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INK-SUPPLIED PRINTER ~~HEAD~~ AND INK SUPPLY TANK

BACKGROUND OF THE INVENTION

This is a continuation-in-part application of pending application Serial No. 08/357,639 filed December 16, 1994 entitled INK-SUPPLIED PRINTER HEAD AND INK CONTAINER, which is a continuation-in-part application of application Serial No. 08/150,676, filed November 10, 1993, which issued as U.S. Patent No. 5,421,658, which is a continuation of application Serial No. 07/962,959, filed October 16, 1992, which issued as U.S. Patent No. 5,328,279, which is a continuation of application Serial No. 07/612,010, filed on November 9, 1990, which issued as U.S. Patent No. 5,156,471, which is a continuation of application Serial No. 07/401,539, filed on August 31, 1989, which issued as U.S. Patent No. 4,969,759, which is a continuation of application Serial No. 07/161,216, filed on February 17, 1988, now abandoned, which is a continuation of application Serial No. 07/035,251, filed on March 23, 1987, now abandoned, which is a continuation of application Serial No. 06/873,871, filed on June 12, 1986, now abandoned, which is a continuation of application Serial No. 06/659,816, now abandoned.

The present invention relates generally to an ink-supplied printer ~~head~~ being supplied with ink from an ink supply tank and more particularly to an ink supply tank which allows for the continuous supply of ink to the printer head while avoiding adverse effects from temperature, atmospheric changes or vibrations. The present invention allows for a larger volume of ink in the ink supply tank and allows for a greater percentage of the ink in the tank to be transferred to the printer head. Also, the present invention comprises a tank with transparent sides so the user is able to easily determine the remaining quantity of ink, and also means for dampening of the unwanted movement of ink within the ink supply tank.

This invention also relates to an ink cartridge for an ink jet printer in which an ink jet recording head, and an ink cartridge are mounted on a movable carriage, and in particular an

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ink jet cartridge in which upon depletion of the ink from the old cartridge, is replaced with a new ink cartridge.

Ink supply systems for a wire dot matrix printer are known in which no ink ribbon is used, but ink is supplied from an ink tank to the distal ends of the wire and transferred from the wires directly to a sheet of print paper. Portions of these ink supply systems, including the supply tanks thereof, are also adaptable to be used in ink jet type printers.

In the parent applications to this application, improved ink storage and delivery was achieved by providing a porous member in an ink tank that essentially filled the tank and carried essentially the entire supply of ink. It was found that while this construction offered substantial improvement over the prior art, the use of the full porous member limited the quantity of ink which would be stored in an ink tank of a given size, increasing the frequency of ink tank replacement.

A prior art ink jet printer in which an ink containing unit and an ink jet recording head are mounted on a carriage is disclosed in European Patent Publication No. 581,531. In the disclosed printer, in order to prevent printing failures caused by variation of the ink level or air bubbles due to movement of the ink cartridge, which is caused by the movement of the carriage, the ink container is divided into two regions. A first region of the container adjacent the recording head houses ink impregnated in a porous member, and a second region contains liquid ink without a porous member. This structure enables the ink to be conducted to the recording head via the porous member so that the problems arising from movement of the ink in the cartridge are prevented from occurring to a certain extent.

The porous member is held in fluid communication with the recording head by a projecting member which is inserted through a hole formed in the side portion of the container. However, such a structure cannot be applied to a recording head in which air bubbles must be stopped from entering a ~~pressurized~~ pressure chamber, such as that for an ink jet printer in which a piezoelectric vibrator is used as an actuator for ink ejection.

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Accordingly, a ink jet printer which solves the above-mentioned problems is derived.

SUMMARY OF THE INVENTION

Generally speaking, in accordance with the present invention, there is provided an ink-supplied printer ~~head~~. Ink is supplied to ~~the~~ a printer head by an ink supply system, including an ink tank having an ink supply port and a pair of side walls. An ink absorbing member is contained therein adjacent the ink supply port which occupies less than the total volume of the ink tank. ~~A plurality of support members extend within the ink tank between the opposed side walls, positioned to locate the ink absorbing member against the ink supply port and for dampening movement of the ink in the portion of the ink supply tank not occupied by the ink absorbing member.~~ The walls of the ink supply tank may be transparent so the user can more easily determine the amount of ink remaining in the ink supply tank.

An ink receiving and transferring member terminating in an ink port may extend into the ink tank, in which case the ink absorbing member abuts and is locally compressed by the ink receiving and transmitting member. The ink receiving and transmitting member has a capillary ink path communicating with the printer head and is supplied with ink from the ink absorbing member.

More specifically an ink cartridge is formed of a ink chamber for storing ink and a foam chamber for receiving a porous member for absorbing ink. A partition separates the ink chamber from the foam chamber and has a hole therein so that the foam chamber is in fluid communication with the ink chamber. The ink cartridge is also formed with an ink supply port. A funnel shaped packing member is disposed within the supply port and supplies ink to a recording head by generation of a pressure difference through the porous member. The packing member is disposed facing upward in the ink supply port. The packing member is resilient.

When an ink supply needle of the recording head is inserted into the ink supply port, the tip of the needle

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resiliently contacts with the packing member. Since the packing member has a funnel-like shape which opens upward, the packing member is easily deformed so as to follow the ink supply needle. Furthermore, the packing member is caused to closely contact with the needle by its resiliency. Therefore, a relative misalignment between the ink supply needle and the ink supply port can be accommodated so that the ink supply port is securely sealed.

Accordingly, it is an object of the invention to provide an improved ink cartridge for an ink jet printer.

It is an object of the present invention to provide a high-quality and highly reliable ink-supplied printer ~~head~~ of a simple construction which is capable of supplying a stable and appropriate quantity of ink from an ink tank to ~~the~~ a printer head and is less subject to the influence of environmental changes such as temperature or atmospheric variations.

It is a further object of the invention to provide a cartridge for an ink jet printer which can be mounted using minimal force and with a large tolerance for misalignment of the ink supply needle, which can cooperate with a recording head to attain a sufficient hermetic seal, while producing a dead space as small as possible.

Yet another object of the invention is to prevent air bubbles from entering the recording head while maintaining a negative pressure in the chamber containing the porous member.

Still other objects, features and advantages of the present invention will become more apparent from the following description when taken in conjunction with the accompanying drawings in which preferred embodiments of the present invention are shown by way of illustrative example and not in a limiting sense.

The invention accordingly comprises the several steps and relation of one or more of such steps with respect to each of the others, and the apparatus embodying features of construction, combinations of elements and arrangement of parts which are adopted to effect such steps, all as exemplified in the following detailed disclosure, and the scope of the invention will be indicated in the claims.

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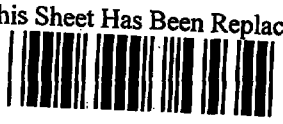

BRIEF DESCRIPTION OF THE DRAWINGS

For a full understanding of the invention, reference is had to the following description taken in connection with the accompanying drawings, in which:

FIG. 1 is an exploded perspective view of a wire dot printer head according to an embodiment of the present invention;

FIG. 2 is a vertical cross-sectional view of the printer head shown in FIG. 1;

FIG. 3 is an exploded perspective view of an ink guide for use with a wire dot printer according to the present invention;

FIG. 4 is a perspective view, partly cut away, of an ink tank according to the present invention;

FIG. 5 is a side elevational view showing the manner in which said ink tank is mounted in place on a print head;

FIG. 6 is a vertical cross-sectional view of an ink guide for a wire dot printer according to another embodiment of the present invention;

FIG. 7 is an exploded perspective view of an ink guide for a wire dot printer according to another embodiment of the present invention;

FIG. 8 is an exploded perspective view of an ink tank according to a still further embodiment of the present invention;

FIG. 9 is a perspective view, partly broken away, of an ink tank according to the invention;

FIG. 10 is a schematic view illustrative of the manner in which air trapped in the ink tank of FIG. 9 is expanded;

FIG. 11 is a schematic view of an arrangement of wires according to the present invention used with a seven-color wire dot printer;

FIG. 12 is a perspective view of an ink tank according to a further embodiment of the present invention with the cover removed, shown exploded from an ink jet print head;

FIG. 13 is a cross-sectional view of the ink tank of FIG. 12;

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FIG. 14 is a perspective view of an ink tank with the cover removed according to a still further embodiment of the present invention;

FIG. 15 is a side cross-sectional view of the ink tank of FIG. 14;

FIG. 16 is a perspective view of an ink tank with the cover removed according to a still further embodiment of the present invention;

FIG. 17 is a cross-sectional view of the ink tank of FIG. 16;

FIG. 18 is a side elevational view of an ink jet type printer of the present invention with the ink supply tank in cross section.

FIG. 19 is a perspective view of an ink tank according to still another embodiment of the present invention shown exploded from an ink jet print head;

FIG. 20 is a cross-sectional view of an ink tank according to a still further embodiment of the present invention;

FIG. 21 is a cross-sectional view of an ink tank according to a further embodiment of the present invention; and

FIG. 22 is a cross sectional view of an ink tank according to a further embodiment of the present invention.

FIG. ~~23~~ 2 is a cross-sectional view of a multi-color ink jet printer cartridge constructed in accordance a first ~~additional~~ embodiment of the invention;

FIG. ~~24~~ 3 is a cross-sectional view of the first ~~additional~~ embodiment rotated 90° from the view in FIG. ~~23~~ 2;

FIG. ~~25~~ 4 is a perspective view showing the ink cartridge of FIGS. ~~23~~ 2 and ~~24~~ 3 with the lid removed;

FIG. ~~26~~ 5 is a perspective view showing a single color ink cartridge constructed in accordance with a second ~~additional~~ embodiment of the invention;

FIG. ~~27~~ 6(a) is a ~~bottom~~ top plan view of the lid of FIG. ~~23~~ 2;

FIG. ~~27~~ 6(b) is a ~~bottom~~ top plan view showing the lid with a seal affixed thereto;

Fig. 1 is a schematic view showing an ink supply system of an ink-jet type recording apparatus according to one embodiment of the present invention;

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FIG. ~~28~~ 7(a) is a cross-sectional view showing a packing member with an ink supply needle inserted therein in accordance with the invention;

FIG. ~~28~~ 7(b) is a cross-sectional view of the packing member prior to insertion;

FIG. ~~29~~ 8 is a graph showing the relationships of the ink consumption, the ~~ink~~ pressure level, and the amount of ink remaining in an ink chamber;

FIG. ~~30~~ 9 is a partial cross-sectional view of the ink cartridge showing the boundary between ink and foam chambers in accordance with a third ~~additional~~ embodiment of the invention;

FIG. ~~31~~ 10 is a partial cross-sectional view of the ink cartridge showing the boundary between ink and foam chambers in accordance with a fourth ~~additional~~ embodiment of the invention;

FIG. ~~32~~ 11 is a partial cross-sectional view of the boundary between ink and foam chambers of an ink cartridge constructed in accordance with a fifth ~~additiona~~l embodiment of the invention;

FIG. ~~33~~ 12 is a cross-sectional view taken along line 33-33 of FIG. ~~32~~ 11;

FIG. ~~34~~ 13 is a partial cross-sectional view showing the boundary between ink and foam chambers of an ink cartridge constructed in accordance with a sixth ~~additiona~~l embodiment of the invention;

FIG. ~~35~~ 14 is a cross-sectional view taken along line 35-35 of FIG. ~~34~~ 13;

FIG. ~~36~~ 15 is a cross-sectional view showing an ink cartridge constructed in accordance with a seventh ~~additional~~ embodiment of the invention;

FIG. ~~37~~ 16 is a cross-sectional view showing an ink cartridge constructed in accordance with a eighth ~~additional~~ embodiment of the invention;

FIG. ~~38~~ 17 is a cross-sectional view showing an ink cartridge for an ink jet printer constructed in accordance with a ninth ~~additional~~ embodiment of the invention; and

FIG. ~~39~~ 18 is a cross-sectional view of the ninth ~~additional~~ embodiment of the invention rotated 90° from FIG. ~~38~~ 17.

