case component 120 on the ink supply part 120 side (right front side of Figure 2) to align the ink reservoir 100 which is to be enclosed within the outer case 200 , and there are rod components 215b and 215c which protrude toward the second case component 220 (upper side of Figure 2) near the side wall of the first case component 120 on the air intake part 130 side (left back side of Figure 2) to align the ink reservoir 100 which is to be enclosed within the outer case 200. Due to the fact that alignment of the ink reservoir 100 can be performed by the three locations of these rod components 215a-215c, it is possible to prevent the ink reservoir 100 from being attached in a wrong orientation.

[0018] Within the second case component 220, as in the case component 210, not only are there three case cut-out parts 221-223, there is a contact groove 221a that is connected to the case cut-out part 221 and a contact groove 222a that is connected to the case cut-out part 222. Also, on both sides of the case cut-out parts 221-223, there are case protrusion parts 224a and 224b, the this case protrusion part 224a has a sloped surface 224a2 from a part connected to the side surface of the second case component 220 to an end of the case protrusion part 224a. Further, in the case protrusion part 224b, there is a case protrusion cut-out part 224b1 with the same construction as the case protrusion cut-out part 214b1, and a case mating groove 224b2 that extends over the side surface of the second case component 220

from the end of the case protrusion part 224b. Also, within the second case component 220, there are holes (not shown) for mating with the rod components 215a-215c, which open towards the first case component 210 side (lower side of Figure 2) corresponding to the positions in which the rod components 215a-215c of the first case component 210 are formed.

[0019] Next, the outer shape of the external case 200 will be described. The first and second case components 210 and 220 have both side surfaces shaped in a concave shape in the direction that intersects the longitudinal direction A (the direction connecting the right back side of Figure 2 and the left front side of Figure 2, as indicated by A in Figure 2), and there is a step formed with respect to the surface of the first and second case components 210 and 220. In this stepped part, the first and second case components 210 and 220 are attached, and the ink reservoir 110 is fixed with respect to the external case 200. The stepped part on the ink supply part 120 side (right front side of Figure 2) is a first case attachment part 216 and 226, and the stepped part on the air intake part 130 side (left back side of Figure 2) is a second case attachment part 217 and 227.

[0020] In the following, the longitudinal direction A of the first and second case component 210 and 220 is called the longitudinal direction of the ink cartridge 1, the longitudinal direction of the ink reservoir 100 and the longitudinal direction of the external case 200.

[0021] The first and second case attachment parts 226 and 227 of the second case component 220 will be described. The first case attachment part 226 is not only connected to the same planar surface as the case protrusion part 224a, there is also a concave part 226a which is formed in a concave shape in the inner direction of the second case component 220 on the opposite side to the case protrusion part 224a, and a mating part 226b that mates a mating component 1017 (see Figure 6) when the ink cartridge 1 is installed into the printer 1000 (see Figure 6). The concave part 226a is a region for the range of movement of an engaging member 1017 when the engaging member 1017 (see Figure 6) moves. The case attachment part 227 has a locking part 227a which is formed in a concave shape at a central position in the longitudinal direction of the second case component 220, and this locking part 227a is a part to lock the ink cartridge 1 when it is installed in the printer 1000 (see Figure 6).

[0022] While a detailed explanation is omitted, within the first case component 210, there is a concave part, a mating part and a locking part 217a formed in the same shape as the concave part 226a, the mating part 226b and the locking part 227a of the second case component 220, though this is not shown in the figure.

[0023] Next, while referring to Figures 3-5, the ink reservoir 100 will be described. Figure 3 is a side view of the ink reservoir 100 in Figure 2. Figure 4 is a cross-sectional diagram of the left edge area of the ink reservoir 100 shown in Figure 3 at the central part in the direction perpendicular to the plane of Figure 3. Figure 5 is a diagram showing a schematic of the rotating member, where (a) is a rotating member 32 of the present embodiment, and (b) is a rotating member 50 of a conventional structure where there is a blocking part 52 and a float part 53 located at the both ends of an arm part 51. The arm part 51 is supported at its middle part such that it can rotate about the fulcrum 51a at the middle part. The blocking part 52 and the float part 53 are located on the opposite sides of the fulcrum 51 a . The state of the ink reservoir 100 shown in Figure 3 is the state when the ink cartridge 1 is installed in the printer 1000 (see Figure 6). In other words, the ink supply part 120, the air intake part 130 and the protrusion part 140 are positioned on the side surface, where the ink supply part 120 is positioned on the lower side, and the air intake part 130 is positioned on the top side. Also, in Figure 3, while showing the outer boundaries of a side wall 160 using a bold line, the positions of a light emitting part 1014a and light receiving part 1014b when the ink cartridge 1 is installed in the printer 1000 are shown using the dashed line. Also, in Figure 4, illustration of the rotating member 32 is omitted.

[0024] As shown in Figures 3 and 4, the ink reservoir 100 is formed with an ink reservoir chamber 111 and an ink supply path 116, etc, within a rectangularly shaped case 110. Also, on the lower surface of the case 110, there is a single attachment part 110a which extends downwards, and on the upper surface of the case 110, there are two attachment parts 110b and 110c which extend upwards, where the attachment parts 110a-110c have through-holes 460a-460c which mate with rod components 512a-512c of the first cast component 210, respectively. Further, by mating the through-holes 460a-460c with the rod components 512a-512c respectively, it is possible to align the ink reservoir 100 into the external case 200.

[0025] The ink reservoir chamber 111 is provided in almost the entire space inside the case 110 except the ink supply path 116, an air intake path 117 and the protrusion part 140, which will all be described later. Within the ink reservoir chamber 111, the ink is stored. The ink has light-permeability properties and is supplied to the printer 1000 from the ink supply path 116.

[0026] The protrusion part 140 protrudes leftwards in the central part in the vertical direction of the side wall (one side wall) 161 on the left side of the ink reservoir chamber 111. Inside the protrusion part 140, there is an inner space 140a that is communicated with the ink reservoir chamber 111. The protrusion part 140 is formed to be positioned between the light emitting part 1014a and the light receiving part 1014b that form the optical sensor 1014, which will be discussed later, when the ink cartridge 1 is installed into the printer 1000. The light emitting part 1014a and the light receiving part 1014b are placed respectively on the front side and back side of Figure 3. The protrusion part 140 has light-permeable properties (translucent or transparent), and when the light emitted from the light emitting part 1014a is not blocked by the light blocking part 42, it will reach the light

receiving part 1014b.

