

[DESCRIPTION]

[Title of Invention]

LIQUID CARTRIDGE

[Technical Field]

[0001] The present invention relates to a liquid cartridge including: a housing having a liquid chamber therein; and a liquid supply portion for supplying liquid stored in the liquid chamber to an outside thereof.

[Background Art]

[0002] There has been known a printer including a recording head for ejecting, through nozzles, ink supplied from an ink cartridge (for example, refer to PTL 1). In this kind of printer, a new ink cartridge is to be mounted once the ink in the liquid cartridge is used up. The ink cartridge includes a housing having an ink chamber therein, and a light-blocking plate. The light-blocking plate is provided at a top surface of the housing, and is configured to block or attenuate light emitted in a left-right direction.

[Citation List]

[Patent Literature]

[0003]

[PTL 1] Japanese Patent Application Publication No. 2019-64046

[Summary of Invention]

[Technical Problem]

[0004] In a case where a circuit board provided on the ink cartridge gets damaged when the ink cartridge is dropped and is collided with a flat surface such as a floor, there is likelihood that the circuit board cannot provide communication, thereby hindering use of the ink cartridge.

[0005] In view of the foregoing, it is an object of the present invention to provide a liquid cartridge in which damage to a circuit board can be suppressed even if the liquid cartridge is collided with a flat surface.

[Solution to Problem]

[0006] A liquid cartridge according to the present invention includes: a housing defining a liquid storage chamber therein; a circuit board including an electrode; and a liquid supply portion including a liquid passage opening frontward and configured to supply liquid in the liquid storage chamber to an outside through the liquid passage. The housing includes: a top wall positioned upward of the liquid supply portion and supporting

the circuit board directly or indirectly; a first protrusion positioned rearward of the circuit board and protruding upward from the top wall; and a second protrusion positioned frontward of the circuit board and protruding upward from the top wall. An upper surface of the first protrusion is positioned upward of an upper surface of the second protrusion. An outer surface of the liquid cartridge is positioned below an imaginary plane between the upper surface of the first protrusion and the upper surface of the second protrusion. The imaginary plane is in contact with each of the upper surface of the first protrusion and the upper surface of the second protrusion and extending in a left-right direction. A front edge of the electrode is positioned rearward of a center in a front-rear direction between the upper surface of the first protrusion and the upper surface of the second protrusion each of which the imaginary plane is in contact with.

[0007] With the above structure, a clearance between the imaginary plane and the circuit board can be obtained. Hence, damage to function of the circuit board upon collision of the dropped liquid cartridge against a flat plane such as a floor can be suppressed.

[0008] Further, a distance L1 in the front-rear direction between a front edge of the electrode and a position of the first protrusion in contact with the imaginary plane is smaller than a distance L2 in the front-rear direction between the front edge of the electrode and a position of the second protrusion in contact with the imaginary plane.

[0009] Further, when the liquid cartridge is viewed in a left-right direction perpendicular to the front-rear direction and a vertical direction, a contour of the liquid cartridge is positioned below an imaginary line in an entire region that is rearward of a front end of the housing and frontward of a rear end of the housing. The imaginary line includes at least upper edges of the first protrusion and the second protrusion. A distance L1 in the front-rear direction between a front edge of the electrode and the upper edge of the first protrusion included in the imaginary line is smaller than a distance L2 in the front-rear direction between the front edge of the electrode and the upper edge of the second protrusion included in the imaginary line.

[0010] Further, a liquid cartridge according to the present invention may include: a housing defining a liquid storage chamber therein; a circuit board including an electrode; and a liquid supply portion including a liquid passage opening frontward and configured to supply liquid in the liquid storage chamber to an outside through the liquid passage. The housing includes: a top wall positioned upward of the liquid supply portion

and supporting the circuit board directly or indirectly; a first protrusion positioned rearward of the circuit board and protruding upward from the top wall; and a second protrusion positioned frontward of the circuit board and protruding upward from the top wall. A front end in a front-rear direction of the second protrusion is positioned frontward of an opening of the liquid supply portion. When the first protrusion and the second protrusion is in contact with a single flat plane, a gap is formed between the flat plane and the circuit board. A distance in the front-rear direction between a front edge of the electrode and a point of contact between the first protrusion and the flat plane is smaller than a distance in the front-rear direction between the front edge of the electrode and a point of contact between the second protrusion and the flat plane.

[0011] The present invention may be embodied as a cartridge set configured of a plurality of the above-described liquid cartridges. The plurality of the liquid cartridges is configured to be accommodated in positions different from one another in a cartridge case, and the second protrusions of the plurality of the liquid cartridges are at positions different from one another in the left-right direction.

[Advantageous Effects of Invention]

[0012] According to the present invention, the liquid cartridge can suppress damage to function of the circuit board upon collision of the liquid cartridge against the flat surface.

[Brief Description of Drawings]

[0013]

[Fig. 1]

Fig. 1 is a vertical cross-sectional view schematically illustrating an internal configuration of a printer portion 11.

[Fig. 2]

Fig. 2 is a horizontal cross-sectional view of a cartridge-attachment section 110.

[Fig. 3]

Fig. 3 is a vertical cross-sectional view illustrating a state where an ink cartridge 30 is attached to the cartridge-attachment section 110.

[Fig. 4]

Fig. 4 is a rear perspective view of the ink cartridge 30.

[Fig. 5]

Fig. 5 is a side view of the ink cartridge 30.

[Fig. 6]

Fig. 6 is a side view illustrating a state where the ink cartridge 30 turned upside down collides against a floor 160 with a horizontal surface 154 of a protrusion 43.

[Fig. 7]

Fig. 7 is a side view illustrating a state where the ink cartridge 30 turned upside down collides against the floor 160 with a boundary 156 of the protrusion 43 and an upper edge 67FU of a front end 67F of a rib 67.

[Fig. 8]

Fig. 8 is a rear perspective view of the ink cartridge 30 having the rib 67 at a different left-right position.

[Fig. 9]

Fig. 9 is a partial perspective view illustrating a structure for supporting an IC board 64 according a variation of the embodiment.

[Fig. 10]

Fig. 10 is a side view of a liquid cartridge 30 according to another variation of the embodiment in which a protrusion 91 is provided.

[Description of Embodiments]

[0014] Hereinafter, an embodiment of the disclosure will be described with reference to accompanying drawings. It would be apparent to those skilled in the art that the embodiment described below is merely an example of the present invention and modifications and variations may be made therein without departing from the scope of the invention.

[0015] In the following description, a frontward direction 51 is defined as a direction in which an ink cartridge 30 is inserted into a cartridge-attachment section 110. A rearward direction 52 is defined as a direction in which the ink cartridge 30 is extracted from the cartridge-attachment section 110. In the following example, the ink cartridge 30 is inserted and extracted horizontally relative to the cartridge-attachment section 110. Hence, description will be made assuming that the frontward direction 51 and the rearward direction 52 are horizontal, but the frontward direction 51 and the rearward direction 52 may not be horizontal. Further, a downward direction 53 is defined as a direction perpendicular to the frontward direction 51 or the rearward direction 52. An upward direction 54 is defined as a direction opposite the downward direction 53. Further, a rightward direction 55 is defined as a direction perpendicular to the frontward direction 51

and the downward direction 53. A leftward direction 56 is defined as a direction opposite the rightward direction 55. Accordingly, in a state where the ink cartridge 30 is attached to the cartridge-attachment section 110 and is used therewith, the downward direction 53 coincides with the gravitational direction and the upward direction 54 is opposite the gravitational direction. That is, in the state where the ink cartridge 30 is attached to the cartridge-attachment section 110 and is used therewith, an outer surface of a main bottom wall 42 of a housing 130 faces downward in the gravitational direction. Further, the rightward direction 55 and the leftward direction 56 are defined as directions perpendicular to the frontward direction 51 and the downward direction 53. More specifically, in the state where the ink cartridge 30 is attached to the cartridge-attachment section 110 and is used therewith, the rightward direction 55 is a direction toward the right and the leftward direction 56 is a direction toward the left when the ink cartridge 30 is viewed from a rear side thereof. Note that a state where the ink cartridge 30 is attached to the cartridge-attachment section 110 and is used therewith implies a state where the ink cartridge 30 has been completely inserted into an attached position in the cartridge-attachment section 110. At the attached position of the ink cartridge 30, an ink supply tube 102 of the cartridge-attachment section 110 is inserted in an ink supply portion 34 of the ink cartridge 30 and is connected thereto. Further, hereinafter, a posture of the ink cartridge 30 in a state where the ink cartridge 30 is attached to the cartridge-attachment section 110 and is used thereby will be referred to as an “operable posture.”