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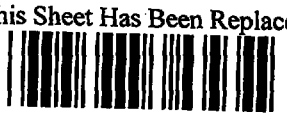

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A printer head according to the present invention may be used in four-color printer plotter or color image printer and has four-color ink systems and ~~wires or~~ ink jets corresponding respectively to four ink colors. The four-color printer plotter employs black, red, green and blue inks, and moves the head or a sheet of print paper or both and then ~~projects a wire, or~~ ejects ink ~~without the use of a projecting wire~~ as in a conventional ink jet print head, corresponding to a desired one of the colors against the print paper at a prescribed position thereon to form an ink dot. Desired characters and figures can thus be recorded by repeating the above cycle. The present invention is applicable to ink jet printers of all varieties, including print heads using heat from heated resistors or the like or the displacement of piezoelectric or with transducers to project a drop of ink from a chamber upon application of a print signal. The ink supply tanks according to the invention can supply ink continuously to said chambers through capillary paths.

In a color image printer using inks of four colors, that is, black, red, green and blue, a sheet of print paper is scanned by a printer head in a direction perpendicular to the direction of feed of the print paper to form one-dot line in one scanning stroke, and the print paper is fed along by line pitches to record images. In seven-color printers, inks of four colors, that is, black, yellow, magenta and cyan, are used, and the colors of red, green and blue are formed on a sheet of print paper by superimposing inks of two out of the three desired colors other than black, thereby recording color images of seven colors.

The present invention is concerned primarily with the printer head, and in particular with the ink tanks, and detailed description of the overall printer construction will be given only by way of a single example.

FIG. 1 is an exploded perspective view of a ~~printer~~ head, and FIG. 2 is a ~~vertical cross-sectional~~ view of the printer head constructed in ~~accordance~~ with the ~~invention~~. An ink tank, shown ~~generally~~ as 2, is detachably mounted by a holder 70 ~~on top~~ of a

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Fig. 1 is a schematic view showing an ink supply system of an ink-jet type recording apparatus according to one embodiment of the present invention.

A print head unit 1 of an ink-jet type is connected to an ink tank 3 through a connecting member 2. Ink is supplied from the ink tank 3 to the print head unit 1 through a hollow needle 2a and an ink supply passage 2b of the connecting member 2, so that the print head unit 1 emits ink droplets in accordance with print signals.

The apparatus shown in Fig. 1 also includes a cap member 4 disposed at non-printing area, which cap member comes into abutment against the nozzle plate of the print head unit 1 by a drive mechanism (not shown) for preventing the nozzle openings from drying. The cap member 4 is connected through a tube 8 to a suction pump 5 which is operated by a control device 6 to suck ink from the print head unit 1 through the cap member 4. The apparatus shown in Fig. 1 is also provided with an effluent tank 7 connected to an outlet port of the suction pump 5 through a tube 9.

The recording head may be of any structure such as described in European Patent Publication Nos. 581,531, 609,863, 584,823 and so on.

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With the present invention, ink can be uniformly supplied through a simple construction from an ink tank to a printer head, and ink is uniformly provided to the printer head for producing a uniform and proper ink density. In the printer head of the invention, ink flow will not be interrupted in an ink guide path to prevent an ink supply failure. A quantity of ink absorbed in the ink guide path is smaller than would be absorbed with a conventional arrangement in which a porous member is used to apply ink directly to the tip end of the wire. Therefore, any wasted ink which is not used for printing is of a small quantity, and all the ink in an ink tank can effectively be used for printing. When the ink tank runs short of ink, and the ink in the tank is rendered highly viscous by being dried at high temperature, or is solidified and thus failing to supply ink, a cartridge ink tank can be mounted in place so that fresh ink can immediately be supplied to the print head for resuming desired printing operation.

According to the printer head of the present invention, no ink flow interruption occurs due to variations in temperature and atmospheric pressure and a uniform ink density is produced. Unintentional ink flow out of the ink tank is avoided, thus avoiding smearing the print paper with the undesired ink spots. Ink will not enter the printer head mechanism, preventing malfunctioning. The cartridge ink tank can easily be detached and attached for ink replenishment.

Since the ink supply system of the invention is simple in construction, it takes up a small space. Where a multicolor printer head employs ink supply systems of the invention, the ink supply systems for different ink colors can be spaced widely so that mixing of colors can be avoided.

The ink cartridge is ~~also~~ configured so as to be mounted with a small force and with accommodating a misalignment of a certain degree. Reference is first made to FIGS. ~~23~~ 2 and ~~24~~ 3 which depict an ink cartridge constructed in accordance with a first ~~additional~~ embodiment of the invention. A main container 501, is divided into three compartments 504, 505, and 506 by partitions 502 and 503 as shown in FIG. ~~24~~ 3. Each of the three compartments 504,

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505, and 506 is divided by a center partition wall 510 into foam chambers 511, 511′ or 511″ housing a respective porous member 520, 520′ or 520″ and ink chambers 512, 512′ or 512″ which are adapted to contain liquid ink. Foam chambers 511, 511′, 511″ are dimensioned to receive a respective porous member 520, 520′ 520″.

The volume of each of porous members 520, 520′ and 520″ is selected so as to be larger than the capacity of each of the respective foam chambers 511, 511′ or 511″, so as to be compressed while being retained in the respective foam chamber in a preferred embodiment. The ratio of the capacities of each foam chamber 511, 511′ or 511″ and each ink chamber 512, 512′ or 512″ is selected so that each foam chamber 511, 511′ or 511″ is dimensioned to hold 20 to 30% more ink than the respective ink chamber 512, 512′ or 512″.

When inks of three colors are contained within a single cartridge as in FIGS. ~~23~~ 2 - ~~25~~ 4, it may be difficult to see if different amounts of ink remain in the chambers, which may be caused by unbalanced consumption of the different color inks. When ink of one color is depleted, and the user wishes to dispose of the cartridge, the user need not unnecessarily worry about any remaining ink of the other colors in the cartridge leaking. When a cartridge of the invention is disposed of, ink is prevented from flowing out of the cartridge because ink of each color is absorbed by each respective porous member, thereby protecting the environment from any leakage of ink.

Ink supply ports 513, 513′ and 513″ (not shown), chamber 511 being exemplary of each chamber 511, 511′ and 511″, are formed in main container 501 within a respective foam chamber 511, 511′, 511″. Each ink supply port 513, 513′ and 513″ is adapted to engage with a respective ink supply needle (not shown) of the recording head which are inserted at the lower end of each of the foam chambers 511, 511′ and 511″.

Referring now to FIG. ~~24~~ 2 and 3, the upper end of the main container 501 is sealed by a lid 516. Two ink filling ports 514 and 515 are formed at positions on lid 516 corresponding to foam chamber 511. Similarly, as shown in FIG. ~~27~~ 6(a), each chamber 511, 511′ and 511″ includes corresponding ink filling ports 514 and 515,

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514′ and 515′, and 514″ and 515″. Projections 516a and 516b, FIG. ~~23~~ 2, are integrally formed with the inner surface of lid 516 and are positioned in foam chamber 511, so as to surround filling ports 515 and 514, respectively. Porous member 520 is compressed by projections 516a and 516b against the bottom wall of foam chamber 511 in which ink supply port 513 is formed. Projections 516a′ and 516b′, and 516a″ and 516b″ are similarly formed in the inner wall of lid 516, and are positioned in foam chambers 511′ and 511″, which contain ink supply ports 513′ and 513″, respectively as shown in FIG. ~~24~~ 3.

Projection 516a which opposes ink supply port 513 is formed with its lower tip located at a position lower than the lower tip of projection 516b, whereby the portion of porous member 520 in the vicinity of ink supply port 513 is compressed to the greatest extent.

Protrusion portions 522, 522′ and 522″ (collectively "522"), which cooperate with lid 516 to compress porous members 520, 520′ and 520″ respectively are formed on the bottom of each of foam chambers 511, 511′ and 511″. Recesses 523, 523′ and 523″ (collectively "523"), which define spaces having a fixed opening area, are formed at the upper end of respective protrusion portions 522. Through holes 524, 524′ and 524″ (collectively "524") are disposed within the respective protrusion portions 522. One end of each through hole 524 is in fluid communication with the spaces defined by recesses 523 and the other end with a respective packing (collectively "530"), which will be hereinafter described. Filters 525, 525′ and 525″ (not shown) (collectively "525") are fixed to the upper end of recesses 523 respectively.

Packing members 530 of which only 530 is shown, are disposed at the lower end of ink supply ports 513, 513′ and 513″ respectively and are made of a resilient material such as rubber. Packing members 530, are configured as a funnel-shaped packing which opens upward. The lower ends of tubular portions 531 are thicker than the other portions. The respective upper peripheral edges 533 of taper portions 532 of respective packing members 530 contact with step portions 513a of respective ink supply ports 513,

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513′ and 513″. Each packing member 530 is formed with protrusions 535 received by ~~stepped~~ groove portion 527 within the inner wall of ink supply port 513. The boundary between tubular portions 531 and taper portions 532, are configured as thin connection portions 534.

In this design, packing members 530 are fixed by tubular portions 531 to respective ink supply ports 513. Additionally, upward movement of upper peripheral edges 533 is prevented by respective step portions 513a. Thus, even when the respective ink supply needle is inserted or extracted, packing members 530 are adequately fixed to ink supply ports 513. Since taper portions 532 serve to attain the hermetic seal between the packing member and the ink supply needle of the respective ink supply port 513 by the respective thin connection portions 534, the taper portions can be moved somewhat without causing deformation. Consequently, the air tight seal between the respective packing member and ink supply needle can be maintained while accommodating a relative misalignment between the respective ink supply needle and ink supply port.

Communicating holes 519, 519′ and 519″ are formed in center partition wall 510, which separates foam chambers 511, 511′ and 511″ from ink chambers 512, 512′ and 512″ respectively. Slots 519a, 519a′ 519a″ which extend ~~from the bottom of container 501~~ to a predetermined height are formed to be in communication with communicating holes 519, 519′ and 519″ respectively for gas-liquid ~~separation~~ replacement. Between each respective pair of foam and ink chambers 511 and 512, 511′ and 512′, and 511″ and 512″, porous members 520, 520′ and 520″ are housed in the foam chambers 511, 511′ and 511″ respectively in such a manner that each porous member is held against the respective communicating hole 519, 519′ or 519″. Ribs 518, 518′, and 518″ are formed on a back wall 501a of container 501 within a respective ink chamber 512, 512′ and 512″. An individual communication hole is formed between each respective chamber pair 511, 512, and extend along only a portion of the length of partition 510 formed thereat.