[0027] Inside the ink reservoir chamber 111, as shown in Figure 3, there is a shutter mechanism 30. The shutter mechanism 30 is constructed of a support dais 31 and a rotating member 32. The rotating member 32 is molded of a resin material with a smaller specific gravity than that of the ink within the ink reservoir chamber 111, and the mass per unit volume is smaller than that of the ink within the ink reservoir chamber 111. The support dais 31 extends perpendicularly from the bottom surface of the ink reservoir chamber 111, and as will be described below, this supports the rotating member 32 such that it can rotate. The rotating member 32 has an arm part 41, a light blocking part 42, a float part 43, and a branched arm part 44. The arm part 41 is rotatably supported at a fulcrum 41a (pivot part) in a support part provided in the support dais 31. The fulcrum 41a is formed at the right end of the arm part 41. The arm part 41 extends from the fulcrum 41a towards the left upper side of Figure 3 to the protrusion part 140. The light blocking part 42 is provided at (connected to) left end of the arm part 41 and is positioned within the inner space 140a of the protrusion part 140. Further, the light blocking part 42 will, as will be described later, block the light that is emitted from the light emitting part 1014a of the optical sensor 1014 and permeates the protrusion part 140 when positioned within the inner space 140a (in other words, the light blocking part 42 has light blocking properties). Further, the branched arm part 44 branches and protrudes from the part of the arm part 41 between the fulcrum 41a and the light blocking part 42, and it protrudes towards the bottom side of the ink reservoir chamber 111. The float part 43 is placed on the end of the branched arm part 44, and the volume of the float part 43 is sufficiently large in comparison to the other parts of the rotating member 32. The float part 43 has a cavity inside in which air is packed, and the mass per unit volume including the air inside is smaller than the other parts of the rotating member 32.

[0028] In the state in which there is sufficient ink remaining within the ink reservoir chamber 111 (the state in which the entirety of the rotating member 32 is positioned within the ink solution), because the buoyancy generated on the entirety of the rotating member 32 is greater than the gravity, a clockwise moment about the fulcrum 4 1 a in Figure 3 acts on the rotating member 32, and the arm part 41 rotates in a clockwise direction about the fulcrum 41a along with the light blocking part 42. However, at this time, the top edge of the light blocking part 42 is in contact with the upper surface (rotation control means) of the protrusion part 140 which bounds the top of the inner space 140a and the arm part 41 is prevented from rotating in the clockwise direction. In other words, when the ink within the ink reservoir chamber 111 is greater than a specific amount (when the ink level within the ink reservoir chamber 111 is higher than the position of the solid line in Figure 3), the light blocking part 42 is in contact with the upper surface of the protrusion part 140. At this time, the light emitted from the light emitting part 1014a is blocked by the light blocking part 42. In this way, because the rotation of the arm part 41 is prevented due to the upper surface of the protrusion part 140, when there is more than a certain amount of ink remaining within the ink reservoir chamber 111, the light blocking part 42 accurately blocks the light emitted from the light emitting part 1014a.

[0029] Then, as the amount of ink within the ink reservoir chamber 111 decreases, the light blocking part 42 and the arm part 41 are gradually exposed from the ink surface, and the buoyancy generated on the rotating member 32 decreases. However, the volume of the float 43 within the ink is sufficiently large in comparison to the volume of the exposed part, and in addition, the float part 43 has a smaller mass per unit volume in comparison to the exposed part (the buoyancy per unit volume is larger than that of the exposed part), and therefore, the buoyancy generated on the entirety of the rotating member 32 is still greater than gravity, so the position of the rotating member 32 does not change. Then, as the amount of ink further decreases, one part of the float part 43 will be exposed from the ink surface, and the buoyancy generated on the rotating member 32 becomes equal to gravity. (In the present embodiment, the volume of these components is established such that, when the arm part 41, light blocking part 42 and the branched arm part 44 are completely exposed from the ink surface, and when a part of the float part 43 is also exposed, the buoyancy and gravity generated on the rotating member 32 becomes equal.) After this, the float part 43 moves downwards in step with the drop of the ink level as the ink decreases. As a result, the rotating member 32 rotates in an anticlockwise direction. As a result, the light blocking part 42 moves downwards in Figure 3, and when the arm part 41 has rotated by a certain amount in an anticlockwise direction, the light blocking part 42 is no longer able to block light emitted from the light emitting part 1014a, and this light reaches the light receiving part 1014b. As a result, the optical sensor 1014 (see Figure 6) detects that the amount of ink remaining within the ink reservoir chamber 111 has fallen. Then, by a display means that is not shown in the figure, a warning is displayed to change the ink cartridge.

[0030] As the amount of ink within the ink reservoir chamber 111 falls further, the arm part 41 further rotates in the anticlockwise direction. However, as the arm part 41 rotates in an anticlockwise direction, the lower edge of the light blocking part 42 comes into contact with the lower surface of the protrusion part 140 that bounds bottom of the inner space 140a at a certain point (shown by the double-dotted line in Figure 2). As a result, any further rotation of the arm part 41 in the anticlockwise direction is prevented. In other words, the arm part 41 can rotate in the range between the position where the top edge of the light blocking part 42 is in contact with the upper surface of the protrusion part 140 and the position where the bottom edge of the light blocking part 42 is in contact with the lower surface of the protrusion part 140. Further,

when the arm part 41 rotates within this range, the fulcrum 41a is always positioned below the light blocking part 42, and the float part 43 is always positioned below the light blocking part 42 and the fulcrum 41a. As a result, when the ink level within the ink reservoir chamber 111 has really fallen, in other words, when the ink within the ink reservoir chamber 111 has really decreased, the light blocking part 42 stops blocking the light emitted from the light emitting part 1014a. However, the height of the float part 43 (the height of the ink level) when the light blocking part 42 stops blocking the light emitted from the light emitting part 1014a is higher than the top end of the ink outlet 116a of the ink supply path 116, which will be discussed later. As a result, before it becomes impossible for the ink to be supplied to the printer 1000 from the ink supply path 116, it is possible to accurately detect that the amount of ink remaining within the ink reservoir chamber 111 has fallen. Because the mass per unit volume of the rotating member 32 is smaller than that of the ink within the ink reservoir chamber 111, the rotating member 32 can rotate in step with the drop of the ink level.

[0031] Comparison of the rotating member 32 of the present embodiment and a conventional rotating member 50 will be described with reference to the schematic of the rotating members 32 and 50 in Figures 5(a) and (b). In order to make the movement distance of the light blocking parts 42 and 52 the same, if the distance between the fulcrum 41 a and the light blocking part 42 is made to be the same as the distance between the fulcrum 51a and the light blocking part 52, then instead of setting the float part 53 on the opposite side of the fulcrum 51 a from the light blocking part as shown in Figure 5(b), when setting the float part 43 to be positioned between the fulcrum 41a and the light blocking part 42 as shown in Figure 5(a), it is possible to shorten the arm part 41 to be smaller than the arm part 51 because it is not necessary to extend the arm part 41 to the opposite side of the fulcrum 41a from the light blocking part 42 as in the arm part 51. As a result, it is possible to minimize the size of the rotating member 32. Further, in the rotating member 32, as shown in Figure 5(a), because the float part 43 is positioned on the end of the branched arm part 44 which branches from the arm part 41, it is possible to detect that there is little ink remaining when the ink level within the ink reservoir chamber 111 is at a lower position than the conventional case shown in Figure 5(b).