[0016] Further, in the following description, the frontward direction 51 and the rearward direction 52 may be collectively referred to as a front-rear direction. The upward direction 54 and the downward direction 53 may be collectively referred to as an up-down direction. The rightward direction 55 and the leftward direction 56 may be collectively referred to as a left-right direction.

[0017] In the following description, "facing frontward" includes facing in a direction including a frontward component, and "facing rearward" includes facing in a direction including a rearward component. Further, "facing downward" includes facing in a direction including a downward component, and "facing upward" includes facing in a direction including an upward component. For example, "a front surface faces frontward" denotes that the front surface may face in a frontward direction, or the front surface may face in a direction inclined relative to the frontward direction.

[0018] [Overview of Printer 10]

As illustrated in Fig. 1, a printer 10 is an image-recording apparatus configured to record an image by selectively ejecting ink droplets onto a sheet based on an inkjet recording system. For example, the printer 10 is an inkjet printer. The printer 10 includes a recording head 21, an ink-supplying device 100, and an ink tube 20 connecting the recording head 21 to the ink-supplying device 100. The ink-supplying device 100 includes the cartridge-attachment section 110. To the cartridge-attachment section 110, the ink cartridge 30 (an example of a liquid cartridge) is attachable. The cartridge-attachment section 110 has a surface formed with an opening 112. The ink cartridge 30 is inserted forward into the cartridge-attachment section 110 through the opening 112, and extracted rearward from the cartridge-attachment section 110 through the opening 112.

[0019] The ink cartridge 30 stores ink therein. For example, the ink cartridge 30 stores ink (an example of liquid) that the printer 10 can use for printing. In a state where the ink cartridge 30 has been completely attached to the cartridge-attachment section 110, the ink cartridge 30 and the recording head 21 are connected to each other through the ink tube 20. The recording head 21 includes a damper chamber 28 for temporarily storing ink supplied through the ink tube 20. The recording head 21 is configured to eject the ink supplied from the damper chamber 28 through a plurality of nozzles 29. More specifically, a head control board provided in the recording head 21 is configured to selectively apply drive voltages to piezoelectric elements provided in correspondence with the plurality of nozzles 29. Thus, ink can be ejected selectively through the nozzles 29. That is, the recording head 21 is configured to consume the ink stored in the ink cartridge 30 attached to the cartridge-attachment section 110.

[0020] The printer 10 includes a sheet tray 15, a sheet feeding roller 23, a conveying roller pair 25, a platen 26, a discharge roller pair 27, and a sheet discharge tray 16. The sheet feeding roller 23 is configured to convey a sheet in the sheet tray 15 toward a conveying path 24. The sheet conveyed onto the conveying path 24 reaches the conveying roller pair 25. The conveying roller pair 25 is configured to convey the arrived sheet onto the platen 26. The recording head 21 is configured to selectively eject ink onto the sheet that is moving over the platen 26, thereby recording an image on the sheet. The sheet that have passed the platen 26 then arrives at the discharge roller pair 27. The discharge roller pair 27 is configured to discharge the arrived sheet onto the sheet discharge tray 16 that is disposed at a downstream end of the conveying path 24.

[0021] [Ink-Supplying Device 100]

The printer 10 includes the ink-supplying device 100, as illustrated in Fig. 1. The ink-supplying device 100 is configured to supply ink to the recording head 21. As described above, the ink-supplying device 100 includes the cartridge-attachment section 110 to which the ink cartridge 30 is attachable, and the ink tube 20. Incidentally, Fig. 1 depicts a state where attachment of the ink cartridge 30 to the cartridge-attachment section 110 is completed. In other words, in Fig. 1, the ink cartridge 30 is in an attached state. A posture of the ink cartridge 30 in this state is the operable posture.

[0022] [Cartridge-Attachment Section 110]

As illustrated in Figs. 1 through 3, the ink-supplying device 100 includes a cartridge case 101, and the ink supply tube 102. In the cartridge-attachment section 110, four kinds of the ink cartridges 30 corresponding to respective colors of cyan, magenta, yellow and black can be accommodated. Further, four of the ink supply tubes 102 are provided in correspondence with the four kinds of ink cartridges 30.

[0023] [Cartridge Case 101]

As depicted in Fig. 2, the cartridge case 101 constitutes a housing of the cartridge-attachment section 110. The cartridge case 101 is in a shape of a box and has a top surface 57, a bottom surface, a right side surface 107, a left side surface 108, an end surface 59, and the opening 112. The top surface 57 defines a ceiling which is an upper end of an internal space of the cartridge case 101. The bottom surface defines a bottom which is a lower end of the internal space of the cartridge case 101. The right side surface 107 defines a right edge of the internal space of the cartridge case 101. The left side surface 108 defines a left edge of the internal space of the cartridge case 101. The end surface 59 is connected to the top surface 57, the bottom surface, the right side surface 107 and the left side surface 108. The opening 112 is formed to oppose the end surface 59 in the front-rear direction in the cartridge case 101. The opening 112 can be exposed to a user-interface surface which is a surface that a user can face when using the printer 10.

[0024] The ink cartridge 30 is insertable into the cartridge case 101 through the opening 112, and is removable from the cartridge case 101 through the opening 112. In a bottom portion of the cartridge case 101, guide grooves 109 are formed. By a lower end of the ink cartridge 30 being inserted in the guide groove 109, the ink cartridge 30 is guided by the guide groove 109 in the front-rear direction (a direction orthogonal to a sheet surface of Fig. 2). The cartridge case 101 also includes three plates 104 that partition the internal space into four different spaces elongated in the up-down direction. In each of the four

spaces partitioned by the plates 104, one ink cartridge 30 is accommodated.

[0025] [Ink supply tube 102]

As illustrated in Figs. 2 and 3, the ink supply tube 102 is hollow cylindrical shaped, and is disposed at a lower end portion of the end surface 59 of the cartridge case 101. The ink supply tube 102 is disposed at a position corresponding to the ink supply portion 34 of the ink cartridge 30 attached to the cartridge-attachment section 110. The ink supply tube 102 protrudes rearward from the end surface 59 of the cartridge case 101, and has a tip end that is open rearward (opening 116).

[0026] In an internal space of the ink supply tube 102, a tube valve 114 and a coil spring 115 are accommodated. The tube valve 114 is movable in the frontward direction 51 and the rearward direction 52, in the internal space of the ink supply tube 102, between an open position for opening the opening 116 and a closing position for closing the opening 116. The coil spring 115 urges the tube valve 114 in a direction for moving the tube valve 114 toward the closing position, i.e., in the frontward direction 51. At the closing position, a front end of the tube valve 114 protrudes further in the frontward direction 51 than the opening 116.

[0027] [Lock Shaft 145]

As illustrated in Fig. 3, a lock shaft 145 is provided at the cartridge case 101 at a position near the top surface 57 and the opening 112 to extend in the left-right direction. The lock shaft 145 is a bar-like member extending in the left-right direction. The lock shaft 145 is columnar-shaped metal, for example. The lock shaft 145 has both ends in the left-right direction that are fixed to respective walls defining left and right end portions of the cartridge case 101 in the left-right direction. Accordingly, the lock shaft 145 does not make any movement, such as pivoting, relative to the cartridge case 101. The lock shaft 145 extends across the four spaces in which four of the ink cartridges 30 can be respectively accommodated. In each of the four spaces for accommodating one ink cartridge 30, a space is provided around the lock shaft 145. Hence, the lock shaft 145 is accessible by, for example, a rear surface 43BF of the ink cartridge 30 that is moving upward or rearward.