In a second ~~additional~~ embodiment of the invention an ink cartridge is utilized for a single color ink. A cartridge 5100 for

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a single color, or black ink can be made smaller in size than that for color inks, but the ink chamber 5112 for black ink would have a larger capacity than each of the corresponding chambers for a color ink. According to the second additional embodiment of the invention, a cartridge for black ink is shown in FIG. ~~26~~ 5 having a partition wall 5117 formed within a container 5100 so as to extend between center partition wall 5110 which separates a foam chamber 5111 from a ink chamber 5112 and a side wall 5100a of main container 5100, thereby dividing ink chamber 5112 into two cells 5112a and 5112b. This structure prevents container 5100 from being deformed by a negative pressure produced during the ink filling process which will be hereinafter described, or by an external pressure during usage, thereby preventing any ink from leaking. Cells 5112a and 5112b are retained in fluid communication with foam chamber 5111 via a communicating hole 5119 in center partition 5110 which extends along only a portion of the length of partition 5110. In addition, a communicating hole may be formed in the lower portion of partition wall 5117.

On the inner face of wall 5100a, which can easily be seen when the cartridge is mounted on a carriage, a plurality of ribs 5118 are formed which extend vertically along inner face 5100a. These ribs allow ink to flow more easily down along wall 5100a, and the user can easily recognize the amount of ink remaining in the cartridge by seeing the ink level.

Reference is now made to FIGS. ~~27~~ 6(a) and ~~27~~ 6(b) which depict lid 516 constructed in accordance with the first additional embodiment of the invention. Ink filling holes 514, 514′ and 514″, and 515, 515′ and 515″ are formed in the regions of lid 516 corresponding to the placement of porous members 520, 520′ and 520″ within container 501. Air communicating ports 541, 541′ and 541″ are connected to ink filling holes 514, 514′ and 514″ via grooves 540, 540′ and 540″, respectively.

When a seal 542 for covering ink filling holes 514, 514′ and 514″, 515, 515′ and 515″, and air vent ports 541, 541′ and 541″ is fixed to the ~~underside~~ upperside of lid 516, FIG. ~~27~~ 6(b), after ink ~~compartments~~ foam chambers 511, 511′ and 511″ are filled, grooves 540, 540′ and

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540″ form capillary tubes with seal 542. A tongue piece 545 of seal 542, which protrudes from lid 516, is formed with a neck portion 543 disposed in seal 542 at a midpoint of the route of air vent ports 541, 541′ and 541″. When tongue piece 545 is peeled from lid 516, tongue piece 545 is easily separated from seal 542. This in turn exposes air vent ports 541, but no other portions of the underside of ~~lid 516~~ seal 542.

In a preferred embodiment, seal 542 is formed with patterns such as characters and illustrations printed on its main portion 544 which permanently seals grooves 540, 540′ and 540″. Patterns, colors, or other printing different from that printed on main portion 544 of seal 542 may be placed on tongue piece 545 which is connected to main portion 544 of seal 542 via neck portion 543.

For example, in a further preferred embodiment, the main portion 544 of seal 542 has a blue background, black characters and other illustrations printed thereon. The background color of tongue piece 545 is a color such as yellow or red which contrasts with the background color of main portion 544. Characters and illustrations are printed on the background in colors which are mainly black or blue. In this way, main portion 544 and tongue piece 545 are distinguished from each other in color and pattern. Consequently, it is possible to call the user's attention to the need for the removal of tongue piece 545.

Each of ink supply ports 513, 153′ and 513″ are sealed by a film 546 (FIG. ~~23~~ 2), and ink filling needles are hermetically inserted into the ink filling holes 514, 514′ and 514″ and 515, 515′ and 515″ respectively. The first of filling holes 514, 514′ and 514″ is connected to evacuating means, and the second of the filling holes 515, 515′and 515″ is closed.

The evacuating means reduces the pressure in each of foam chambers 511, 511′ and 511″ and in each of ink chambers 512, 512′ and 512″. When the pressure is reduced to a predetermined value, the evacuating operation is stopped and the first filling hole is closed. Thereafter, the second filling hole is placed in fluid communication with a measuring tube filled with ink. Ink contained

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in the measuring tube is drawn into the evacuated container and is then absorbed by respective porous member 520, 520′ and 520″ and thereafter flows into ink chamber 512, 512′ or 512″ via communicating holes 519, 519′ or 519″ respectively.

After the specified amount of ink flows into the appropriate ink chamber, seal 542 is fixed to the ~~inner~~ outer surface of lid 516 so that the ink filling holes 514, 514′ and 514″ and 515, 515′ and 515″, grooves 540, 540′ and 540″, and communicating ports 541, 541′ and 541″ are sealed under reduced pressure. Seal 542 thereafter maintains the reduced pressure states of foam chambers 511, 511′ and 511″ and ink chambers 512, 512′ and 512″.

Before use of the cartridge, tongue piece 545 of ~~lid 516~~ seal 542 is then peeled off so that tongue piece 545 is broken at neck portion 543 and is separated from main portion 544. Thus, ink filling holes 514, 514′ and 514″ are placed in fluid communication with air vent ports 541, 541′ and 541″ via grooves 540, 540′ and 540″. Also, foam chambers 511, 511′ and 511″ are placed in fluid communication with air vent ports 541, 541′ and 541″ and therefore ambient air, via grooves 540, 540′ and 540″. Thus, while the ink is prevented from evaporating, the ink cartridge is ventilated.

Reference is now made to FIGS. ~~28~~ 7(a) and ~~28~~ 7(b), wherein an ink supply port 513 of the ink cartridge is positioned so as to be aligned with an ink supply needle 550 of the recording head. Thereafter the ink cartridge is pushed toward the recording head upon insertion of the ink cartridge. A taper portion 551 of ink supply needle 550 passes through a film seal 546 and engages the hole of packing member 530 as shown in FIG. ~~28~~ 7(a). Since packing member 530 opens upward, packing member 530 allows ink supply needle 550 to pass therethrough while packing member 530 is resiliently deformed by taper portion 551 of ink supply needle 550.

When the cartridge is used, ink supply needle 550 passes through packing member 530. The resiliency of connection portion 534 of packing member 530 enables taper portion 532 to engage ink supply needle 550. Even if ink supply needle 550 of the recording head and the center of packing 530 are somewhat misaligned, ink supply port 513 and ink supply needle 550 are hermetically sealed.

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To conduct ink into the recording head after the ink cartridge is mounted, or to ~~restart the flow of ink to the recording head~~ recover the ink ejection performance, a negative pressure is applied to the recording head and through ink supply needle 550 so that ink in the cartridge flows through ink supply needle 550 and into the recording head. Because of the pressure difference, this high negative pressure applied to the cartridge causes taper portion 532 of packing member 530, which hermetically seals and isolates the cartridge from ambient air, to deform upward in FIG. ~~28~~ 7(a) toward the interior of the ink cartridge. Thus, the pressure difference aids in causing taper portion 532 of packing member 530 to be resiliently pressed against ink supply needle 550, and thereby aids in hermetically sealing the ink cartridge.

Even if ink supply needle 550 is not positioned completely through packing member 530, the resilient force in taper portion 532 of packing member 530 allows taper portion 532 to remain in contact with ink supply needle 550 as long as the tapered portion 551 of ink supply needle 550 remains in contact with taper portion 532 as shown in FIG. ~~28~~ 7(b). Consequently, it is possible to secure the air tightness of packing member 530 and ink supply needle 550 even if the needle is not properly inserted.

Since the tip of ink supply needle 550 is sealed upon contact with packing member 530, the dead space in the cartridge can be made very small, and any air bubbles which may be produced by the piston effect upon insertion of the cartridge onto the recording head are prevented from entering the cartridge.

When a negative pressure is applied from the nozzle openings of the recording head, ink absorbed by porous member 520 flows into the recording head via through hole 524 and through holes 552 of ink supply needle 550. When ink of a predetermined amount is consumed from porous member 520 and the ink level in porous member 520 is reduced, the pressure of ink chamber 512 overcomes the holding force of porous member 520 in the vicinity of communicating hole 519, so that air bubbles enter ink chamber 512 via communicating hole 519. Consequently, the pressure in a

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ink chamber 512 is increased and ink therefore flows into a foam chamber 511.

The ink flowing into foam chamber 511 is absorbed by porous member 520 and causes the ink level in foam chamber 511 to be raised. At the instant when the ink holding force of porous member 520 in the vicinity of communicating hole 519 is balanced with the pressure in ink chamber 512, the flow of ink from ink chamber 512 into foam chamber 511 is stopped.

The graph of FIG. ~~29~~ 8 illustrates this process. In the figure, the letter F indicates the ~~ink~~ pressure level in porous member 520 of foam chamber 511, and the letter G indicates the ink level in ink chamber 512. When a predetermined amount of ink w1 which was initially contained in porous member 520 is consumed so that the ink level in porous member 520 is reduced to a predetermined value at which the pressure in ink chamber 512 overcomes the ink holding force of porous member 520 in the vicinity of communicating hole 519, ink gradually flows in a stepwise manner from ink chamber 512 into the foam chamber 511. This process occurs until the balance between the pressure of the ink chamber 512 and the ink holding force of porous member 520 in the vicinity of communicating hole 519 is restored. As a result, although the ink level in ink chamber 512 is gradually reduced, the ink level in porous member 520 can be maintained at a substantially constant level so that ink is supplied to the recording head by a constant pressure difference at a constant rate.

After a predetermined amount of ink w2 is consumed by the recording head, no ink will remain in ink chamber 512, but the amount of ink contained in porous member 520 will be at a level equal to the level when ink was intermittently being supplied to foam chamber 511 from ink chamber 512. Therefore, ~~although~~ printing can be continued using the amount of ink absorbed in porous member 520, although no further ink is available in ink chamber 512 to replenish the ink supply ~~in~~ into porous member 520. After a predetermined amount of ink w3 is consumed during printing, the ink supply in porous member 520 will be depleted, and the ink cartridge will no longer support printing.

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19 35 all the ink contained in ink chamber 512 has been absorbed in porous member 520

During the entire printing operation from when ~~the cartridge is filled~~ until the ink is depleted, a constant amount of ink is supplied to the recording head. The depletion of ink from ink chamber 512 indicates the impending depletion of ink ~~and accompanying print failure.~~ in the ink tank cartridge If a fresh cartridge is inserted at this stage, it is possible to ensure a constant supply of ink to the recording head without interruption.

As described above, the inner space of the ink cartridge of the invention must be maintained at a negative pressure during the printing process. In addition to the achievement of the above-described hermetic seal between the ink supply port and the ink supply needle, the transfer of ink from ink chamber 512 to the foam chamber 511 must be performed properly to ensure a constant flow of ink to the recording head. Hereinafter, the structure for controlling the supply of ink from ink chamber 512 to foam chamber 511 will be described.

Reference is now made to FIG. ~~30~~ 9 which depicts the boundary between foam chamber 511 and ink chamber 512 in a third additional embodiment of the invention. Like numerals are utilized to indicate like structures, the primary difference between this embodiment and the first additional embodiment being a step portion formed in hole 519.

A step portion 560 is formed in communicating hole 519. A portion 563 of the base of ink chamber 512 is higher than that of foam chamber 511, step portion 560 being the dividing point. A groove ~~562~~ 561 connecting the foam and the ink chambers is formed in the lower part of step portion 560.

Porous member 520 is in contact with communicating hole 519 and is received by step portion 560 so that the portion of porous member 520 in the vicinity of communicating hole 519 is compressed, whereby the required pressure difference between ink chamber 512 and foam chamber 511 via communicating hole 519 can be attained. When the ink level of ink chamber 512 is reduced to a low level, groove 561 enables ink from ink chamber 512 to be collected and then absorbed by porous member 520 in foam chamber 511. Consequently, all of the ink in ink chamber 512 can be

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supplied to the recording head for printing without wasting any ink.