[0032] Returning to Figure 4, there is the ink supply path 116 formed below the protrusion part 140 on the side wall 161, and above the protrusion part 140 of the side wall 161, there is the air intake path 117. In the state shown in Figure 4 (installation state), the ink supply path 116 and the air intake path 117 extend in the horizontal direction, inside the ink supply path 116, there is a valve mechanism 500 which can open or close an ink outlet 116a of the ink supply path 116, and inside the air intake path 117, there is an air intake mechanism 510 that can open or close an air intake inlet 117a of the air intake path 117. Further, the ink supply part 120 is constructed of the ink supply path 116 and the valve mechanism 500, and the air intake part 130 is constructed of the air intake path 117 and the air intake mechanism 510.

[0033] The ink supply path 116 is, as shown in Figure 4, constructed of a valve storage part 800 and the ink supply chamber 801. The valve storage part 800 stores a part of the valve mechanism 500. The valve storage part 800 communicates with the ink supply chamber 801 via a connection hole 421. The ink supply chamber 801 communicates with the ink reservoir chamber 111 via a connection hole 423. The path from the ink supply chamber 801 to the ink outlet 116a via the connection hole 421 and the valve storage part 800 extends in the horizontal direction overall. In the ink supply path 116, the ink within the ink reservoir chamber 111 flows into the ink supply chamber 801 via the connection hole 423, and further, it flows into the valve storage part 800 via the connection hole 421.

[0034] The valve mechanism 500 will be described in more detail. As shown in Figure 4, the valve mechanism 500 comprises a supply cap 600, a supply joint 610, a supply valve 620, a first supply spring 630, a supply slider 640, a second supply spring 650, a valve seat 660, a check valve 670, and a cover 680.

[0035] The supply cap 600 is attached near the ink outlet 116a of the ink supply path 116. The supply joint 610 is constructed of a resin material having elasticity such as rubber. A through-hole 610a which extends in the horizontal direction is formed in the central part of the supply joint 610, into which an ink extraction pipe 1015 (see Figure 6) of the printer 1000 (see Figure 6) can be inserted. The supply joint 610 covers the surrounding area of the ink outlet 116a of the ink supply path 116. When the ink cartridge 1 is not installed in the printer 1000, the supply valve 620 is pressed towards the left-hand side of the figure by the first supply spring 630, and the left side wall of the supply valve 620 is in contact with the right side edge part of the supply joint 610, and as a result, the through-hole 610a is closed. On the other hand, when the ink cartridge 1 is installed into the printer 1000, the supply joint 610 moves to the right side of the figure because it is pressed by the ink extraction pipe 1015, which will be discussed later, and because a spacing is built up between the supply joint 610 and the supply valve 620, the ink supply path 116 (valve storage part 800) and the ink extraction pipe 1015 communicate, making it possible to supply ink to the printer 1000. In this way, it is possible to perform opening and closing of the ink outlet 116a of the ink supply path 116.

[0036] The first supply spring 630 and the second supply spring 650 sandwiche the supply slider 640. The supply slider 640 can operate in the movement direction (right/left direction of Figure 4) of the supply valve 620, which is pressed by the ink extraction pipe 1015, and it also covers the right side of the supply valve 620. The second supply spring 650 is formed in the same shape using the same material as the first supply spring 630 and is stored within the supply slider 640. The second

supply spring 650 presses the supply slider 640 to the left side. The valve seat 660 is in contact with the second supply spring 650, and also supports the check valve 670. The check valve 670 is placed near the connection hole 421, and it prevents back-flow of the ink in the connection hole 421. The cover 680 and the valve seat 660 cover the check valve 670.

[0037] The air intake path 117 extends in the horizontal direction, and it has an air intake mechanism storage part 810 which stores a part of the air intake mechanism 510 and a connection hole 434 which communicates the air intake mechanism storage part 810 and the ink reservoir chamber 111.

[0038] The air intake mechanism 510 will be described in detail. The air intake mechanism 510 is, as shown in Figure 4, composed of an air cap 700, an air joint 710, an air valve 720, a first air spring 730, an air slider 740, and a second air spring 750.

[0039] The air cap 700 is attached to the air intake inlet 117a of the air intake path 117. The air joint 710 is constructed of a resin material having elasticity such as rubber. A through-hole 710a which extends in the horizontal direction is formed in the central part of the air joint 710. The air joint 710 covers the surrounding area of the air intake inlet 117a. When the ink cartridge 1 is not installed within the printer 1000, the supply valve 720 is pressed to the left-hand direction of the figure by the first supply spring 730. The left side wall of the supply valve 720 is in contact with the right edge part of the supply joint 710, and as a result, the through-hole 710a is closed. On the other hand, when the ink cartridge 1 is installed into the printer 1000, a protrusion part 720a which protrudes to the outer side of the ink intake inlet 117a from the left edge of the air valve 720 moves to the right side of the figure because it is pressed by contact with a attachment surface 1013 (see Figure 6), which will be discussed later, and because a spacing is created between the air joint 710 and the air valve 720, the air intake path 117 and an air intake part 1013b, which will be discussed later, communicates, enabling intake of air. In this way, it is possible to perform opening and closing of the air intake inlet 117a of the air intake path 117.

[0040] The first air spring 730 and the second air spring 750 sandwiches the air slider 740. The air slider 740 covers the right side of the air valve 720. The air slider 740 can also operate in the movement direction (right/left direction of Figure 4) of the air valve 720 which is pressed by contact with the wall surface of the attachment surface 1013. The second air spring 750 is formed in the same shape of the same material as the first air spring 730. The second air spring 750 is stored within the air slider 740, and it presses the air slider 740 to the left side.

[0041] Next, while referring to Figure 6, the way the ink cartridge is installed into the printer 1000 will be described.

[0042] Before describing how to install the ink cartridge 1 into the printer 1000, the installation parts for the ink cartridge 1 in the printer 1000 will be first described.

[0043] As shown in Figure 6(a), the installation part 1010 of the printer 1000 has a locking rod 1011 that protrudes in the right-side direction in Figure 6 from the attachment part 1010. The locking rod 1011 locks the locking parts 217a and 227a of the external case 200. The installation part 1010 also has a support part 1012 which supports the first case attachment parts 216 and 226 of the external case 200 from below and is formed in a concave shape corresponding to the shape of the first attachment parts 216 and 226. There is a convex part 1011a on the locking rod 1011 which protrudes toward the support part 1012 and which is formed in the same shape as the locking parts 217a and 227a.