[0028] The lock shaft 145 functions to retain the ink cartridge 30 attached to the cartridge-attachment section 110 at the attached position. By the ink cartridge 30 being inserted in the cartridge-attachment section 110 and pivoted into the operable posture, the lock shaft 145 is engaged with the rear surface 43BF of a rear protruding portion 43B

(see Fig. 4). Further, the lock shaft 145 retains the ink cartridge 30 inside the cartridge-attachment section 110 against a pressing force of a coil spring 78 that pushes the ink cartridge 30 rearward.

[0029] As illustrated in Fig. 2, at the top surface 57 of the cartridge case 101, openings 111 are formed one for each of the four spaces partitioned by the plates 104. A gate 113 is exposed through a corresponding one of the openings 111. Each gate 113 has a slit 117 that is open downward and that extends in the front-rear direction. Left-right positions of the respective slits 117 of the gates 113 are different from one another depending on partitioning positions of the plates 104. The position of the slit 117 in each space coincides with a type of the ink cartridge 30 that is to be mounted in the space in the cartridge case 101. Accordingly, a rib 67 (see Fig. 4) of the ink cartridge 30 that is inserted into the correct space to which the ink cartridge 30 is to be attached in the cartridge case 101 can pass through the slit 117 of the gate 113 in the correct space. On the other hand, the rib 67 of the ink cartridge 30 that is inserted into a wrong space to which the ink cartridge 30 is not to be attached in the cartridge case 101 cannot pass through the slit 117 of the gate 113 in that wrong space.

[0030] [Overall Configuration of the Ink Cartridge 30]

The ink cartridge 30 is a container for storing ink as liquid. In the present embodiment, four of the ink cartridges 30 corresponding to respective colors of cyan, magenta, yellow and black can be attached to the cartridge-attachment section 110. Of the four ink cartridges 30, configurations of the three ink cartridges 30 corresponding to the colors of cyan, magenta and yellow are identical to one another, except the positions of the ribs 67 in the left-right direction, as illustrated in Fig. 4. On the other hand, the ink cartridge 30 corresponding to the color of black has a structure different from those of the other three ink cartridges 30 in that the ink cartridge 30 for black has a larger left-right width than those of the three ink cartridges 30. Other than this point, the configuration of the ink cartridge 30 for black is generally identical to those of the other three ink cartridges 30, except the left-right position of the rib 67.

[0031] Hereinafter, a structure of the ink cartridge 30 corresponding to one of the colors of cyan, magenta and yellow will be described.

[0032] The posture of the ink cartridge 30 depicted in Fig. 4 is a posture in which the ink cartridge 30 can be used, i.e., the operable posture. The ink cartridge 30 includes a lower base 130B (an example of a base), and an outer cover 134 (an example of

a cover). The outer cover 134 is assembled to the lower base 130B to constitute the housing 130. The housing 130 includes a front wall 40, a rear wall 41, a top wall 39, and a bottom wall (42, 48), and side walls 37, 38.

[0033] The front wall 40 is a wall that faces frontward in the operable posture of the ink cartridge 30. The rear wall 41 is a wall that faces rearward in the operable posture of the ink cartridge 30. The top wall 39 faces upward in the operable posture of the ink cartridge 30. The top wall 39 has a front end connected to an upper end of a front wall 82, and a rear end connected to an upper end of a rear wall 83.

[0034] The bottom wall faces downward in the operable posture of the ink cartridge 30. The bottom wall has a front end connected to a lower end of the front wall 40, and a rear end connected to a lower end of the rear wall 41. In the present embodiment, the bottom wall includes a step wall 49. In the present embodiment, the bottom wall includes the main bottom wall 42 and a sub bottom wall 48. In the bottom wall, the main bottom wall 42 is a wall connecting the lower end of the rear wall 41 to a lower end of the step wall 49. In the bottom wall, the sub bottom wall 48 is a wall connecting the lower end of the front wall 40 to an upper end of the step wall 49.

[0035] In the operable posture of the ink cartridge 30, a direction from the rear wall 41 toward the front wall 40 is coincident with the frontward direction 51, and a direction from the front wall 40 toward the rear wall 41 is coincident with the rearward direction 52. Further, in the operable posture of the ink cartridge 30, a direction from the top wall 39 toward the bottom wall is coincident with the downward direction 53 (gravitational direction), and a direction from the bottom wall to the top wall 39 is coincident with the upward direction 54. Further, in the operable posture of the ink cartridge 30, a direction from the side wall 38 toward the side wall 37 is coincident with the rightward direction 55, and a direction from the side wall 37 to the side wall 38 is coincident with the leftward direction 56. Further, when the ink cartridge 30 is attached to the cartridge-attachment section 110, an outer surface of the front wall 40 faces frontward; an outer surface of the rear wall 41 faces rearward; an outer surface of the bottom wall faces downward; and an outer surface of the top wall 39 faces upward.

[0036] As illustrated in Fig. 4, the ink cartridge 30, as a whole, has a flat shape whose dimensions in the up-down direction and the front-rear direction are respectively greater than a dimension thereof in the left-right direction.

[0037] [Housing 130]

As illustrated in Fig. 3, the housing 130 has a box-like shape that is open upward. In other words, the housing 130 has an upper end portion formed with an opening. In the present embodiment, the housing 130 is a container made of resin. Inside the housing 130, a first storage chamber 32 (an example of a liquid storage chamber) and a second storage chamber 33 are formed.

[0038] The housing 130 includes, as outer walls, the front wall 40, the rear wall 41, the side wall 37, the side wall 38, the main bottom wall 42, and the sub bottom wall 48. A distance between the front wall 40 and the rear wall 41 is greater than a distance between the side wall 37 and the side wall 38. The front wall 40, the rear wall 41, the side wall 37, the side wall 38, the main bottom wall 42 and the sub bottom wall 48 define the first storage chamber 32.

[0039] In the operable posture of the ink cartridge 30, a surface of the housing 130 facing frontward is the front wall 40, and a surface of the housing 130 facing rearward is the rear wall 41. The side walls 37 and 38 respectively extend to cross the front wall 40 and the rear wall 41. The side walls 37 and 38 respectively connect the front wall 40, the rear wall 41, the main bottom wall 42 and the sub bottom wall 48. In the operable posture, an outer surface of the side wall 37 faces rightward, and an outer surface of the side wall 38 faces leftward.

[0040] As illustrated in Fig. 4, the main bottom wall 42 is sloped relative to the front-rear direction such that a rear end thereof is positioned higher than a front end thereof. The front end of the main bottom wall 42 is positioned frontward of the rear surface 43BF described later. The rear end of the main bottom wall 42 is connected to the lower end of the rear wall 41. That is, the main bottom wall 42 extends frontward from the lower end of the rear wall 41. The sub bottom wall 48 is positioned higher than and frontward of the main bottom wall 42.

[0041] As illustrated in Fig. 3, an inner cover 131 closes the opening in the upper end portion of the housing 130. In the present embodiment, two kinds of inner covers 131 and 132 close the opening in the upper end portion of the housing 130. A space between the inner covers 131 and 132 is an airflow path 72 for allowing the first storage chamber 32 to be open to an atmosphere. Of the two inner covers 131 and 132, the inner cover 131 defining a ceiling of the first storage chamber 32 is formed with a through-hole 146. Through the through-hole 146, the first storage chamber 32 and the space between the two inner covers 131 and 132 is allowed to communicate with each

other. Incidentally, the through-hole 146 can be opened and closed by a valve mechanism 147.

[0042] As illustrated in Fig. 3, the outer cover 134 is box-like shaped, and is open downward. The outer cover 134 is coupled to an upper end portion of the lower base 130B such that the outer cover 134 covers the inner cover 131.

[0043] [Internal Structure of the Ink Cartridge 30]

As illustrated in Fig. 3, the first storage chamber 32, the second storage chamber 33, an ink valve chamber 35, and the airflow path 72 are formed inside the ink cartridge 30.

[0044] The ink cartridge 30 includes, therewithin, a lower wall 45. The lower wall 45 is a wall extending in the front-rear direction and the left-right direction. The lower wall 45 and the inner cover 131 oppose each other in the up-down direction. The first storage chamber 32 and the second storage chamber 33 are partitioned by the lower wall 45.