Reference is now made to FIG. ~~31~~ 10, which depicts an ink cartridge constructed in accordance with a fourth ~~additional~~ embodiment of the invention. Again, like numerals are used to indicate like structures, the primary difference between this embodiment and the first additional embodiment is the different leveled bottoms of the respective chambers.

The bottom face 564 of ink chamber 512 is higher than the bottom face 567 of foam chamber 511, thereby forming a step portion 562. Step portion 562 receives the lower portion of porous member 520 so that the portion of porous member 520 in the vicinity of communicating hole 519 is compressed. When required, a slope 563 which is directed from the ink chamber 512 to the foam chamber 511 may be formed to aid in the supply of ink. Since slope 563 allows ink in ink chamber 512 to flow more easily toward foam chamber 511, irrespective of the inclination of the carriage, ink from ink chamber 512 can be constantly supplied to the recording head.

Reference is now made to FIGS. ~~32~~ 11 and ~~33~~ 12 which depict an ink jet cartridge constructed in accordance with a fifth additional embodiment of the invention. Like structures are indicated by like reference numerals, the primary difference between this embodiment and the first additional embodiment is the formation of a through hole. This embodiment is the same as shown in FIGS. 4 and 5.

Groove 519a (FIGS. ~~25~~ 4 and ~~26~~ 5) is formed in the face of center partition 510 separating foam chamber 511 from ink chamber 512. Groove 519a is formed in the face of partition 510 on the side of the foam chamber 511 and is in communication with the upper portion of communicating hole 519 of center partition 510 within the respective chambers 511, 512. In order to allow air to pass from ink chamber 512 to foam chamber 511 and to retain these chambers in fluid communication with each other, a through hole 519b is formed in the lower end of the groove 519a. Thus, the upper portion of porous member 520 which exhibits a relatively small capillary force is maintained in fluid communication with communicating hole 519 via the space formed by thin groove 519a.

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Therefore, ink can be smoothly replaced with air so that ink in ink chamber 512 constantly flows into foam chamber 511, thereby preventing too much or not enough ink from being supplied.

Reference is now made to FIGS. ~~34~~ 13 and ~~35~~ 14 which depict an ink cartridge constructed in accordance with a sixth additional embodiment of the invention. Like numerals are utilized to depict like structures, the primary difference being the use of a projection into foam chamber 511.

A horseshoe-shaped projection 565 is formed on the bottom of foam chamber 511 as is shown in FIG. ~~35~~ 14. Projection 565 ensures a space in the vicinity of communicating hole 519 so that ink from ink chamber 512 can easily flow into foam chamber 511.

As described above, foam chamber 511 and ink chamber 512 are separated from each other by the single center partition 510. In seventh or eighth additional embodiments of a single-color ink cartridge, as shown in FIGS. ~~36~~ 15 and ~~37~~ 16 respectively, an ink chamber 571 may be formed so as to surround two or three sides of a foam chamber 570, and a communicating hole 573 may be formed in at least one of the walls 572 separating the foam chamber 570 from the ink chamber 571. An exit port 574 is positioned within foam chamber 570. An ink cartridge of this design can store an amount of ink which is relatively large as compared with the volume of the whole ink cartridge. Furthermore, because of the location of the chambers, the user can easily see if replacement of the ink cartridge is required because of depletion of the ink.

References is now made to FIGS. ~~38~~ 17 and ~~39~~ 18 wherein an ink jet printer cartridge constructed in accordance with a ninth additional embodiment of the invention is provided. This embodiment is similar to the first additional embodiment, the primary difference being the use of a resilient O-ring 5300 which is retained in contact with the peripheral face of an ink supply needle of the recording head upon insertion of the ink supply needle into the ink supply cartridge. However, this ink jet printer results in other problems solved by the first additional embodiment. A large frictional force may be produced when mounting the cartridge on the carriage and inserting the ink supply needle

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into the cartridge. This results in an extra strain on the recording head and the carriage. Furthermore, O-ring 5300 is supported at its periphery by the body 5302 of the cartridge. If there is a misalignment between the cartridge and the ink supply needle of the recording head upon insertion of the ink supply needle in the ink supply cartridge, it is very difficult to mount the cartridge. Furthermore, when a three color ink cartridge in which tanks 5304, 5306, and 5308 for the three color inks are integrated into one piece as shown in FIG. ~~39~~ 18, it is extremely difficult to mount such a cartridge on the recording head if the cartridge and any of the ink supply needles are misaligned.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description are efficiently attained and, since certain changes may be made in carrying out the above construction and method set forth without departing from the spirit and scope of the invention, it is intended that all matter contained in the above description and shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall there between.

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CLAIMS

WHAT IS CLAIMED IS:

1. An ink tank cartridge for an ink-jet type recording apparatus, comprising:

a plurality of first chambers;

a plurality of second chambers, each second chamber being adjacent to and associated with a first chamber;

a plurality of partition walls disposed in said cartridge, each said partition being formed with a communicating hole formed therein disposed between said associated chambers, said communicating hole being positioned in the vicinity of the bottom of said partition wall and extending only a portion of the width of said partition wall as viewed in the direction of said bottom of said partition wall; and

a plurality of ink supply ports, each extending through a wall of a respective one of said plurality of second chambers, said plurality of ink supply ports supplying ink to the exterior of said cartridge, all of said first chambers and associated second chambers being formed as an integral unit.

2. The ink cartridge of claim 1, and including a porous member in each of said second chambers positioned to deliver ink to its associated ink supply port and an air vent port communicating between each said second chamber and the exterior of said cartridge at a location spaced from said ink supply port and communicating hole.

3. The ink cartridge of claim 2, wherein the porous member associated with each second chamber and the associated first chamber contain ink different from the ink in the other first and second chambers.

4. The ink tank cartridge of claim 2, wherein the porous member in each said second chamber and the associated first chamber contain ink, the pressure in each of said first chambers and each of said associated second chambers being at a value less than atmospheric pressure.

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5. The ink tank cartridge of claim 4, wherein a pressure ~~difference~~ balance between each of said first chambers and each of said associated second chambers is maintained by the surface tension of each of said associated porous members in the vicinity of each of said associated communicating holes, each said porous member resiliently contacting said associated communicating hole, said pressure ~~difference~~ balance maintaining ink in each of said respective first chambers.

6. The ink tank cartridge of claim 5, wherein each said porous member, associated first and second chambers, partition wall, communication hole ink supply port and air vent port are positioned and dimensioned so that when said ink impregnated in each of said associated porous members is at least partially transmitted through said ink supply port, said pressure ~~difference~~ balance between said associated chambers is no longer maintained and ink is supplied from the first chamber to the associated porous member in the associated second chamber as required until the pressure ~~difference~~ balance is restored.

7. The ink tank cartridge of claim 6, further comprising an associated step portion formed at a lower portion of each of said communicating holes, a groove connecting said associated first and second chambers being formed in said ink cartridge below said associated step portion.

8. The ink tank cartridge of claim 6, further comprising a protrusion portion formed on an inner surface of said partition wall in each of said second chambers, each said protrusion portion maintaining a space about said associated communicating hole to aid in the flow of ink therethrough.

9. The ink tank cartridge of claim 6, further comprising a step portion formed below each of said communicating holes in said partition wall.

10. The ink tank cartridge of claim 9, wherein the part of each of said step portions adjacent said associated first chamber is higher than the part adjacent said associated second chamber.

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11. The ink tank cartridge of claim 6, further comprising a respective vertically extending thin groove formed in each said partition wall above each communicating hole and on the side of the associated second chambers, each of said grooves being in fluid communication with each associated communicating hole, each of said grooves aiding in the flow of air and ink between said associated first and second chambers.

12. The ink tank cartridge of claim 2, further comprising a projection formed on an inside wall of each of said second chambers disposed on a surface of said second chamber opposite said associated ink supply port, said projections compressing said associated porous members against said associated ink supply ports.

13. The ink tank cartridge of claim 12, wherein each said ink supply port includes a ~~partition~~ projection including its entrance projecting into said second chamber.

14. The ink tank cartridge of claim 12, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

15. The ink tank cartridge of claim 2, wherein the volume of each of said porous members is larger than the capacity of each of said associated second chambers.

16. The ink tank cartridge of claim 2, further comprising at least one chamber partition wall, said chamber partition wall extending from each said partition wall and dividing said first chamber into a plurality of such chambers while permitting communication between each such chamber and the associated second chamber through the associated communicating hole.

17. The ink tank cartridge of claim 6, further comprising a respective vertically extending rib formed on an inner surface of said first chamber, each of said ribs assisting in the flow of ink.

18. The ink tank cartridge of claim 1, wherein said first chamber and said second chamber are maintained at a pressure

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less than atmospheric pressure and said ink cartridge further comprises a plurality of air vent ports formed in a surface of said cartridge, each having an air-impermeable sealing member for selectively sealing said air vent ports when said ink cartridge is not in use and unsealing said air vent ports when said ink cartridge is to be used.

19. The ink tank cartridge of claim 18, wherein each of said air vent ports is formed in part as a groove on the outside surface of a wall of said second chamber.

20. The ink tank cartridge of claim 18, wherein said outside surface is of a top lid.

21. The ink tank cartridge of claim 18, wherein said sealing member comprises a main portion, and a tongue piece which is removably connected to said main portion via a neck portion.

22. The ink tank cartridge of claim 21, wherein at least one of different patterns and colors are printed on said main portion and said tongue piece, said neck portion acting as a boundary between said main portion and said tongue piece.

23. The ink tank cartridge of claim 18, further comprising at least one chamber partition wall extending from each partition, said chamber partition walls dividing each said first chambers into a plurality of sub-chambers.

24. The ink tank cartridge of claim 18, further comprising a projection formed on an inside wall of each of said second chambers disposed on a surface of said second chamber opposite said associated ink supply port, said projections compressing said associated porous members against said associated ink supply ports.

25. The ink tank cartridge of claim 24, wherein each said ink supply port includes a portion including its entrance projecting into said second chamber.

26. The ink tank cartridge of claim 24, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

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27. The ink tank cartridge of claim 18, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

28. The ink tank cartridge of claim 18, further comprising a respective vertically extending rib formed on an inner face of each of said first chambers, each of said ribs assisting in the flow of ink.

29. The ink tank cartridge of claim 18, wherein each said air vent port is formed in part as a meandering groove.

30. The ink tank cartridge of claim 1 wherein said second chamber is a foam chamber and said first chamber is an ink chamber.

31. The ink tank cartridge above of claim 1, wherein said cartridge is constructed to be removably mounted on said recording apparatus so that one of a plurality of ink supply needles of said apparatus is received in each ink supply port.

32. An ink-jet type recording apparatus for outputting ink onto a recording medium, comprising:

a recording head for ejecting ink;

~~a plurality of ink supply needles coupled to said recording head;~~ and

a multi-color ink tank cartridge ~~being~~ removably mountable onto ~~said plurality of ink supply needles~~ said recording head of said ink-jet type recording apparatus, said ink tank cartridge, including: for delivery of ink thereto

a plurality of first chambers;

a plurality of second chambers, each second chamber being adjacent to and associated with a first chamber;

a plurality of partition walls disposed in said cartridge, each said partition being formed with a communicating hole formed therein disposed between said associated chambers, said communicating hole being positioned in the vicinity of the bottom of said partition wall and extending only a portion of the width of said partition wall as viewed in the direction of said bottom of said partition wall; and

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a plurality of ink supply ports, each extending through a wall of a respective one of said plurality of second chambers, said plurality of ink supply ports supplying ink to the exterior of said cartridge, all of said first chambers and associated second chambers being formed as an integral unit.