[0044] On an installation surface 1013 of the installation part 1010, there is the optical sensor 1014. The optical sensor 1014 is formed in a U-shape. One end of the U-shaped optical sensor 1014 is the light emitting part 1014a which emits light, and the other end of the U-shaped optical sensor 1014 is the light receiving part 1014b which receives the light. The light emitting part 1014a and light receiving part 1014b protrude from the installation surface 1013 such that they can be inserted into the through-holes formed by the case cut-out parts 213 and 223 and the protrusion part 140. When the light emitted from the light emitting part 1014a is received by the light receiving part 1014b, the optical sensor outputs a signal to the control substrate (not shown) in the printer 1000, and when the light emitted from the light emitting part 1014a is blocked, and the light receiving part 1014b does not receive this light, no signal is output to the control substrate. Then, when this signal is not output to the control substrate, it is possible to print, and when this signal is output to the control substrate, a warning to change the ink cartridge may be made by a display means that is not shown on the figure.

[0045] Also, the ink extraction pipe 1015 protrudes from the installation surface 1013 on the side corresponding to the ink supply part 120 (lower side in Figure 6(a)). The installation surface 1013 on the side (upper side of Figure 6(a)) corresponding to the air intake part 130 (lower side of Figure 6(a)) is formed as a planar surface. An ink path 1013a is connected to the ink extraction pipe 1015, and the ink is supplied to the printer 1000 via the ink path 1013a. Also, there is an air intake path 1013b formed on the installation surface 1013 on the air intake part 130 side, and air is taken into the ink reservoir chamber 111 via the air intake path 1013b.

[0046] Also, the case protrusion parts 214a and 224a as well as the case protrusion parts 214b and 224b of the external case 200 are gently inserted into both side of the installation surface 1013 (both ends of the installation surface 1013 between the locking rod 1011 and support part 1012 in Figure 6(a)), and concave parts 1016a and 1016b are formed corresponding to the outer shape of the case protrusion parts 214a and 224a and case protrusion parts 214b and 224b. Further, there is the mating rod 1016b1 formed on the concave part 1016b which mates with the mating groove which is formed by

the case mating grooves 214b2 and 224b2 of the external case 200. When the ink cartridge 1 is installed, the mating rod 1016b1 is inserted into the mating groove formed by the case protrusion part mating grooves 214b2 and 224b2. In other words, not only is the shape of the case protrusion part formed by the case protrusion parts 214a and 224a of the external case 200 different from that of the case protrusion part formed by the case protrusion parts 214b and 224b, because the shapes of the concave parts 1016a and 1016b of the printer 1000 are also different, when the ink cartridge 1 is installed upside-down, the mating rod 1016b1 becomes an obstacle and the ink cartridge 1 cannot be installed. Therefore, because mistaken installation of the ink cartridge 1 is prevented, it is possible to prevent any damage to the ink supply part 120 or to the air intake part 130, as well as to prevent any damage to the optical sensor 1014 or to the ink extraction pipe 1015.

[0047] Further, within the installation part 1010, on the edge side of the support part 1012 (the left side of Figure 6(a), the edge of the ink cartridge 1 side), there is an engaging member 1017 that can rotate and engage with the locking part 226b and also can fit inside the concave part 226a of the external case 200. The engaging member 1017 engages a engaging edge 1017a which engages with the locking parts 216b and 226b of the external case 200, an axis part 1017b which is connected to the engaging edge 1017a and which acts as the axis of the rotation of the engaging member 1017 and, and a covering part 1017c which is connected to the axis part 1017b and which covers the side surface of the external case opposite from the side surface facing the installation surface 1013. There is a convex part 1017d formed which protrudes in the circumferential direction from the axis part 1017b. The engaging member 1017 can be put in an upright posture through engagement of this convex part 1017d with a concave part 1018 which is formed on the attachment part 1010 of the printer 1000.

[0048] As shown in Figure 6(a), when the ink cartridge 1 (in the state in which the protector 300 has been removed) is installed into the printer 1000, the ink cartridge 1 is be installed such that the ink supply part 120 is on the lower side and the air intake part 130 is on the upper side. This is because, if the ink supply part 120 is not positioned on the lower side, it will not be possible to effectively use the ink within the ink cartridge 1 (ink reservoir chamber 111).

[0049] Also, when the ink cartridge 1 is installed into the printer 1000, the ink supply part 120, the protrusion part 140 and the air intake part 130 is positioned in this order from the bottom to the top and further, the ink supply part 120, the protrusion part 140 and the air intake part 130 are formed on the same surface. Therefore, because the ink supply part 120, the protrusion part 140 and the air intake part 130 are constructed to be positioned closer to each other on the same surface, it is possible to position the optical sensor 1014, the ink extraction pipe 1015 (ink path 1013a) and the air intake path 1013b close to each other on the same surface of the printer 1000. Therefore, it is possible to reduce the size of the printer 1000.

[0050] Installation of the ink cartridge 1 is performed by inserting the case protrusion parts 214a and 224a (first case attachment parts 216 and 226) of the external case 200 such that they are in contact with the support part 1012, and pushing the ink cartridge 1 such that the first case attachment parts 216 and 226 slides across the top of the support part 1012. In other words, as shown in Figure 6(a), the ink cartridge 1 slides in the direction of an arrow E. As described above, because the sloped surfaces 214a2 and 224a2 are formed on the case protrusions 214a and 224a, it is possible to smoothly insert the ink cartridge 1 onto the support part 1012 using these sloped surfaces 214a2 and 224a2.

[0051] As shown in Figure 6(b), when the ink cartridge 1 is pressed toward the installation part 1010 (to the left side of Figure 6(b)), the locking rod 1011 is pressed by the second case attachment parts 217 and 227, and it elastically deforms in the direction away from the support part 1012. Also, the engaging edge part 1017a of the engaging member 1017 comes within the concave part 226a of the external case 200, and then, these come into contact with the locking part 226b. Further, when the ink cartridge 1 is inserted, the engaging member 1017 rotates upwards (direction of an arrow F in Figure 6(b)).

[0052] As shown in Figure 6(c), when the ink cartridge 1 is inserted even further from the state shown in Figure 6(b) (or when the engaging member 1017 is rotated in the arrow F direction in Figure 6(b) by the user), the convex part 1011a of the locking rod 1011 fits into and engages with the locking parts 217a and 227a of the external case 200, and thereby fixing the ink cartridge 1. Also, the convex part 1017d of the engaging member 1017 engages with the concave part 1018, and thereby fixing the ink cartridge 1. Therefore, when the ink cartridge 1 is installed into the installation part 1010, it is possible to prevent easy dislodging of the ink cartridge 1 due to vibrations caused by printing, etc.