[0045] In the operable posture, the second storage chamber 33 is positioned below the first storage chamber 32 in an internal space of the housing 130 and functions to storing ink therein. A capacity of the second storage chamber 33 for accommodating ink therein is smaller than a capacity of the first storage chamber 32 for accommodating ink therein.

[0046] The second storage chamber 33 is in communication with the first storage chamber 32 through a communication port 47 formed in the lower wall 45. The communication port 47 is formed in a rear and right end portion of the lower wall 45. Further, the second storage chamber 33 is communication with the ink valve chamber 35 through a through-hole 99 formed in a partitioning wall 50.

[0047] [Airflow Path 72]

As illustrated in Fig. 3, the airflow path 72 is a space that allows the first storage chamber 32 to communicate with the atmosphere. The space between the two inner covers 131 and 132 is in communication with the atmosphere through a through-hole (not shown) formed in the higher inner cover 132, and another through-hole formed in the outer cover 134. The airflow path 72 can be opened by the valve mechanism 147. The valve mechanism 147 is configured to abut against a rib 118 (see Fig. 3) that protrudes downward in the cartridge case 101 during the attachment of the ink cartridge 30 to the cartridge case 101, thereby being pressed downward. As a result, the valve mechanism

147 opens the airflow path 72.

[0048] [Ink Supply Portion 34]

As illustrated in Figs. 3 and 4, the ink supply portion 34 (an example of a liquid supply portion) extends frontward from the step wall 49. As illustrated in Fig. 3, the ink supply portion 34 includes a cylinder 75, a sealing 76, a valve 77, the coil spring 78, and a cap 79.

[0049] The cylinder 75 protrudes in the frontward direction 51 from the step wall 49. The cylinder 75 has a cylindrical-shaped contour. The cylinder 75 has a front end formed with an opening. The cylinder 75 defines an inner space therein that serves as the ink valve chamber 35 (an example of a liquid passage). The ink valve chamber 35 extends in the front-rear direction. The cylinder 75 has a tip end portion that faces frontward. The tip end portion of the cylinder 75 is positioned below and rearward of the front wall 40.

[0050] The sealing 76 is a generally disk-shaped member. The sealing 76 is made of an elastic material such as rubber or elastomer. The sealing 76 is provided at the front end of the cylinder 75 so as to cover the opening in the front end. The sealing 76 has a center portion formed with a through hole that penetrates the same in the front-rear direction. A tubular-shaped inner peripheral surface defining the through hole provides a through-hole 73 in the sealing 76. The through-hole 73 has a diameter that is slightly smaller than an outer diameter of the ink supply tube 102.

[0051] The valve 77 and the coil spring 78 are accommodated in the ink valve chamber 35. The valve 77 is movable in the frontward direction 51 and the rearward direction 52 so as to be capable of contacting and separating from the sealing 76. By the valve 77 contacting and separating from the sealing 76, the through-hole 73 formed in the center portion of the sealing 76 is opened and closed. The coil spring 78 urges the valve 77 forward. Accordingly, without application of an external force, the valve 77 closes the through-hole 73 of the sealing 76.

[0052] As illustrated in Fig. 4, the cap 79 has an outer shape of a generally rectangular parallelepiped. The cap 79 is hollow. Incidentally, the cap 79 may have a shape other than the rectangular parallelepiped, provided that the cap 79 is a hollow member whose front and rear ends are opened. As illustrated in Fig. 3, the cap 79 has a front surface formed with an ink supply port 71. In a state where the cap 79 covers the cylinder 75 and the sealing 76, the ink valve chamber 35 is in communication with an

outside of the ink cartridge 30 through the through-hole 73 of the sealing 76 and the ink supply port 71 of the cap 79.

[0053] As illustrated in Fig. 3, in the state where the cap 79 covers the cylinder 75 and the sealing 76, the sealing 76 is fixed while being nipped between the cap 79 and the cylinder 75. Further, a gap between the sealing 76 and the cylinder 75, and a gap between the sealing 76 and the cap 79 are liquid-tightly sealed.

[0054] [Outer Cover 134]

As illustrated in Figs. 3 through 5, the outer cover 134 is positioned above the housing 130. In other words, the outer cover 134 is positioned higher than the ink supply portion 34. The outer cover 134 has a box-like shape that is open downward. The outer cover 134 includes the top wall 39, the front wall 82, the rear wall 83, a side wall 84, and a side wall 85. The front wall 82 is connected to the front end of the top wall 39, and extend downward therefrom. The rear wall 83 is connected to the rear end of the top wall 39 and extends downward therefrom. The side wall 84 extends downward from a right end of the top wall 39 to connect the front wall 82 and the rear wall 83. The side wall 85 extends downward from a left end of the top wall 39 to connect the front wall 82 and the rear wall 83.

[0055] As illustrated in Fig. 4, the side wall 85 is formed with three engaging holes 86.

Although not shown in the drawings, the side wall 84 is also formed with three engaging holes 86. In each of the side walls 84 and 85, the three engaging holes 86 are arranged to be spaced away from one another in the front-rear direction.

The three engaging holes 86 formed in the side wall 84 and the three engaging holes 86 formed in the side wall 85 are respectively at the same front-rear positions overlapping with each other when viewed in the left-right direction.

[0056] With each of the engaging holes 86, an engaging pawl 88 of the lower base 130B is engaged. The outer cover 134 is thus coupled to the lower base 130B from above to cover the same. Incidentally, in the present embodiment, the engaging holes 86 are formed in the outer cover 134 and the engaging pawls 88 are formed at the lower base 130B. Alternatively, the engaging pawls 88 may be formed at the outer cover 134 and the engaging holes 86 may be formed in the lower base 130B. In a state where the outer cover 134 is coupled to the lower base 130B, the front walls 82 and 40 constitute an outer surface of the ink cartridge 30 facing frontward. Further, the rear walls 83 and 41

constitute an outer surface of the ink cartridge 30 facing rearward. Still further, the side walls 84 and 37, and the side walls 85 and 38 respectively constitute outer surfaces of the ink cartridge 30 facing laterally.

[0057] The top wall 39 includes a first main top wall 61, a second main top wall 62, and a sub top wall 63. The first main top wall 61 is positioned rearward in the front-rear direction. The second main top wall 62 extends from the first main top wall 61 and is positioned frontward of the first main top wall 61. The sub top wall 63 extends from the second main top wall 62 and is positioned frontward of the second main top wall 62. The first main top wall 61 has an upper surface (an example of a first upper surface) which is a flat plane extending in the left-right direction and the front-rear direction. The second main top wall 62 has an upper surface (an example of the first upper surface) which is a flat plane extending in the left-right direction and the front-rear direction and positioned lower than the upper surface of the first main top wall 61. The sub top wall 63 has an upper surface (an example of a second upper surface) which is a sloped flat plane extending in the left-right direction and sloping downward toward the front. Accordingly, the upper surface of the sub top wall 63 is positioned lower than the upper surface of the second main top wall.

[0058] As illustrated in Figs. 4 and 5, the first main top wall 61 is formed with a slot 44 extending in the front-rear direction. The slot 44 is positioned above the through-hole 146 of the inner cover 131.

[0059] On the first main top wall 61, a protrusion 43 (an example of a first protrusion) is formed to protrude upward. The protrusion 43 includes a right protruding portion 43R, a left protruding portion 43L, and the rear protruding portion 43B. The right protruding portion 43R and the left protruding portion 43L are positioned to be spaced away from each other in the left-right direction. The right protruding portion 43R and the left protruding portion 43L respectively extend in the front-rear direction. The rear protruding portion 43B extends in the left-right direction to connect rear ends of the right protruding portion 43R and the left protruding portion 43L. The right protruding portion 43R, the left protruding portion 43L and the rear protruding portion 43B define right, left and rear edges of the slot 44, respectively. The rear protruding portion 43B has the rear surface 43BF (an example of an engaging surface) with which the lock shaft 145 is accessible.

[0060] The rear surface 43BF is a surface of the protrusion 43 facing rearward.

The rear surface 43BF is positioned higher than the top wall 39. The rear surface 43BF extends in the up-down direction. The rear surface 43BF is a surface that can face rearward and contact the lock shaft 145 in a state where the ink cartridge 30 is attached to the cartridge-attachment section 110. By the rear surface 43BF facing rearward and contacting with the lock shaft 145, the ink cartridge 30 can be held in the cartridge-attachment section 110 against an urging force of the coil spring 78.