33. The ink-jet type recording apparatus of claim 32, and including a porous member in each of said second chambers positioned to deliver ink to its associated ink supply port and an air vent port communicating between each said second chamber and the exterior of said cartridge at a location spaced from said ink supply port and communicating hole.

34. The ink-jet type recording apparatus of claim 33, wherein the porous member associated with each second chamber and the associated first chamber contain ink different from the ink in the other first and second chambers.

35. The ink-jet type recording apparatus of claim 33, wherein the porous member in each said second chamber and the associated first chamber contain ink, the pressure in each of said first chambers and each of said associated second chambers being at a value less than atmospheric pressure.

36. The ink-jet type recording apparatus of claim 35, wherein a pressure ~~difference~~ balance between each of said first chambers and each of said associated second chambers is maintained by the surface tension of each of said associated porous members in the vicinity of each of said associated communicating holes, each said porous member resiliently contacting said associated communicating hole, said pressure ~~difference~~ balance maintaining ink in each of said respective first chambers.

37. The ink-jet type recording apparatus of claim 36, wherein each said porous member, associated first and second chambers, partition wall, communication hole ink supply port and air vent port are positioned and dimensioned so that when said ink impregnated in each of said associated porous members is at least partially transmitted through said ink supply port, said pressure ~~difference~~ balance between said associated chambers is no longer maintained and ink is supplied from the first chamber to the associated porous

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member in the associated second chamber as required until the pressure ~~difference~~ balance is restored.

~~38~~. The ink-jet type recording apparatus of claim ~~37~~, further comprising an associated step portion formed at a lower portion of each of said communicating holes, a groove connecting said associated first and second chambers being formed in said ink cartridge below said associated step portion.

~~39~~. The ink-jet type recording apparatus of claim 37, further comprising a protrusion portion formed on an inner surface of said partition wall in each of said second chambers, each said protrusion portion maintaining a space about said associated communicating hole to aid in the flow of ink therethrough.

~~40~~. The ink-jet type recording apparatus of claim 37, further comprising a step portion formed below each of said communicating holes in said partition wall.

~~41~~. The ink-jet type recording apparatus of claim 40, wherein the part of each of said step portions adjacent said associated first chamber is higher than the part adjacent said associated second chamber.

38 ~~42~~. The ink-jet type recording apparatus of claim 37, further comprising a respective vertically extending thin groove formed in each said partition wall above each communicating hole and on the side of the associated second chambers, each of said grooves being in fluid communication with each associated communicating hole, each of said grooves aiding in the flow of air and ink between said associated first and second chambers.

39 ~~43~~. The ink-jet type recording apparatus of claim 33, further comprising a projection formed on an inside wall of each of said second chambers disposed on a surface of said second chamber opposite said associated ink supply port, said projections compressing said associated porous members against said associated ink supply ports.

40 ~~44~~. The ink-jet type recording apparatus of claim 39 ~~43~~, wherein each said ink supply port includes a ~~partition~~ projection including its entrance projecting into said second chamber.

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41 39
~~45~~. The ink-jet type recording apparatus of claim ~~43~~, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

42
~~46~~. The ink-jet type recording apparatus of claim 33, wherein the volume of each of said porous members is larger than the capacity of each of said associated second chambers.

43
~~47~~. The ink-jet type recording apparatus of claim 33, further comprising at least one chamber partition wall, said chamber partition wall extending from each said partition wall and dividing said first chamber into a plurality of such chambers while permitting communication between each such chamber and the associated second chamber through the associated communicating hole.

44
~~48~~. The ink-jet type recording apparatus of claim 37, further comprising a respective vertically extending rib formed on an inner surface of said first chamber, each of said ribs assisting in the flow of ink.

45
~~49~~. The ink-jet type recording apparatus of claim 32, wherein said first chamber and said second chamber are maintained at a pressure less than atmospheric pressure and said ink cartridge further comprises a plurality of air vent ports formed in a surface of said cartridge, each having an air-impermeable sealing member for selectively sealing said air vent ports when said ink cartridge is not in use and unsealing said air vent ports when said ink cartridge is to be used.

46 45
~~50~~. The ink-jet type recording apparatus of claim ~~49~~, wherein each of said air vent ports is formed in part as a groove on the outside surface of a wall of said second chamber.

47 45
~~51~~. The ink-jet type recording apparatus of claim ~~49~~, wherein said outside surface is of a top lid.

48 45
~~52~~. The ink-jet type recording apparatus of claim ~~49~~, wherein said sealing member comprises a main portion, and a tongue piece which is removably connected to said main portion via a neck portion.

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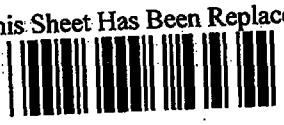

49 48
53. The ink-jet type recording apparatus of claim 52, wherein at least one of different patterns and colors are printed on said main portion and said tongue piece, said neck portion acting as a boundary between said main portion and said tongue piece.

50 45
54. The ink-jet type recording apparatus of claim 49, further comprising at least one chamber partition wall extending from each partition, said chamber partition walls dividing each said first chambers into a plurality of sub-chambers.

51 45
55. The ink-jet type recording apparatus of claim 49, further comprising a projection formed on an inside wall of each of said second chambers disposed on a surface of said second chamber opposite said associated ink supply port, said projections compressing said associated porous members against said associated ink supply ports.

52 51
56. The ink-jet type recording apparatus of claim 55, wherein each said ink supply port includes a portion including its entrance projecting into said second chamber.

53 51
57. The ink-jet type recording apparatus of claim 55, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

54 45
58. The ink-jet type recording apparatus of claim 49, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

55 45
59. The ink-jet type recording apparatus of claim 49, further comprising a respective vertically extending rib formed on an inner face of each of said first chambers, each of said ribs assisting in the flow of ink.

5660. The ink-jet type recording apparatus of claim 49, wherein each said air vent port is formed in part as a meandering groove.

5761. The ink-jet type recording apparatus of claim 32 wherein said second chamber is a foam chamber and said first chamber is an ink chamber.

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58 ~~62~~. The ink-jet type recording apparatus of claim 32, wherein said cartridge is constructed to be removably mounted on said recording apparatus so that one of a plurality of ink supply needles of said apparatus is received in each ink supply port.

59 ~~63~~. A system for supplying ink to an ink-jet type recording apparatus and outputting ink onto a recording medium, said system comprising:

a recording head for ejecting ink;

~~a plurality of ink supply needles coupled to said recording head~~; and

a multi-color ink tank cartridge ~~being~~ removably mountable onto said recording head ~~plurality of ink supply needles~~ for delivery of ink thereto of said ink-jet type recording apparatus, said ink tank cartridge, including:

a plurality of first chambers;

a plurality of second chambers, each second chamber being adjacent to and associated with a first chamber;

a plurality of partition walls disposed in said cartridge, each said partition being formed with a communicating hole formed therein disposed between said associated chambers, said communicating hole being positioned in the vicinity of the bottom of said partition wall and extending only a portion of the width of said partition wall as viewed in the direction of said bottom of said partition wall; and

a plurality of ink supply ports, each extending through a wall of a respective one of said plurality of second chambers, said plurality of ink supply ports supplying ink to the exterior of said cartridge, all of said first chambers and associated second chambers being formed as an integral unit.

60 ~~64~~. The system of claim 59 ~~63~~, and including a porous member in each of said second chambers positioned to deliver ink to its associated ink supply port and an air vent port communicating between each said second chamber and the exterior of said cartridge at a location spaced from said ink supply port and communicating hole.

61 ~~65~~. The system of claim 60 ~~64~~, wherein the porous member associated with each second chamber and the associated first

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chamber contain ink different from the ink in the other first and second chambers.

62 ~~66~~. The system of claim 60 ~~64~~, wherein the porous member in each said second chamber and the associated first chamber contain ink, the pressure in each of said first chambers and each of said associated second chambers being at a value less than atmospheric pressure.

63 ~~67~~. The system of claim 62 ~~66~~, wherein a pressure balance ~~difference~~ between each of said first chambers and each of said associated second chambers is maintained by the surface tension of each of said associated porous members in the vicinity of each of said associated communicating holes, each said porous member resiliently contacting said associated communicating hole, said pressure balance ~~difference~~ maintaining ink in each of said respective first chambers.

64 ~~68~~. The system of claim 63 ~~67~~, wherein each said porous member, associated first and second chambers, partition wall, communication hole ink supply port and air vent port are positioned and dimensioned so that when said ink impregnated in each of said associated porous members is at least partially transmitted through said ink supply port, said pressure balance ~~difference~~ between said associated chambers is no longer maintained and ink is supplied from the first chamber to the associated porous member in the associated second chamber as required until the pressure balance ~~difference~~ is restored.

~~69~~. The system of claim 68, further comprising an associated step portion formed at a lower portion of each of said communicating holes, a groove connecting said associated first and second chambers being formed in said ink cartridge below said associated step portion.

~~70~~. The system of claim ~~68~~, further comprising a protrusion portion formed on an inner surface of said partition wall in each of said second chambers, each said protrusion portion maintaining a space about said associated communicating hole to aid in the flow of ink therethrough.

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~~71~~. The system of claim 68, further comprising a ~~step~~ portion formed ~~below~~ each of said communicating ~~holes~~ in said partition wall.

~~72~~. The system ~~of~~ claim 71, ~~wherein~~ the part of each of said step ~~portions~~ adjacent said associated first ~~chamber~~ is higher than ~~the~~ part adjacent said associated second chamber.

65 ~~73~~. The system of claim ~~64~~ 68, further comprising a respective vertically extending thin groove formed in each said partition wall above each communicating hole and on the side of the associated second chambers, each of said grooves being in fluid communication with each associated communicating hole, each of said grooves aiding in the flow of air and ink between said associated first and second chambers.

66 ~~74~~. The system of claim 60 ~~64~~, further comprising a projection formed on an inside wall of each of said second chambers disposed on a surface of said second chamber opposite said associated ink supply port, said projections compressing said associated porous members against said associated ink supply ports.

67 ~~75~~. The system of claim 66 ~~74~~, wherein each said ink supply port includes a ~~partition~~ projection including its entrance projecting into said second chamber.

68 ~~76~~. The system of claim 66 ~~74~~, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

69 ~~77~~. The system of claim 60 ~~64~~, wherein the volume of each of said porous members is larger than the capacity of each of said associated second chambers.

70 ~~78~~. The system of claim 60 ~~64~~, further comprising at least one chamber partition wall, said chamber partition wall extending from each said partition wall and dividing said first chamber into a plurality of such chambers while permitting communication between each such chamber and the associated second chamber through the associated communicating hole.

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71 ~~79~~. The system of claim 64 ~~68~~, further comprising a respective vertically extending rib formed on an inner surface of said first chamber, each of said ribs assisting in the flow of ink.

72 ~~80~~. The system of claim 59 ~~63~~, wherein said first chamber and said second chamber are maintained at a pressure less than atmospheric pressure and said ink cartridge further comprises a plurality of air vent ports formed in a surface of said cartridge, each having an air-impermeable sealing member for selectively sealing said air vent ports when said ink cartridge is not in use and unsealing said air vent ports when said ink cartridge is to be used.