[0053] Also, because movement of the ink cartridge 1 in the vertical direction can be restricted by the locking rod 1011 and support part 1012, it is possible to prevent damage to the optical sensor 1014 or ink extraction pipe 1015 due to insertion of the ink cartridge 1 at an angle.

[0054] Also, when the ink cartridge 1 is installed into the installation part 1010, the ink extraction pipe 1015 is inserted inside the ink supply part 120, and as described above, it is possible to perform supply of ink, and as the protrusion part 720a of the air valve 720 of the air intake part 130 comes into contact with the attachment surface 1013, it is possible to have air intake, as described above, and when the optical sensor 1014 is inserted into the through-hole formed by the case cut-out parts 213 and 223 and the protrusion part 140, as described above, it is possible to perform detection of the amount of ink remaining.

[0055] Also, when the ink cartridge 1 is installed into

the installation part 1010, the optical sensor 1014 is inserted into the through-hole formed by the case cut-out parts 213 and 223 and the protrusion part 140, so the light emitting part 1014a and light receiving part 1014b of the optical sensor 1014 is positioned within the external case 200. Therefore, not only is it possible to reduce any damage to the optical sensor 1014, it is also possible to reduce any mistaken detection due to dust or debris on the light emitting part 1014a or the light receiving part 1014b.

[0056] According to the embodiment described above, the float part 43 is placed at the end of the branched arm part 44 which protrudes from the part of the arm part 41 between the light blocking part 42 and the fulcrum 41a, there is no need to extend the arm part 41 to the opposite side of the fulcrum 41a from the light blocking part 42, making it possible to shorten the arm part 41. Therefore, it is possible to reduce the size of the rotating member 32, and it is possible to position the rotating member 32 without needing to increase the size of the ink cartridge 1. Also, because it is possible to reduce the size of the rotating member 32, it is possible to avoid decreasing the amount of ink that can be stored within the ink reservoir chamber 111 due to the positioning of the rotating member 32.

[0057] Also, when the arm part 41 is within the range of possible rotation, the float part 43 is always positioned below the light blocking part 42 and the fulcrum 41a, so when the float part 43 is in a really low position, in other words, when the amount of ink remaining within the ink reservoir chamber 111 has really fallen, it is possible to detect that the amount of ink remaining within the ink reservoir chamber 111 has fallen. By placing the float part 43 at the end of the branched arm part 44, it is possible to easily position the float part 43 below the light blocking part 42 and the fulcrum 41a. While it is also possible to construct the rotating member 32 such that the fulcrum 41a is positioned below the float part 43, by positioning the fulcrum 41a below the float part 43, the arm part 41 becomes longer in comparison to the case of the present embodiment, so it is preferable to position the float part 43 to be below the fulcrum 41a.

[0058] Also, because the mass per unit volume of the entirety of rotating member 32 which is composed of arm part 41 light blocking part 42 and float part 43 is smaller than the ink, it is possible to generate sufficiently large buoyancy (a sufficiently large buoyancy in relation to gravity) when the entirety of the rotating member 32 is positioned within the ink (when there is a large amount of ink remaining). Therefore, it is possible to reduce the possibility of mistaken detection of a low level of ink remaining due to accidental rotation of the rotating member 32, such as when there is external vibration.

[0059] Also, by increasing the volume ratio of the float part 43 in the rotating member 32, and further, by having an inner space packed with air within the float part 43, and thereby making the mass per unit volume of the float part 43 smaller than the other parts of the rotating member 32, it is possible to balance gravity and the buoyancy generated on the rotating member 32 when the ink level has fallen sufficiently. Therefore, because it is possible to rotate the rotating member 32 when there is little ink remaining, it is possible to reduce any ink wastage.

[0060] Also, the ink reservoir chamber 111 is formed within the rectangular case 110, and the ink supply path 116, air intake path 117 and protrusion part 140 are formed on the same side wall on the left side of the case 110, making it possible to position the optical sensor 1014 and ink extraction pipe 1015 close to each other on the same surface of the printer 1000, making it possible to reduce the size of the printer 1000.

[0061] Next, a modified embodiment to which various modifications have been added to the present invention will be described.

[0062] In the present embodiment, the arm part 41 is restricted to a certain degree of clockwise rotation by contact of the top edge of the light blocking part 42 with the upper surface of the protrusion part 140 bounding the top part of the inner space 140a, and the arm part 41 is restricted to a certain degree of anticlockwise rotation by contact of the lower edge of the light blocking part 42 with the lower surface of the protrusion part 140 bounding the inner space 140a, but the present invention is not limited to this, and it is acceptable to have separate means to restrict the rotation of the arm part 41 such as forming a protrusion to prevent excess rotation of the arm part 41 that contacts with the arm part 41 when the arm part 41 has made a certain degree of clockwise or anticlockwise rotation in the ink reservoir chamber 111.

[0063] Also, in the present embodiment, the fulcrum 41a is always positioned below the light blocking part 42 when the rotating member 32 is within the range of permissible rotation, but the present invention is not limited to this, and it is acceptable to position the fulcrum 41a to be always above the light blocking part 42. It would also be acceptable to have a construction in which the fulcrum 41a is positioned at a height between the position when the light blocking part 42 is at its highest position and the position when the light blocking part 42 is at its lowest position, and when the light blocking part 42 is positioned above a certain position, the fulcrum 41a is positioned below the light blocking part 42, but when the light blocking part [42] is positioned below a certain position, the fulcrum 41a is positioned above the light blocking part 42.

[0064] Also, in the present embodiment, there is a fulcrum 41a formed on the arm part 41 of the rotating member 32, where this fulcrum 41a is supported in a support part of the support dais 31, but as long as the rotating member 32 is pivotally supported by the support dais 31, it is acceptable to have a construction where a fulcrum is formed on the support dais 31 and the rotating member 32 has a part for receiving the fulcrum.

[0065] Also, in the present embodiment, the case has been described where the present invention is applied to an ink cartridge in which the ink supply path 116 is on the side surface of the case 110, but the present invention

is not limited to this, and for instance, it is possible to apply the present invention to an ink cartridge in which the ink supply path 116 is formed on the bottom surface of the case which forms the ink reservoir chamber.

Claims

1. An ink cartridge (1) comprising:

an ink reservoir (100) storing ink;
a rotating member (32) supported within the ink reservoir (100) and configured to rotate about a fulcrum (41a) positioned within the ink reservoir (100);
wherein the rotating member (32) comprises:

a light blocking part (42);
a pivot part (41 a) serving as the fulcrum (41a);
an arm part (41) that connects the light blocking part (42) and said pivot part (41a);
a branched arm part (44) that branches from the part of the arm part (41) positioned between the light blocking part (42) and the pivot part (41a); and
a float part (43) that has a smaller mass per unit volume than that of ink and that is positioned at the tip of the branched arm part (44);

an rotation control means configured to control the rotation of the rotating member (32) in the direction in which the rotating member (32) rotates due to the buoyancy generated on the float part (43) when the float part (43) is submerged in ink,

wherein the float part (43) is configured to be positioned below the light blocking part (42) when the ink cartridge (1) is installed in a printer (1000).