[0061] In the protrusion 43, the right protruding portion 43R and the left protruding portion 43L are formed frontward of the rear surface 43BF with the slot 44 interposed between the right protruding portion 43R and the left protruding portion 43L. Each of the right protruding portion 43R and the left protruding portion 43L has an upper surface configured of a horizontal surface 154 and a sloped surface 155. The horizontal surface 154 is connected to the rear surface 43BF. The sloped surface 155 is positioned frontward of the horizontal surface 154. The sloped surface 155 is connected to the horizontal surface 154. The sloped surface 155 faces upward and frontward. The sloped surface 155 is sloped such that a front end thereof is positioned lower than a rear end thereof. The rear surface 43BF and the sloped surface 155 are connected to each other via the horizontal surface 154. Thus, a boundary edge between the rear surface 43BF and the sloped surface 155 does not form a ridge-like shape. The lock shaft 145 can be guided smoothly to the rear surface 43BF by the sloped surface 155 and horizontal surface 154, while being in contact therewith, during the insertion of the ink cartridge 30 into the cartridge-attachment section 110.

[0062] On the first main top wall 61, an operation portion 90 is also provided at a position rearward of the rear surface 43BF. The operation portion 90 is adapted to be accessed and operated by a user. The operation portion 90 is formed integrally with the outer cover 134.

[0063] Incidentally, each of the outer surfaces of the front walls 40 and 82, the rear walls 41 and 83, the top wall 39, the main bottom wall 42, the sub bottom wall 48, the side walls 37 and 84, and the side walls 38 and 85 need not be a single flat plane. That is, outer surfaces of the front wall 40 and the side wall 84 are surfaces that can be observed when the ink cartridge 30 in the operable posture is viewed from frontward thereof toward the rear, and that are positioned forward than a front-rear center of the ink cartridge 30 in the operable posture. Outer surfaces of the rear walls 41 and 83 are surfaces that can be observed when the ink cartridge 30 in the operable posture is viewed from rearward thereof

toward the front, and that are positioned rearward than the front-rear center of the ink cartridge 30 in the operable posture. An outer surface of the top wall 39 (that is, outer surfaces of the first main top wall 61, the second main top wall 62, and the sub top wall 63) is a surface that can be observed when the ink cartridge 30 in the operable posture is viewed from above, and that is positioned upward of a center of the ink cartridge 30 in the operable posture with respect to the up-down direction. Outer surfaces of the main bottom wall 42 and the sub bottom wall 48 are surfaces that can be observed when the ink cartridge 30 in the operable posture is viewed from below, and that are positioned lower than the center of the ink cartridge 30 in the operable posture with respect to the up-down direction. The same can be applied to outer surfaces of the side walls 37, 38, 84 and 85, respectively. Incidentally, the ink cartridge 30 does not necessarily include the housing 130 and the outer cover 134. Further, a chamber for storing ink need not be divided into the first storage chamber 32 and the second storage chamber 33. That is, the ink cartridge 30 may include a casing having a storage chamber therein that is defined by the top wall 39, the front wall 40, the rear wall 41, the side wall 37, the side wall 38, the main bottom wall 42 and the sub bottom wall 48.

[0064] As illustrated in Figs. 4 and 5, the rib 67 (an example of a second protrusion) is formed on the upper surfaces of the second main top wall 62 and the sub top wall 63 to protrude upward. The rib 67 extends in the front-rear direction to span across the upper surfaces of the second main top wall 62 and sub top wall 63. The rib 67 is positioned forward of the protrusion 43. The rib 67 is positioned forward of an IC board 64 described later. The rib 67 has a flat plate-like shape whose front-rear dimension is larger than left-right and up-down dimensions thereof. The rib 67 has a main upper surface 68, and a sub upper surface 69. The main upper surface 68 is a flat plane extending in the front-rear direction and the left-right direction. The sub upper surface 69 is connected to the main upper surface 68 and positioned frontward of the main upper surface 68. The sub upper surface 69 is a sloped flat plane that is inclined downward toward the front. The main upper surface 68 has a front-rear dimension that is larger than a front-rear dimension of the sub upper surface 69. The sub upper surface 69 is positioned higher than the sub top wall 63.

[0065] As illustrated in Figs. 4 and 8, the left-right position of the rib 67 on the second main top wall 62 varies according to a type of the ink cartridge 30, such as a type and an initial amount of the ink stored in the ink cartridge 30. The rib 67 can pass through

the slit 117 of the gate 113 when inserted into the right place in the cartridge-attachment section 110. However, the rib 67 cannot pass through a slit of a gate when inserted into a place to which the ink cartridge 30 should not be attached. Further, the user can visually confirm the left-right position of the rib 67 to identify the type of the ink cartridge 30.

[0066] [IC Board 64]

As illustrated in Figs. 4 and 5, the IC board 64 (an example of a circuit board) is disposed at the upper surface of the first main top wall 61 at a position between the rib 67 and the protrusion 43 in the front-rear direction. In other words, the IC board 64 is supported directly at the top wall 39 of the outer cover 134. A support portion 66 is formed on the upper surface of the first main top wall 61 to protrude upward therefrom, and the IC board 64 is fixed to the outer cover 134 by being coupled to the support portion 66. The IC board 64 is electrically connected to three contacts 106 (see Fig. 3) during the insertion of the ink cartridge 30 into the cartridge-attachment section 110, and is also electrically connected to the contacts 106 in the state where the ink cartridge 30 is attached to the cartridge-attachment section 110.

[0067] The IC board 64 includes a substrate, an IC (not shown in the drawings), and three electrodes 65. The substrate supports the IC. The three electrodes 65 are formed on the substrate. The three electrodes 65 and the IC are electrically connected to each other. The three electrodes 65 respectively extend in the front-rear direction, and arrayed in the left-right direction. The three electrodes 65 are arranged on an upper surface of the substrate such that the electrodes 65 are exposed to allow electrically access thereto. With this configuration, the three contacts 106 of the cartridge case 101 can directly make contact with upper surfaces of the three electrodes 65, respectively. The IC is an integrated circuit, and readably stores data indicating information relating to the ink cartridge 30, such as a lot number, a manufacturing date, and a color of the ink. Incidentally, the substrate may be a so-called rigid substrate or may be a flexible substrate having flexibility. Further, the number of electrodes 65 is not limited, and may be four, for example.

[0068] [Position of Each Element in the Ink Cartridge 30]

Hereinafter, with reference to the posture of the ink cartridge 30 illustrated in Fig. 5, positions of the respective elements in a state where the ink cartridge 30 is viewed in the left-right direction will be described.

[0069] The horizontal surface 154, which is the upper surface of the protrusion

43, is positioned higher than an upper edge 67FU of a front end 67F of the rib 67. The horizontal surface 154 of the protrusion 43 is positioned rearward of a center C1 of the housing 130 in the front-rear direction. The protrusion 43 is positioned on the upper surface of the first main top wall 61. The upper edge 67FU of the front end 67F of the rib 67 is positioned frontward of the center C1. The front end 67F of the rib 67 is positioned frontward of the ink supply port 71 of the ink supply portion 34. The front end 67F of the rib 67 is positioned at the sub top wall 63.

[0070] The front end 67F of the rib 67 is positioned forward of any one of the engaging holes 86. A rear end 67R of the rib 67 is positioned rearward of one of the engaging holes 86 which is positioned frontmost thereamong. The rib 67 extends to span more than a half of a front-rear dimension D1 which is a sum of front-rear dimensions of the upper surfaces of the second main top wall 62 and the sub top wall 63.

[0071] In Fig. 5, an imaginary plane 150 is indicated by a phantom line. The imaginary plane 150 is in contact with each of: a boundary 156 between the horizontal surface 154, which is the upper surface of the protrusion 43, and the sloped surface 155; and the upper edge 67FU of the front end 67F of the rib 67. The imaginary plane 150 also extends in the left-right direction.