73 ~~81~~. The system of claim 72 ~~80~~, wherein each of said air vent ports is formed in part as a groove on the outside surface of a wall of said second chamber.

74 ~~82~~. The system of claim 72 ~~80~~, wherein said outside surface is of a top lid.

75 ~~83~~. The system of claim 72 ~~80~~, wherein said sealing member comprises a main portion, and a tongue piece which is removably connected to said main portion via a neck portion.

76 ~~84~~. The system of claim 75 ~~83~~, wherein at least one of different patterns and colors are printed on said main portion and said tongue piece, said neck portion acting as a boundary between said main portion and said tongue piece.

77 ~~85~~. The system of claim 72 ~~80~~, further comprising at least one chamber partition wall extending from each partition, said chamber partition walls dividing each said first chambers into a plurality of sub-chambers.

78 ~~86~~. The system of claim 72 ~~80~~, further comprising a projection formed on an inside wall of each of said second chambers disposed on a surface of said second chamber opposite said associated ink supply port, said projections compressing said associated porous members against said associated ink supply ports.

79 ~~87~~. The system of claim 78 ~~86~~, wherein each said ink supply port includes a projection ~~portion~~ including its entrance projecting into said second chamber.

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80 ~~88~~. The system of claim ~~86~~, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

81 ~~89~~. The system of claim ~~80~~ 72, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

82 ~~90~~. The system of claim ~~80~~ 72, further comprising a respective vertically extending rib formed on an inner face of each of said first chambers, each of said ribs assisting in the flow of ink.

83 ~~91~~. The system of claim ~~80~~ 72, wherein each said air vent port is formed in part as a meandering groove.

84 ~~92~~. The system of claim ~~63~~ 59, wherein said second chamber is a foam chamber and said first chamber is an ink chamber.

85 ~~93~~. The system of claim ~~63~~ 59, wherein said cartridge is constructed to be removably mounted on said recording apparatus so that one of a plurality of ink supply needles of said apparatus is received in each ink supply port.

86 ~~94~~. A method for providing ink to an ink-jet type recording head, comprising the steps of:

providing an ink tank cartridge having a plurality of first chambers adapted to store ink and a plurality of second chambers adapted to receive a respective porous member impregnated with ink;

separating each of said first and second chambers from each other by use of a partition wall;

communicating ink between said associated first and second chambers through a communicating hole adjacent the bottom of said partition and extending only a portion of the width of said partition wall as viewed in the direction of said bottom of said partition wall, withdrawing ink from each porous member in each second chamber through an ink supply port extending through a wall of each second chamber; and

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providing ambient air to each second chamber at a location spaced from said ink supply port.

87 ~~95~~. The method of claim 86 ~~94~~, further comprising the steps of:

maintaining the pressure in each of said first and second chambers below normal atmospheric pressure;

maintaining a pressure ~~difference~~ balance between each pair of associated first and second chambers by the surface tension of said porous member in the vicinity of said communicating hole;

the withdrawal of ink from a porous member through an associated ink supply port upsetting the pressure balance between said associated first and second chambers so that ink flows from said first chamber to said second chamber until said pressure balance is restored.

88 ~~96~~. The method of claim 86 ~~94~~, further comprising the steps of:

forming air vents at least in part as winding grooves in a surface of said ink tank cartridge to protect said ink against evaporation.

89 ~~97~~. The method of claim 88 ~~96~~, further comprising the steps of:

sealing said grooves with a seal member;

removing a portion of said seal to place the interior of said ink supply tank in fluid communication with ambient air through said winding grooves.

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* C L M S *

ABSTRACT OF THE DISCLOSURE

An ink tank cartridge for an ink-jet type recording apparatus is provided. The ink tank cartridge comprises a plural number of first chambers and a plural number of second chambers adjacent to and associated with a first chamber, each pair of first and second chambers being formed as an integral unit. The ink tank cartridge also has a partition wall disposed in the cartridge which separates each second chamber from an associated first chamber, the two chambers communicating through a communicating hole positioned near the bottom of the partition wall disposed between the associated chambers. The communicating hole extends only a portion of the width that the partition wall. Finally, a plural number of ink supply ports, each extending through a wall of a respective one of the plural number of first chambers, supply ink to the exterior of the ink cartridge from each respective porous member of the plural number of porous members.