2. The ink cartridge as described in Claim 1, wherein the entirety of the rotating member (32) has a smaller mass per unit volume than that of the ink.

3. The ink cartridge as described in Claim 1 or 2, wherein the float part (43) is configured to be positioned below the pivot part (41a) when the ink cartridge (1) is installed in a printer (1000).

4. The ink cartridge as claimed in any of Claims 1-3, wherein the ink reservoir (100) is defined within a rectangular case (110), and the case (110) comprises an ink outlet (116a) and a translucent protrusion part (140) having an inner space (140a) formed therein, the inner space (140a) communicates with the ink reservoir (100), the protrusion part (140) is positioned on the same side of the case (110) as the ink outlet (116a) and positioned above the ink outlet (116a) when the ink cartridge (1) is installed in the printer (1000), and the rotation control means comprises a surface that bounds a top of the inner space (140a).

5. The ink cartridge as described in Claim 4, wherein the printer (1000) comprises an optical sensor (1014), the optical sensor (1014) comprises a light emitting part (1014a) and a light receiving part (1014b), the protrusion part (140) is positioned between the light emitting part (1014a) and the light receiving part (10 14b) when the ink cartridge (1) is installed in the printer (1000).

FIG.1

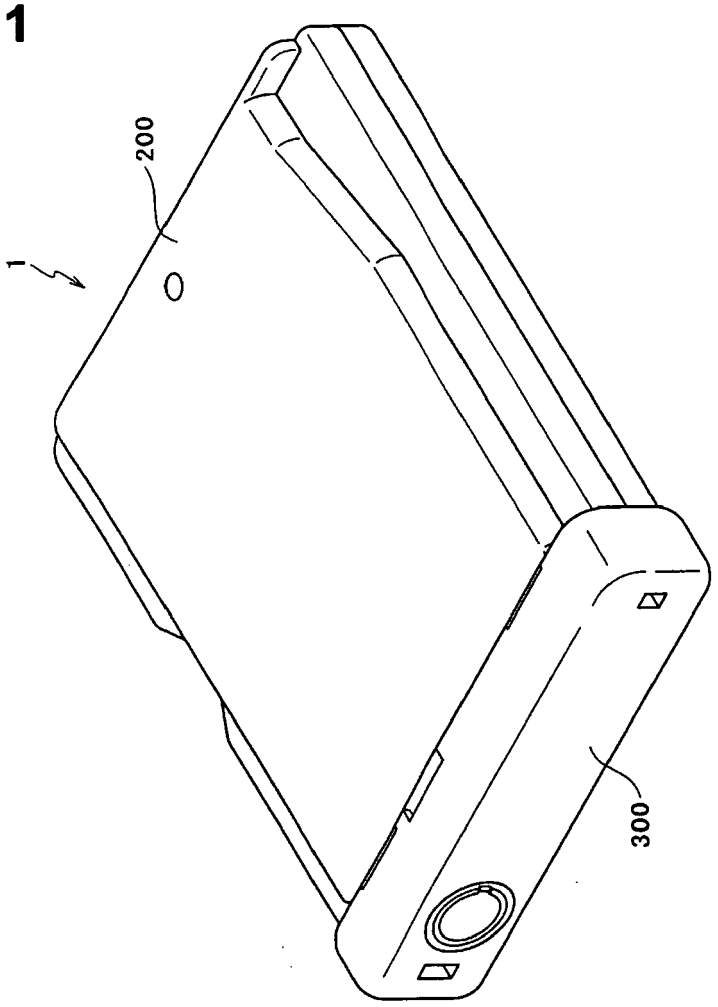


FIG.2

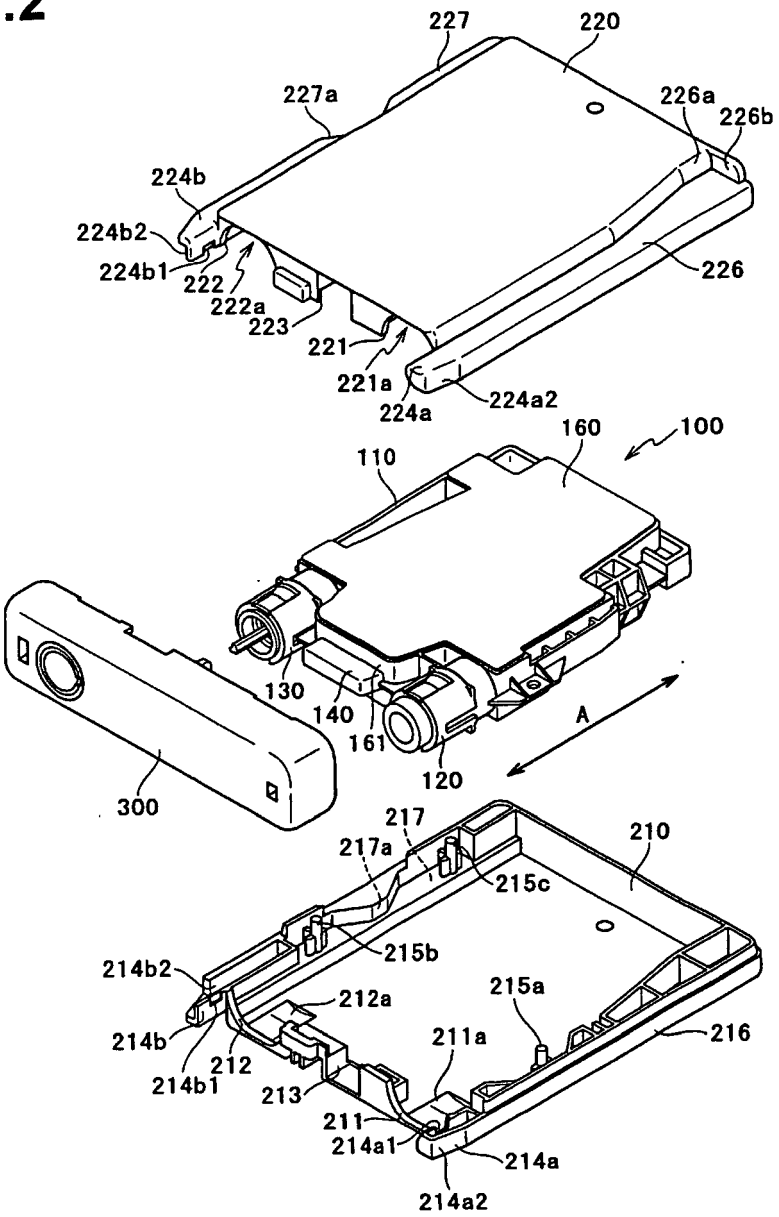

227
220
227a
226a
226b
224b
224b2
224b1
222
222a
223
221
221a
224a
224a2
226
160
100
110
130
140
161
120
A
300
217
217a
215c
210
215b
214b2
212a
215a
214b
212
214b1
213
211a
216
211
214a1
214a
214a2