[0072] An entirety of the outer surface of the ink cartridge 30 positioned between the boundary 156 of the protrusion 43 and the upper edge 67FU of the front end 67F of the rib 67 is positioned below the imaginary plane 150. Accordingly, a boundary 70 between the upper surface of the second main top wall 62 and the upper surface of the sub top wall 63 is positioned below the imaginary plane 150. Further, the IC board 64 is positioned below the imaginary plane 150. Further, the front end of the top wall 39, that is, a front end 63F of the sub top wall 63, is positioned below the imaginary plane 150.

[0073] Further, a front edge 65F of each electrode 65 in the IC board 64 is positioned rearward of a center C2 in the front-rear direction between the boundary 156 of the protrusion 43 and the upper edge 67FU of the front end 67F of the rib 67 each of which the imaginary plane 150 is in contact with.

[0074] A distance L1 in the front-rear direction from the front edges 65F of the electrodes 65 in the IC board 64 to the boundary 156, which is a point of contact between the protrusion 43 and the imaginary plane 150, is shorter than a distance L2 in the front-rear direction from the front edges 65F of the electrodes 65 on the IC board 64 to the upper edge 67FU of the front end 67F of the rib 67, which is a point of contact between the rib

67 and the imaginary plane 150 ($L1 < L2$).

[0075] Further, as illustrated in Fig. 5, in a side view of the ink cartridge 30 in the left-right direction, the imaginary plane 150 can also be defined as an imaginary line that includes at least the following two points: the boundary 156 of the protrusion 43; and the upper edge 67FU of the front end 67F of the rib 67. At this time, in an entire region rearward of the front wall 40 which is the front end of the housing 130 as well as frontward of the rear wall 41 which is the rear end of the housing 130, a contour of the ink cartridge 30 is positioned below the imaginary plane 150 (the phantom line in Fig. 5).

[0076] The distance $L1$ in the front-rear direction from the front edges 65F of the electrodes 65 in the IC board 64 to the boundary 156 of the protrusion 43 included in the imaginary line (150) is shorter than the distance $L2$ in the front-rear direction from the front edges 65F of the electrodes 65 in the IC board 64 to the upper edge 67FU of the rib 67 included in the imaginary line (150).

[0077] Further, the horizontal surface 154, which is the upper surface of the protrusion 43, is positioned closer to the rear end of the housing 130 than to the front end of the housing 130 in the front-rear direction. The sub upper surface 67 of the rib 67 is positioned closer to the front end of the housing 130 than to the rear end of the housing 130 in the front-rear direction.

[0078] [Technical Advantages of the Embodiment]

According to the ink cartridge 30 of the described embodiment, the outer surface of the ink cartridge 30 is located below the imaginary plane 150 between the boundary 156 of the protrusion 43 and the upper edge 67FU of the front end 67F of the rib 67. Hence, when the ink cartridge 30 drops upside down, the horizontal surface 154 of the protrusion 43 first collides against a floor 160 among others, as depicted in Fig. 6. Thereafter, the ink cartridge 30 pivots clockwise in Fig. 6, due to the gravitational force or acceleration, and the upper edge 67FU of the front end 67F of the rib 67 then collides against the floor 160, as illustrated in Fig. 7. With this structure, compared to a configuration where the ink cartridge 30 were without the rib 67, there is smaller change in posture of the housing 130 (angular rotation) upon collision of the dropped ink cartridge 30 against the floor 160. Thus, splash of ink through the ink supply port 71 of the ink supply portion 34 is less likely to occur. Incidentally, a state depicted in Fig. 7 is a state where the protrusion 43 and the rib 67 of the ink cartridge 30 are in contact with a single flat plane. In this state, a gap is formed between the imaginary plane 150 and the IC board

64.

[0079] Further, since the front edges 65F of the electrodes 65 of the IC board 64 is positioned rearward of the center C2, clearance (a gap) in the up-down direction between the imaginary plane 150 and the IC board 64 can be reliably ensured. Accordingly, if the ink cartridge 30 is dropped and collides against a flat plane, there is less likely that the function in the IC board 64 gets damaged by, for example, contact of the IC board 64 against the floor 160.

[0080] Further, since the rib 67 is in a form of a wall elongated in the front-rear direction, the rib 67 is hard to interfere with a component of the cartridge case 101 during the attachment of the ink cartridge 30 into the cartridge case 101. Further, since the front-rear dimension of the rib 67 is greater than the vertical dimension, the rib 67 is hard to get damaged even when the rib 67 is made into contact with the floor 160 as a result of a fall. Further, the protrusion 43 is constituted by the right protruding portion 43R and the left protruding portion 43L connected to each other by the rear protruding portion 43B. Accordingly, the protrusion 43 has a higher impact-resistance than that of the rib 67.

[0081] Further, the sub top wall 63 is provided at the frontmost portion of the top wall 39, and the rib 67 has the sub upper surface 69. Hence, during the attachment of the ink cartridge 30 to the cartridge case 101, abutment of the sub top wall 63 and the sub upper surface 69 against the top surface 57 of the cartridge case 101 and the like less likely occurs.

[0082] [Modifications]

While the imaginary plane 150 is defined by the rib 67 and the protrusion 43 provided on the top wall 39 in the above-described embodiment, instead of the rib 67 or in addition to the rib 67, a protrusion may be provided at a position frontward of the IC board 64 on the top wall 39 to protrude further upward than the rib 67. For example, as illustrated in Fig. 10, a protrusion 91 protruding further upward than the rib 67 may be provided on the top wall 39 at a position frontward of the IC board 64. The protrusion 91 has a circular columnar shape. However, the protrusion 91 may have a prismatic columnar shape, a cone shape, a pyramid shape, or a dome-like shape. In this case, an imaginary plane in contact with each of the horizontal surface 154, which is the upper surface of the protrusion 43, and an upper surface 91U of the protrusion 91 and extending in the left-right direction serves as an imaginary plane 150.

[0083] In the depicted embodiment, the support portion 66 is provided on the

first main top wall 61 of the outer cover 134, and the first main top wall 61 directly supports the IC board 64. However, instead of the support portion 66, a separate supporting member may be assembled to the first main top wall 61 for supporting the IC board 64. That is, the first main top wall 61 may support the IC board 64 indirectly, rather than directly.

[0084] Further, the IC board 64 as a whole, which the support portion 66 supports, may not necessarily be exposed to the outside. For example, as illustrated in Fig. 9, only a portion of the IC board 64 at which the electrodes 65 are positioned may be exposed to the outside of the support portion 66, while a remaining portion of the IC board 64 may be accommodated in an interior of the support portion 66.

[0085] Further, in the above-described ink cartridge 30, the rear surface 43BF of the protrusion 43 is in engagement with the lock shaft 145 in the state where the ink cartridge 30 is attached to the cartridge case 101. Alternatively, the ink cartridge 30 may be retained in the attached state relative to the cartridge case 101 by engagement or contact of a portion of the ink cartridge 30 other than the protrusion 43 with a component of the cartridge case 101.

[0086] Further, in the depicted embodiment, the valve mechanism 147 is positioned between the right protruding portion 43R and the left protruding portion 43L of the protrusion 43. However, the valve mechanism 147 and airflow path 71 may be provided at a position away from the protrusion 43. If this is the case, the right protruding portion 43R and the left protruding portion 43L of the protrusion 43 may only function to provide a space for receiving the rib 118 of the cartridge case 101 during the attachment of the ink cartridge 30 to the cartridge case 101.

[0087] Further, in the above-described embodiment, the front edge 65F of each electrode 65 in the IC board 64 is positioned further rearward than the front-rear center C2 between the boundary 156 of the protrusion 43 and the upper edge 67FU of the front end 67F of the rib 67 with both of which the imaginary plane 150 is in contact. Further preferably, a front edge of the IC board 64 may also be positioned further rearward than the center C2.

[0088] In the depicted embodiment, the ink is used for description as an example of liquid. However, instead of the ink, a pretreatment liquid that is to be ejected onto sheets prior to ink during a printing operation may be stored in a liquid cartridge. Alternatively, cleaning water for cleaning the recoding head 21 may be stored in the liquid

cartridge. That is, the ink cartridge 30 of the disclosure need not be a cartridge for storing ink, but may be a cartridge for storing liquid to be consumed in the printer 10.