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FIG. 1

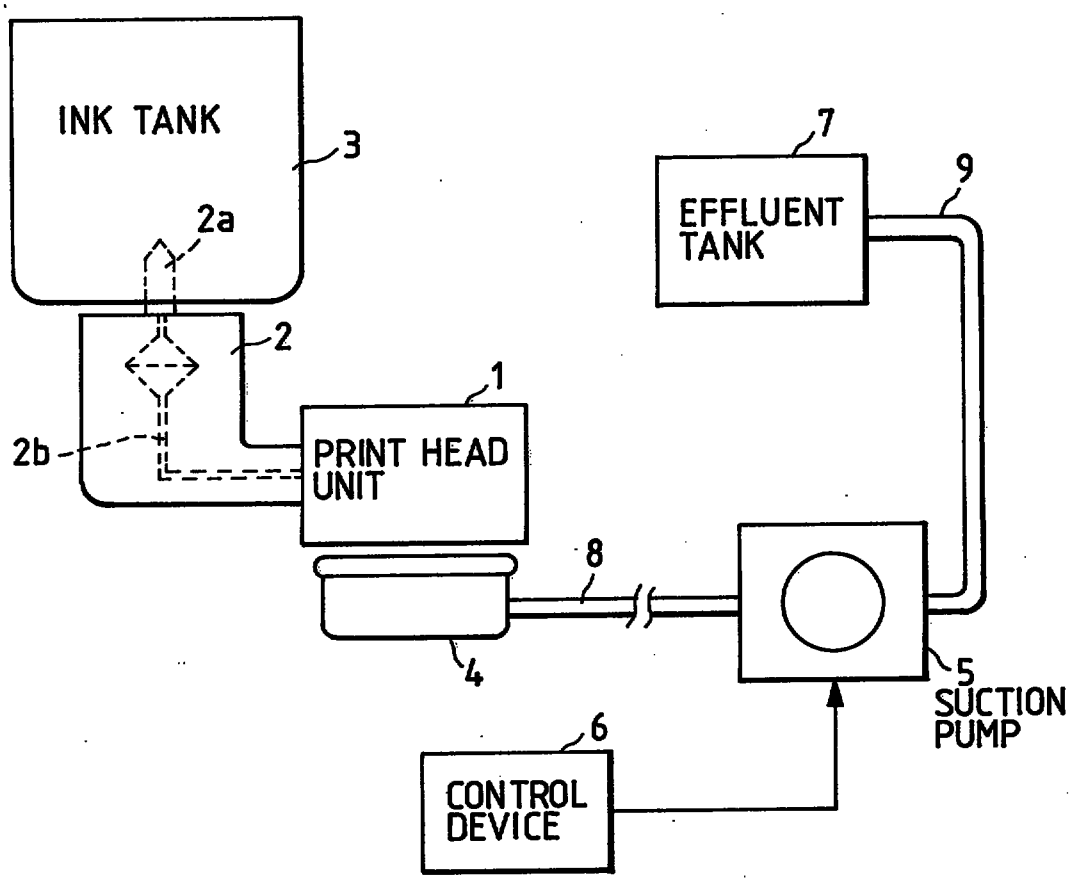

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FIG. 2

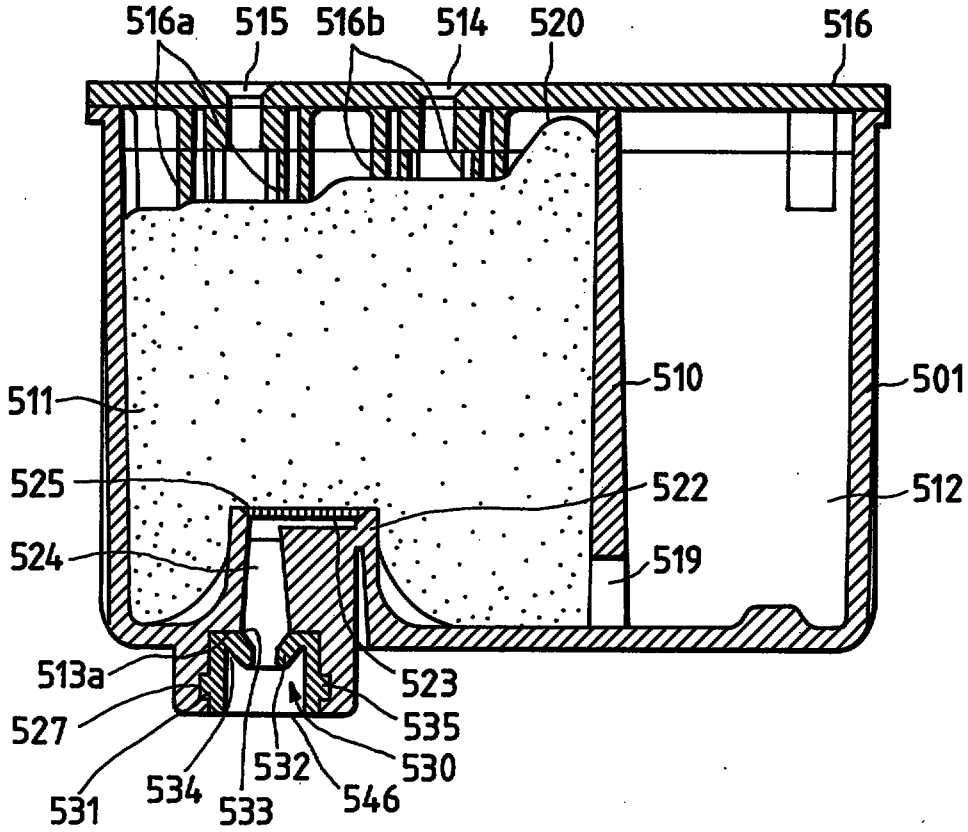

FIG. 3

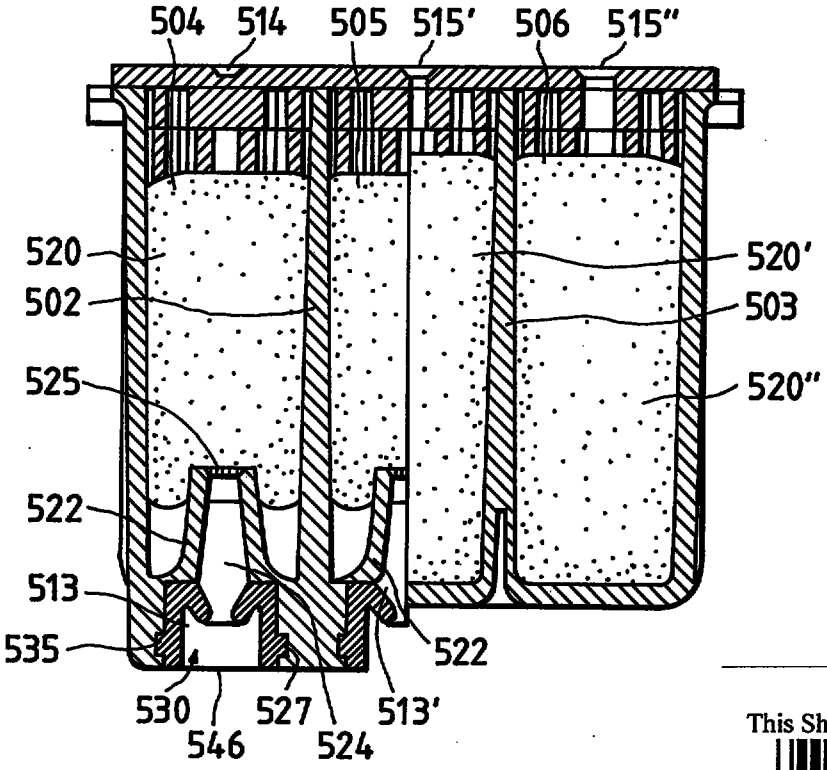

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FIG. 4

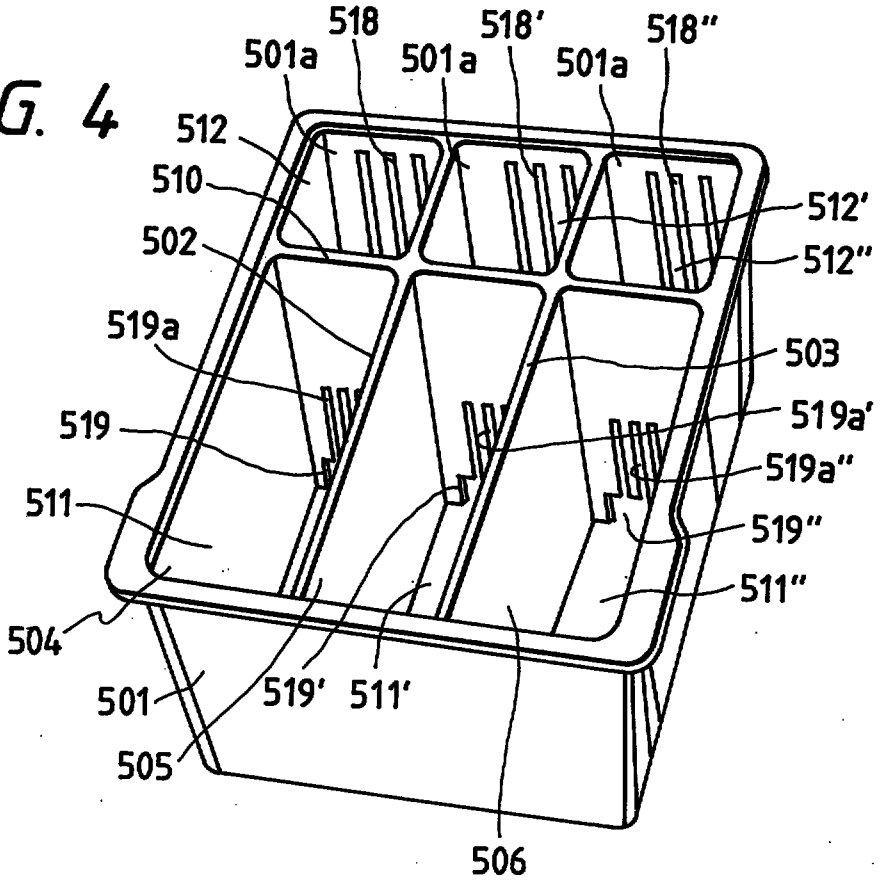

FIG. 5

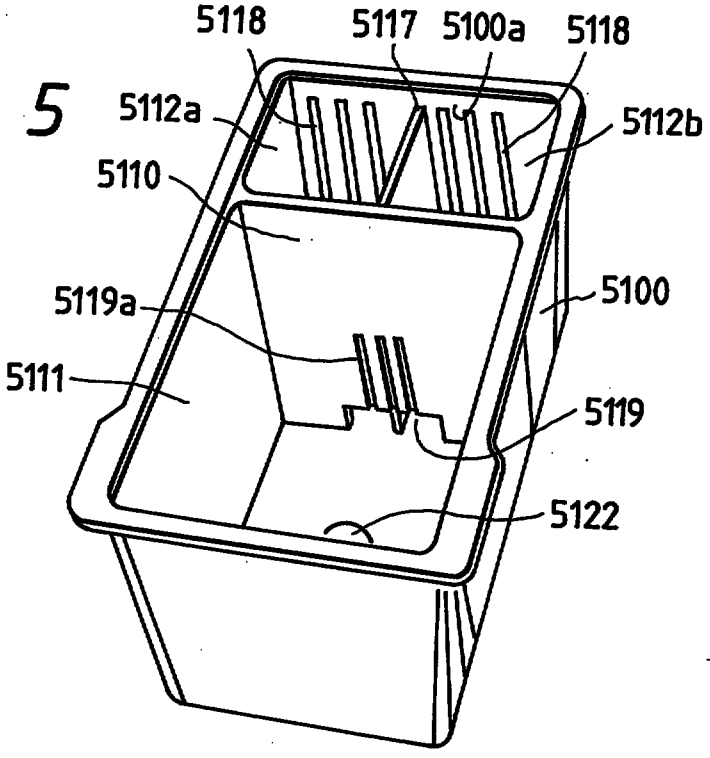

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FIG. 6(a)

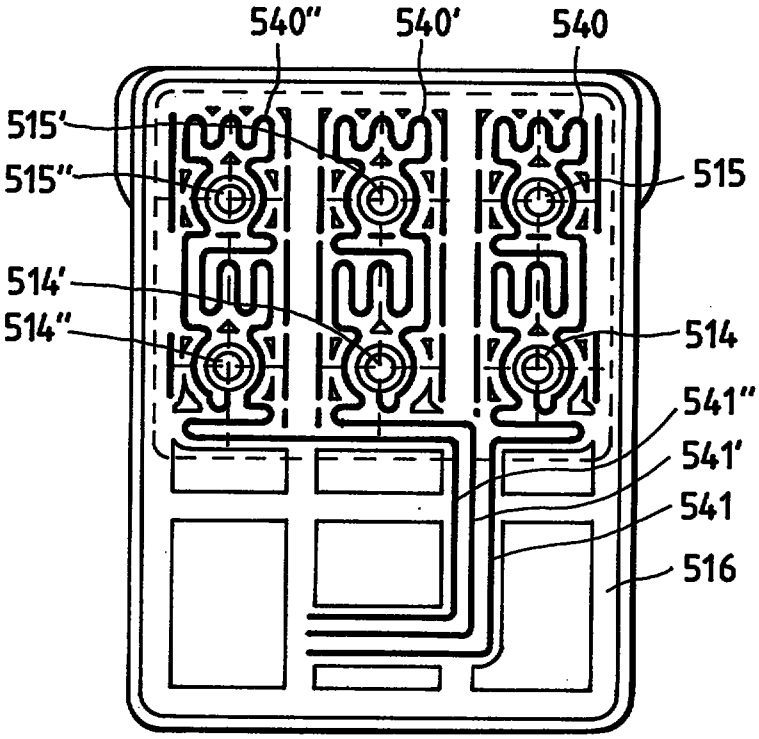

FIG. 6(b)

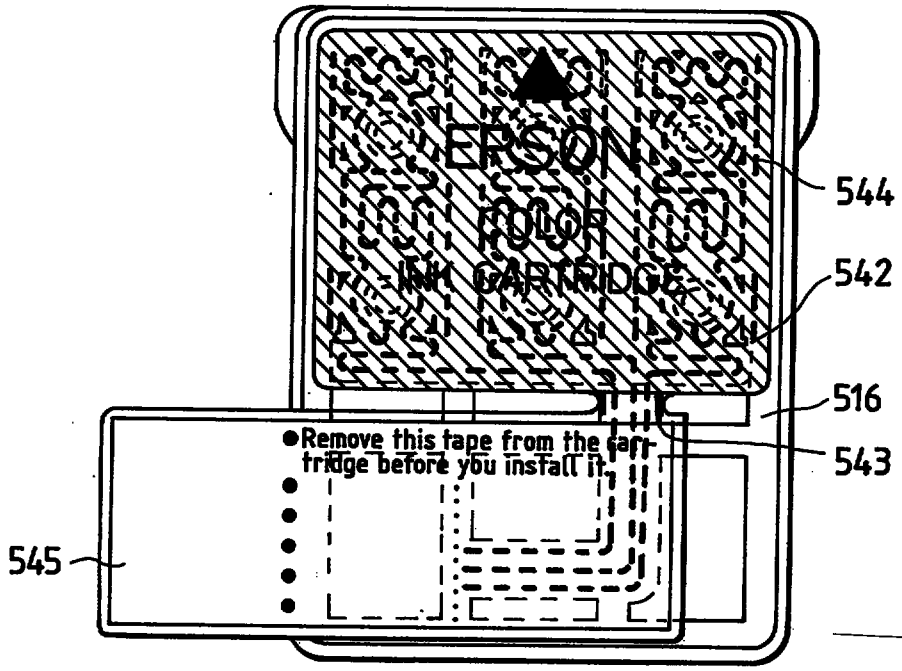

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FIG. 7(a)

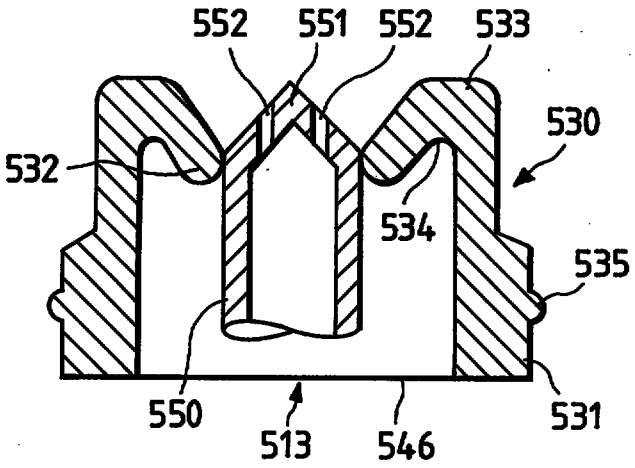

FIG. 7(b)