FIG.3

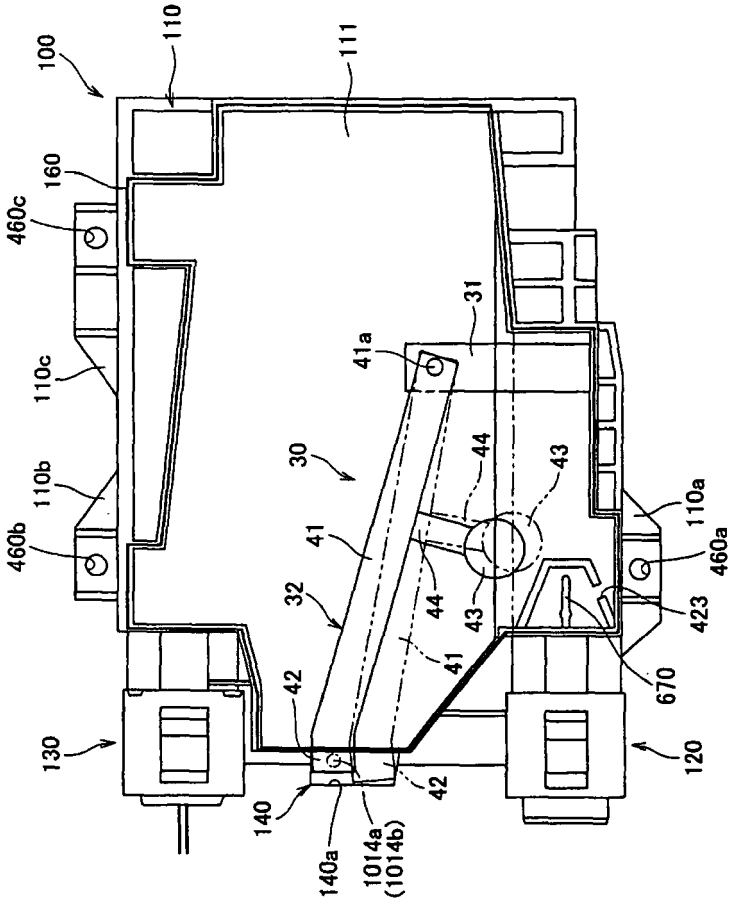

100
110
111
160
460c
110c
110b
460b
31
41a
30
44
43
110a
460a
41
32
44
43
423
41
42
670
130
120
42
140
140a
1014a
(1014b)

FIG.4

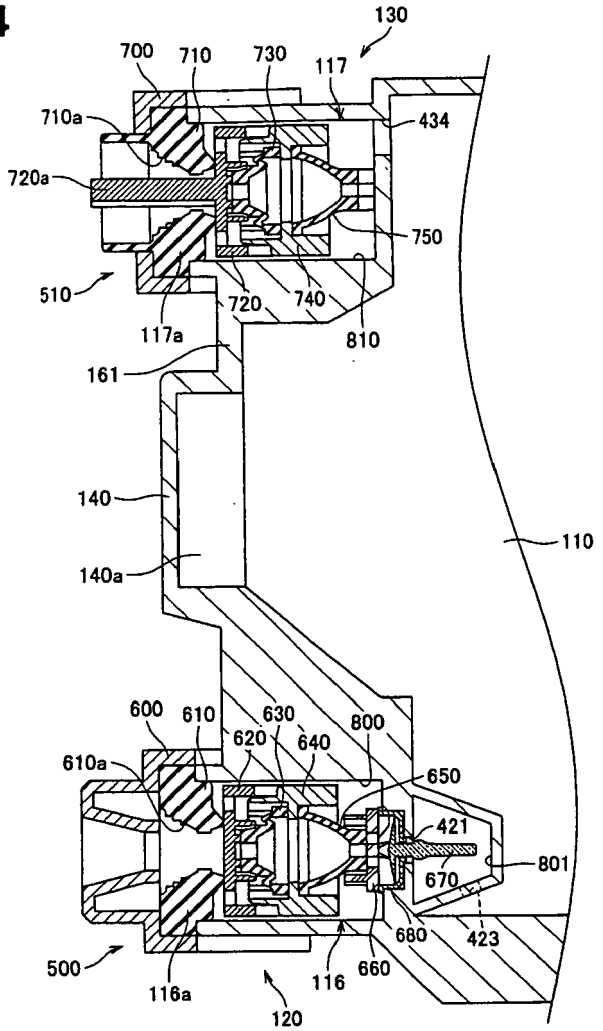

130
700
710
730
117
710a
434
720a
750
510
720
740
117a
810
161
140
110
140a
600
610
630
800
620
640
610a
650
421
801
670
680
423
500
116a
116
660
120