[Reference Signs List]

[0089]

- 30 ... ink cartridge (liquid cartridge)
- 32 ... first storage chamber (liquid storage chamber)
- 34 ... ink supply portion (liquid supply portion)
- 35 ... ink valve chamber (liquid passage)
- 39 ... top wall
- 43 ... protrusion (first protrusion)
- 43R ... right protruding portion (first protruding portion)
- 43L ... left protruding portion (second protruding portion)
- 43B ... rear protruding portion (third protruding portion)
- 43BF ... rear surface (engaging surface)
- 67 ... rib (second protrusion)
- 64 ... IC board (circuit board)
- 65 ... electrode
- 71 ... ink supply port (opening)
- 130 ... housing
- 130B ... lower base (base)
- 134 ... outer cover (cover)
- 150 ... imaginary plane (flat plane)

[CLAIMS]

[Claim 1]

A liquid cartridge comprising:

a housing defining a liquid storage chamber therein;

a circuit board including an electrode; and

a liquid supply portion including a liquid passage opening frontward and configured to supply liquid in the liquid storage chamber to an outside through the liquid passage,

wherein the housing comprises:

a top wall positioned upward of the liquid supply portion and supporting the circuit board directly or indirectly;

a first protrusion positioned rearward of the circuit board and protruding upward from the top wall; and

a second protrusion positioned frontward of the circuit board and protruding upward from the top wall,

wherein an upper surface of the first protrusion is positioned upward of an upper surface of the second protrusion,

wherein an outer surface of the liquid cartridge is positioned below an imaginary plane between the upper surface of the first protrusion and the upper surface of the second protrusion, the imaginary plane being in contact with each of the upper surface of the first protrusion and the upper surface of the second protrusion and extending in a left-right direction,

wherein a front edge of the electrode is positioned rearward of a center in a front-rear direction between a point of contact between the upper surface of the first protrusion and the imaginary plane and a point of contact between the upper surface of the second protrusion and the imaginary plane, and

wherein the first protrusion comprises:

a first protruding portion;

a second protruding portion positioned to be spaced away from the first protruding portion in the left-right direction; and

a third protruding portion connecting a rear end of the first protruding portion and a rear end of the second protruding portion and extending in the left-right direction.

[Claim 2]

A liquid cartridge comprising:

a housing defining a liquid storage chamber therein;

a circuit board including an electrode; and

a liquid supply portion including a liquid passage opening frontward and configured to supply liquid in the liquid storage chamber to an outside through the liquid passage,

wherein the housing comprises:

a top wall positioned upward of the liquid supply portion and supporting the circuit board directly or indirectly;

a first protrusion positioned rearward of the circuit board and protruding upward from the top wall; and

a second protrusion positioned frontward of the circuit board and protruding upward from the top wall,

wherein an upper surface of the first protrusion is positioned upward of an upper surface of the second protrusion,

wherein an outer surface of the liquid cartridge is positioned below an imaginary plane between the upper surface of the first protrusion and the upper surface of the second protrusion, the imaginary plane being in contact with each of the upper surface of the first protrusion and the upper surface of the second protrusion and extending in a left-right direction,

wherein a distance in a front-rear direction between a front edge of the electrode and a point of contact between the first protrusion and the imaginary plane is smaller than a distance in the front-rear direction between the front edge of the electrode and a point of contact between the second protrusion and the imaginary plane, and

wherein the first protrusion comprises:

a first protruding portion;

a second protruding portion positioned to be spaced away from the first protruding portion in the left-right direction; and

a third protruding portion connecting a rear end of the first protruding portion and a rear end of the second protruding portion and extending in the left-right direction.

[Claim 3]

The liquid cartridge according to claim 1 or 2, wherein the upper surface of the first protrusion is positioned rearward of a center in the front-rear direction of the housing, and

wherein the upper surface of the second protrusion is positioned frontward of the center in the front-rear direction of the housing.

[Claim 4]

The liquid cartridge according to any one of claims 1 to 3, wherein the second protrusion has a dimension in the front-rear direction that is longer than dimensions in a vertical direction and the left-right direction, and

wherein the upper surface of the second protrusion is an upper edge of a front end of the second protrusion.

[Claim 5]

The liquid cartridge according to any one of claims 1 to 4, wherein the third protruding portion has an engaging surface configured to engage a part of a cartridge case in a state where the liquid cartridge is attached to the cartridge case.

[Claim 6]

The liquid cartridge according to any one of claims 1 to 5, wherein the top wall of the housing has a first upper surface and a second upper surface positioned lower than the first upper surface,

wherein the first protrusion is positioned on the first upper surface, and

wherein the front end the second protrusion is positioned on the second upper surface.

[Claim 7]

The liquid cartridge according to claim 6, wherein the first upper surface is a flat plane,

wherein the second upper surface is a flat plane extending from the first upper surface and sloping downward and frontward, and

wherein the second protrusion extends across the first upper surface and the second upper surface.

[Claim 8]

The liquid cartridge according to claim 7, wherein a boundary between the first upper surface and the second upper surface is positioned below the imaginary plane.

[Claim 9]

The liquid cartridge according to any one of claims 6 to 8, wherein the second protrusion extends to span more than a half of a sum of front-rear dimensions of a portion of the first upper surface and the second upper surface, the portion of the first upper surface being positioned frontward of the circuit board.

[Claim 10]

The liquid cartridge according to any one of claims 6 to 9, wherein the second protrusion has:

a third upper surface which is a flat plane extending in the front-rear direction and the left-right direction; and

a fourth upper surface positioned frontward of the third upper surface and extending from the third upper surface, the fourth upper surface being a flat plane sloping downward and frontward.

[Claim 11]

The liquid cartridge according to any one of claims 1 to 10, wherein the front end in the front-rear direction of the second protrusion is positioned frontward of an opening of the liquid supply portion.

[Claim 12]

The liquid cartridge according to any one of claims 1 to 11, wherein the housing comprises a base defining the liquid storage chamber and a cover engaged with an upper end portion of the base, and

wherein the cover includes the first protrusion and the second protrusion, and supports the circuit board directly or indirectly.

[Claim 13]

The liquid cartridge according to claim 12, wherein the base comprises a plurality of engaging pawls for engagement with the cover,

wherein the cover includes the top wall and a peripheral wall extending downward from a periphery of the top wall, the cover comprising a plurality of engaging holes formed in the peripheral wall for receiving the engaging pawls, and

wherein the front end of the second protrusion is positioned further frontward than any one of the engaging holes in engagement with the engaging pawls.

[Claim 14]

The liquid cartridge according to claim 13, wherein a rear end of the second protrusion is positioned further rearward than one of the engaging holes that is positioned frontmost thereamong.

[Claim 15]

The liquid cartridge according to any one of claims 1 to 14, wherein the second protrusion is plate-shaped and has a front surface extending from the top wall, a main upper surface facing upward, and a sub upper surface sloping downward relative to the main upper surface, and

wherein an upper edge of a front end of the second protrusion is defined by the front surface and the sub upper surface.

[Claim 16]

A liquid cartridge comprising:

a housing defining a liquid storage chamber therein;

a circuit board including an electrode; and

a liquid supply portion including a liquid passage opening frontward and configured to supply liquid in the liquid storage chamber to an outside through the liquid passage,

wherein the housing comprises:

a top wall positioned upward of the liquid supply portion and supporting the circuit board directly or indirectly;

a first protrusion positioned rearward of the circuit board and protruding upward from the top wall; and

a second protrusion positioned frontward of the circuit board and protruding upward from the top wall,

wherein an upper surface of the first protrusion is positioned upward of an upper surface of the second protrusion,

wherein, when the liquid cartridge is viewed in a left-right direction perpendicular a front-rear direction and a vertical direction, a contour of the liquid cartridge is positioned below an imaginary line in an entire region that is rearward of a front end of the housing and frontward of a rear end of the housing, the imaginary line including at least an upper end of the first protrusion and an upper end of the second protrusion,

wherein a distance in the front-rear direction between a front edge of the electrode and the upper end of the first protrusion included in the imaginary line is smaller than a distance in the front-rear direction between the front edge of the electrode and the upper end of the second protrusion included in the imaginary line, and

wherein the first protrusion comprises:

a first protruding portion;

a second protruding portion positioned to be spaced away from the first protruding portion in the left-right direction; and

a third protruding portion connecting a rear end of the first protruding portion and a rear end of the second protruding portion and extending in the left-right direction.