FIG.5

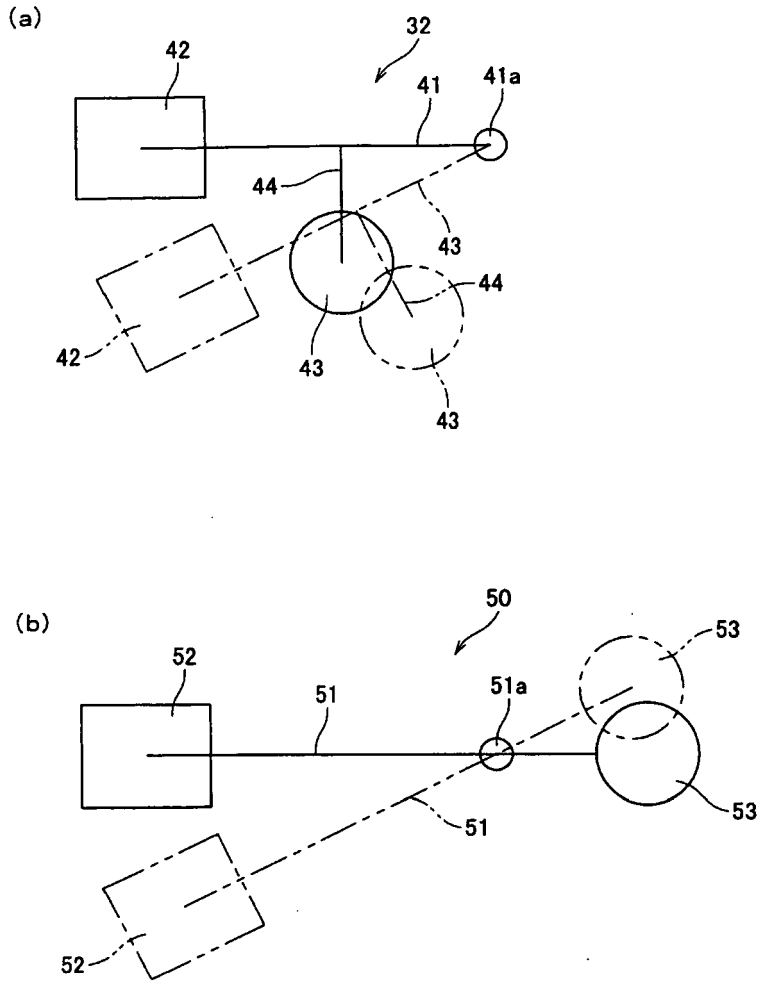
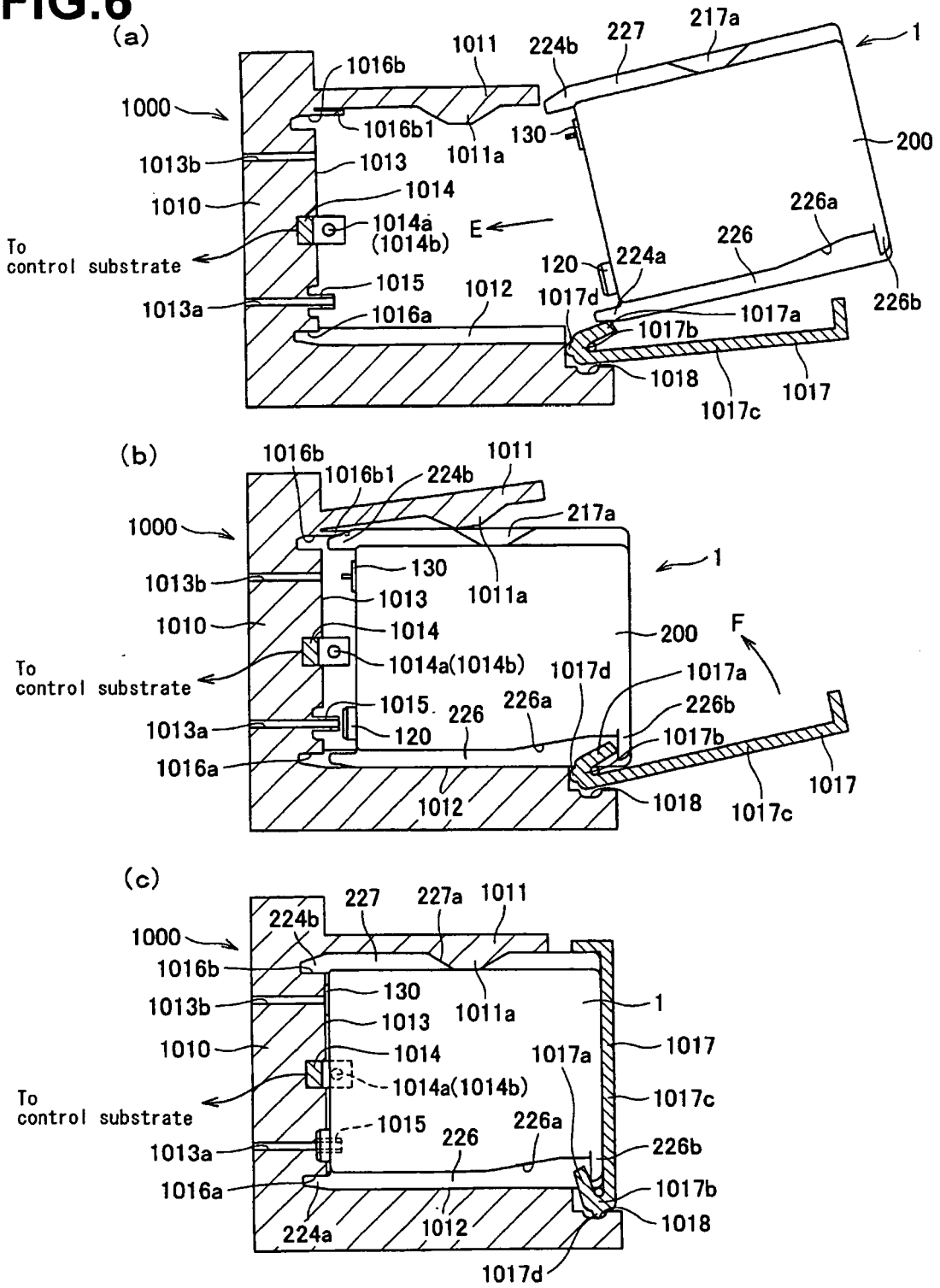


FIG.6


(a)
1000
1016b
1011
224b
227
217a
1
1016b1
1011a
130
200
1013b
1013
1014
1010
226a
1014a
(1014b)
E
226
To
control substrate
120
224a
1015
1012
1017d
226b
1013a
1016a
1017a
1017b
1018
1017
1017c
(b)
1016b
1016b1
224b
1011
1000
217a
1
130
1013b
1013
1011a
1010
1014
200
F
1014a(1014b)
1017d
1017a
To
control substrate
1015
226
226a
226b
1013a
120
1017b
1016a
1017
1012
1018
1017c
(c)
227
227a
1011
224b
1000
1016b
130
1011a
1
1013b
1013
1010
1014
1017a
1017
1014a(1014b)
1017c
To
control substrate
1015
226
226a
1013a
226b
1016a
1017b
224a
1012
1018
1017d

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 06 01 9207

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 1 520 706 A (BROTHER IND LTD [JP]) 6 April 2005 (2005-04-06) * the whole document * -----	1-5	INV. B41J2/175
A	EP 1 097 814 A (SEIKO EPSON CORP [JP]) 9 May 2001 (2001-05-09) * the whole document * -----	1-5	

TECHNICAL FIELDS SEARCHED (IPC)

B41J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	14 November 2006	Axters, Michael

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

2

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 06 01 9207

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

14-11-2006

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1520706 A	06-04-2005	AU 2004214527 A1	14-04-2005
		BR 0404117 A	24-05-2005
		CA 2481165 A1	30-03-2005
		CN 1603113 A	06-04-2005
		KR 20050031905 A	06-04-2005
		MX PA04009333 A	04-04-2005
		SG 110204 A1	28-04-2005
		TW 246465 B	01-01-2006
		US 2005068389 A1	31-03-2005
EP 1097814 A	09-05-2001	AT 269788 T	15-07-2004
		DE 60011733 D1	29-07-2004
		DE 60011733 T2	14-07-2005
		US 6378971 B1	30-04-2002

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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 2005125738 A **[0002] [0003]**