[Claim 17]

The liquid cartridge according to claim 16, wherein the upper surface of the first protrusion is positioned closer to the rear end of the housing than to the front end of the housing in the front-rear direction, and

wherein the upper surface of the second protrusion is positioned closer to the front end of the housing than to the rear end of the housing in the front-rear direction.

[Claim 18]

The liquid cartridge according to claim 16 or 17, wherein the second protrusion has a dimension in the front-rear direction that is longer than dimensions in the vertical

direction and the left-right direction, and

wherein the upper surface of the second protrusion is an upper edge of a front end of the second protrusion.

[Claim 19]

The liquid cartridge according to any one of claims 16 to 18, wherein the third protruding portion has an engaging surface configured to engage a part of a cartridge case in a state where the liquid cartridge is attached to the cartridge case.

[Claim 20]

The liquid cartridge according to any one of claims 16 to 19, wherein the top wall of the housing has a first upper surface and a second upper surface positioned lower than the first upper surface,

wherein the first protrusion is positioned on the first upper surface, and

wherein the front end the second protrusion is positioned on the second upper surface.

[Claim 21]

The liquid cartridge according to claim 20, wherein the first upper surface is a flat plane,

wherein the second upper surface is a flat plane extending from the first upper surface and sloping downward and frontward, and

wherein the second protrusion extends across the first upper surface and the second upper surface.

[Claim 22]

The liquid cartridge according to claim 20 or 21, wherein the second protrusion extends to span more than a half of a sum of front-rear dimensions of a portion of the first upper surface and the second upper surface, the portion of the first upper surface being positioned frontward of the circuit board.

[Claim 23]

The liquid cartridge according to claim 21 or 22, wherein the second protrusion

has:

a third upper surface which is a flat plane extending in the front-rear direction and the left-right direction; and

a fourth upper surface positioned frontward of the third upper surface and extending from the third upper surface, the fourth upper surface being a flat plane sloping downward and frontward.

[Claim 24]

The liquid cartridge according to any one of claims 16 to 23, wherein the front end in the front-rear direction of the second protrusion is positioned frontward of an opening of the liquid supply portion.

[Claim 25]

The liquid cartridge according to any one of claims 16 to 24, wherein the housing comprises a base defining the liquid storage chamber and a cover engaged with an upper end portion of the base, and

wherein the cover includes the first protrusion and the second protrusion, and supports the circuit board directly or indirectly.

[Claim 26]

The liquid cartridge according to claim 25, wherein the base comprises a plurality of engaging pawls for engagement with the cover,

wherein the cover includes the top wall and a peripheral wall extending downward from a periphery of the top wall, the cover comprising a plurality of engaging holes formed in the peripheral wall for receiving the engaging pawls, and

wherein the front end of the second protrusion is positioned further frontward than any one of the engaging holes in engagement with the engaging pawls.

[Claim 27]

The liquid cartridge according to claim 26, wherein a rear end of the second protrusion is positioned further rearward than one of the engaging holes that is positioned frontmost thereamong.

[Claim 28]

The liquid cartridge according to any one of claims 16 to 27, wherein the second protrusion is plate-shaped and has a front surface extending from the top wall, a main upper surface facing upward, and a sub upper surface sloping downward relative to the main upper surface, and

wherein the upper edge of the front end of the second protrusion is defined by the front surface and the sub upper surface.

[Claim 29]

A liquid cartridge comprising:

a housing defining a liquid storage chamber therein;

a circuit board including an electrode; and

a liquid supply portion including a liquid passage opening frontward and configured to supply liquid in the liquid storage chamber to an outside through the liquid passage,

wherein the housing comprises:

a top wall positioned upward of the liquid supply portion and supporting the circuit board directly or indirectly;

a first protrusion positioned rearward of the circuit board and protruding upward from the top wall; and

a second protrusion positioned frontward of the circuit board and protruding upward from the top wall,

wherein a front end in a front-rear direction of the second protrusion is positioned frontward of an opening of the liquid supply portion,

wherein, when the first protrusion and the second protrusion is in contact with a single flat plane, a gap is formed between the flat plane and the circuit board,

wherein a distance in the front-rear direction between a front edge of the electrode and a point of contact between the first protrusion and the flat plane is smaller than a distance in the front-rear direction between the front edge of the electrode and a point of contact between the second protrusion and the flat plane, and

wherein the first protrusion comprises:

a first protruding portion;

a second protruding portion positioned to be spaced away from the first

protruding portion in the left-right direction; and

a third protruding portion connecting a rear end of the first protruding portion and a rear end of the second protruding portion and extending in the left-right direction.

[Claim 30]

The liquid cartridge according to claim 29, wherein an upper surface of the first protrusion is positioned closer to a rear end of the housing than to a front end of the housing in the front-rear direction, and

wherein an upper surface of the second protrusion is positioned closer to the front end of the housing than to the rear end of the housing in the front-rear direction.

[Claim 31]

The liquid cartridge according to claim 29 or 30, wherein the second protrusion has a dimension in the front-rear direction that is longer than dimensions in a vertical direction and the left-right direction, and

wherein the upper surface of the second protrusion is an upper edge of the front end of the second protrusion.

[Claim 32]

The liquid cartridge according to any one of claims 29 to 31, wherein the third protruding portion has an engaging surface configured to engage a part of a cartridge case in a state where the liquid cartridge is attached to the cartridge case.

[Claim 33]

The liquid cartridge according to any one of claims 29 to 32, wherein the top wall of the housing has a first upper surface and a second upper surface positioned lower than the first upper surface,

wherein the first protrusion is positioned on the first upper surface, and

wherein the front end the second protrusion is positioned on the second upper surface.

[Claim 34]

The liquid cartridge according to claim 33, wherein the first upper surface is a flat plane,

wherein the second upper surface is a flat plane extending from the first upper surface and sloping downward and frontward, and

wherein the second protrusion extends across the first upper surface and the second upper surface.

[Claim 35]

The liquid cartridge according to claim 33 or 34, wherein the second protrusion extends to span more than a half of a sum of front-rear dimensions of a portion of the first upper surface and the second upper surface, the portion of the first upper surface being positioned frontward of the circuit board.

[Claim 36]

The liquid cartridge according to claim 33 or 34, wherein the second protrusion has:

a third upper surface which is a flat plane extending in the front-rear direction and the left-right direction; and

a fourth upper surface positioned frontward of the third upper surface and extending from the third upper surface, the fourth upper surface being a flat plane sloping downward and frontward.

[Claim 37]

The liquid cartridge according to any one of claims 29 to 36, wherein the housing comprises a base defining the liquid storage chamber and a cover engaged with an upper end portion of the base, and

wherein the cover includes the first protrusion and the second protrusion, and supports the circuit board directly or indirectly.

[Claim 38]

The liquid cartridge according to claim 37, wherein the base comprises a plurality of engaging pawls for engagement with the cover,

wherein the cover includes the top wall and a peripheral wall extending downward

from a periphery of the top wall, the cover comprising a plurality of engaging holes formed in the peripheral wall for receiving the engaging pawls, and

wherein the front end of the second protrusion is positioned further frontward than any one of the engaging holes in engagement with the engaging pawls.

[Claim 39]

The liquid cartridge according to claim 38, wherein a rear end of the second protrusion is positioned further rearward than one of the engaging holes that is positioned frontmost thereamong.

[Claim 40]

The liquid cartridge according to any one of claims 29 to 39, wherein the second protrusion is plate-shaped and has a front surface extending from the top wall, a main upper surface facing upward, and a sub upper surface sloping downward relative to the main upper surface, and

wherein the upper edge of the front end of the second protrusion is defined by the front surface and the sub upper surface.

[Claim 41]

A cartridge set comprising a plurality of the liquid cartridges according to any one of claims 1 to 40,

wherein the plurality of the liquid cartridges is configured to be accommodated in positions different from one another in a cartridge case, and the second protrusions of the plurality of the liquid cartridges are at positions different from one another in the left-right direction.