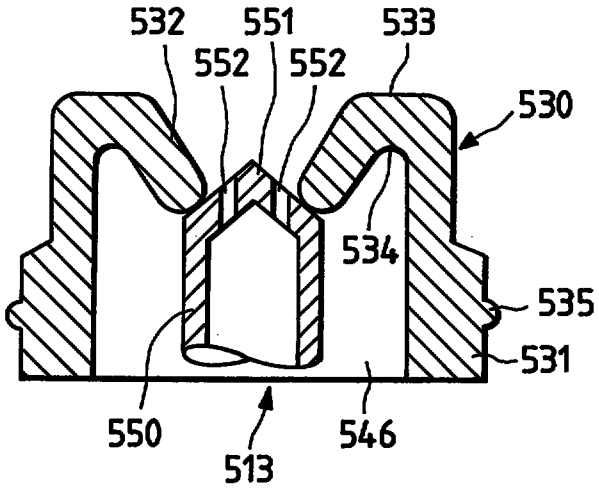

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FIG. 8

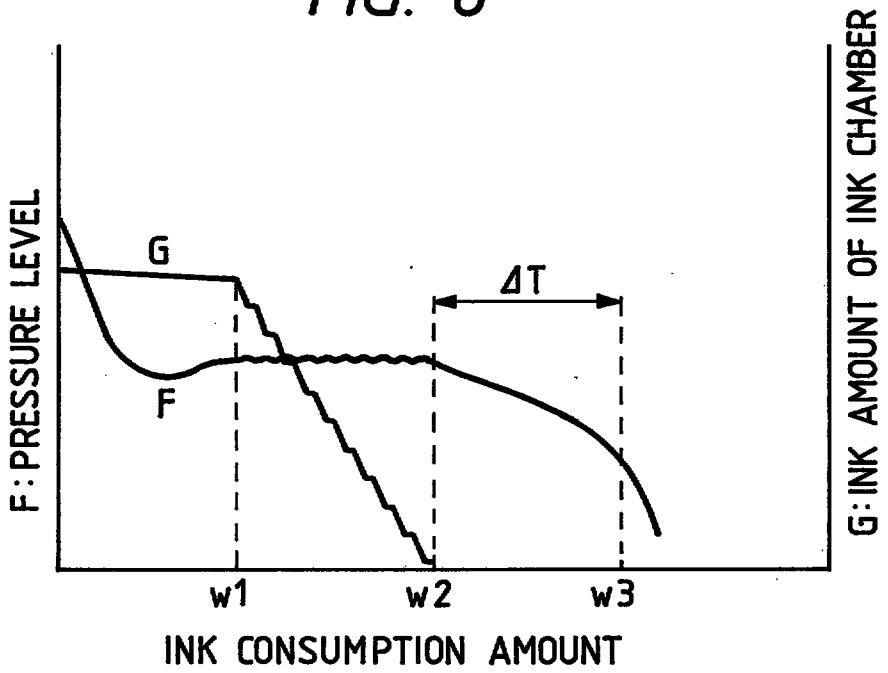

FIG. 15

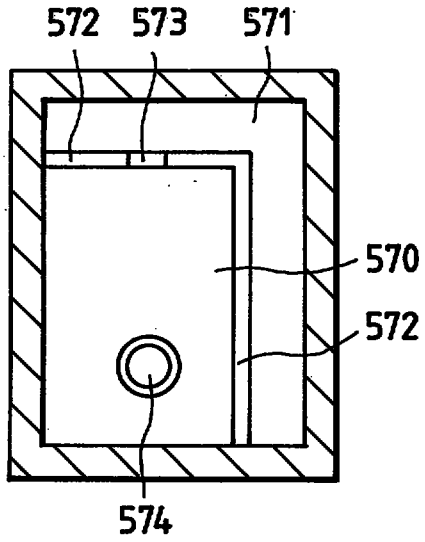

FIG. 16

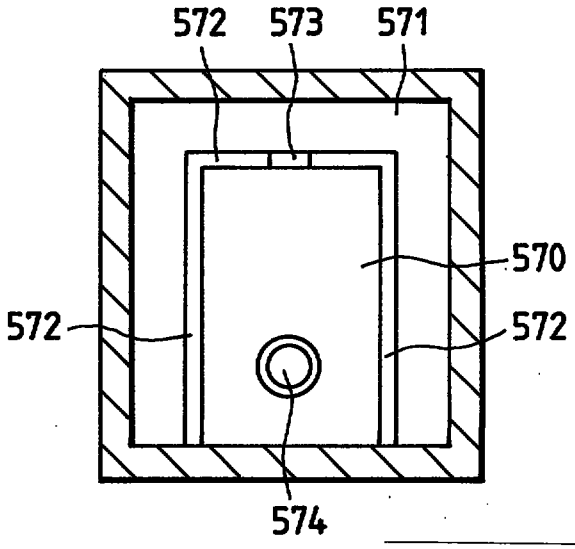

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FIG. 9

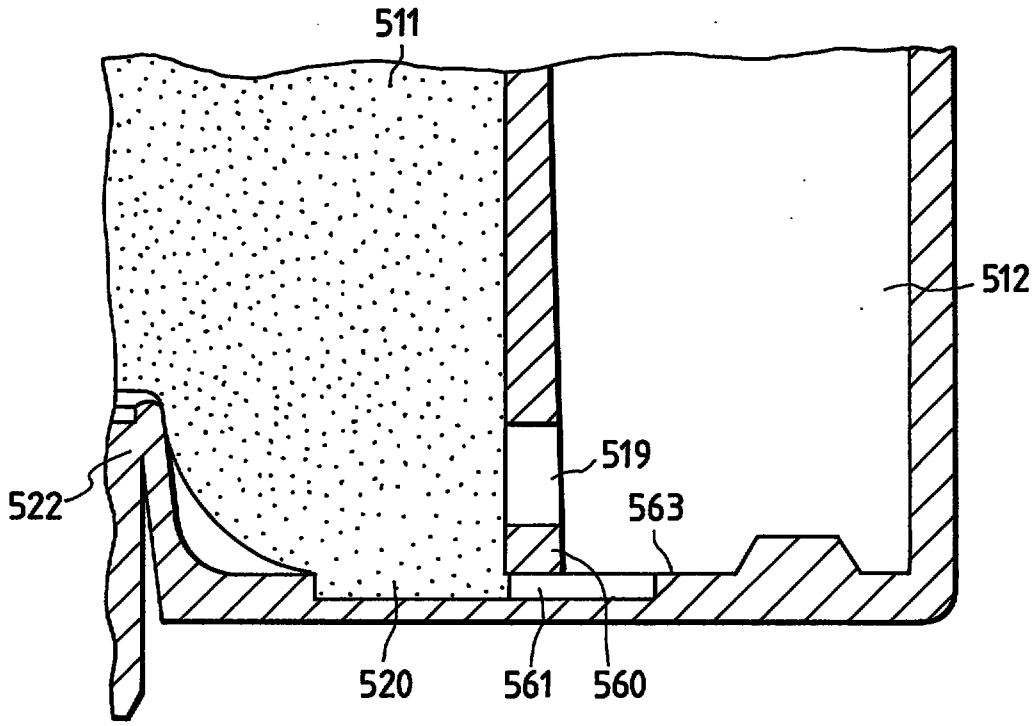

FIG. 10

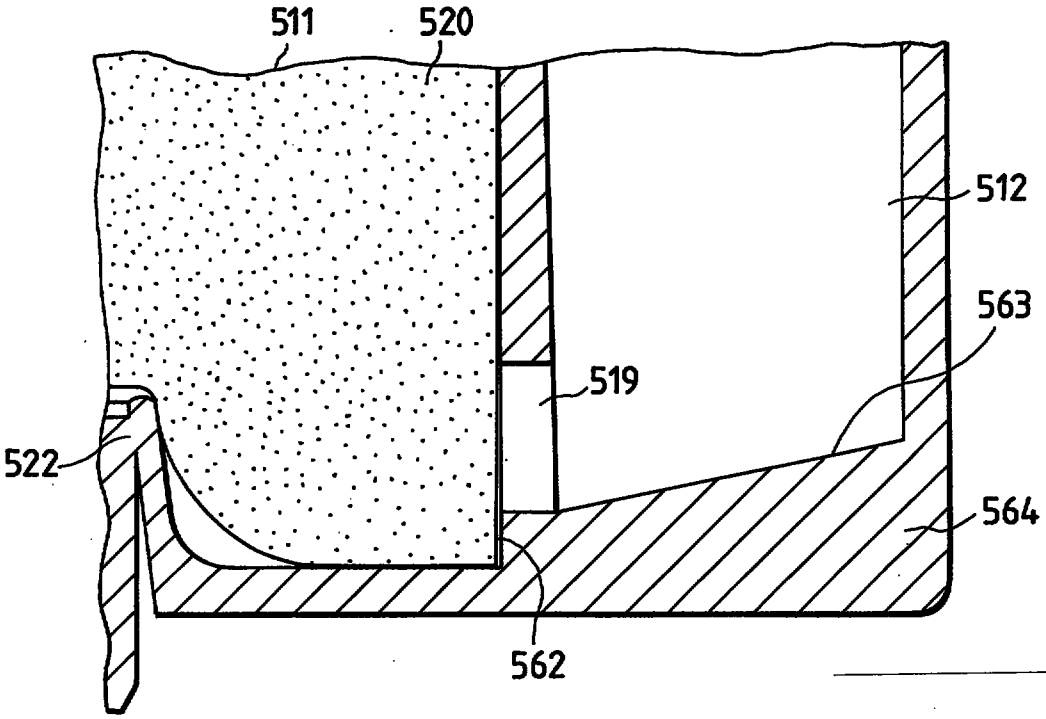

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FIG. 11

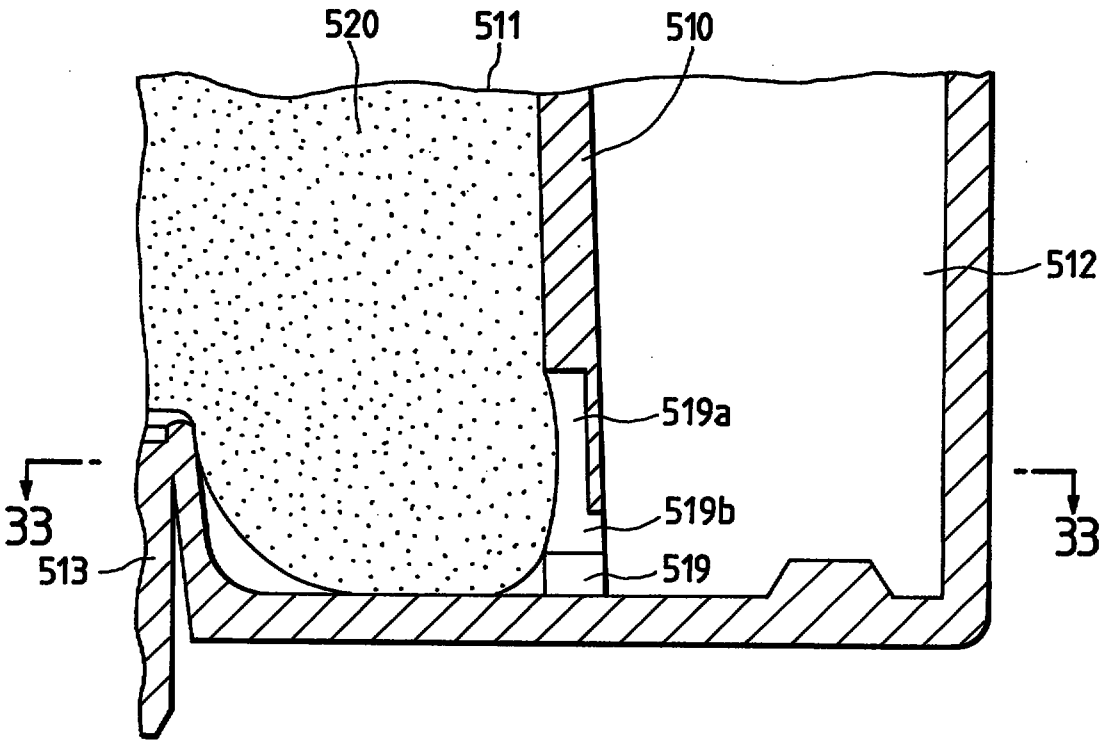

FIG. 12

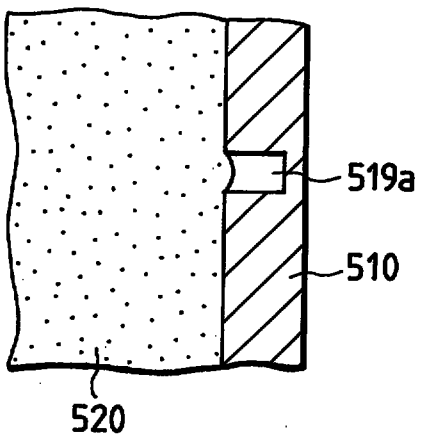

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FIG. 13

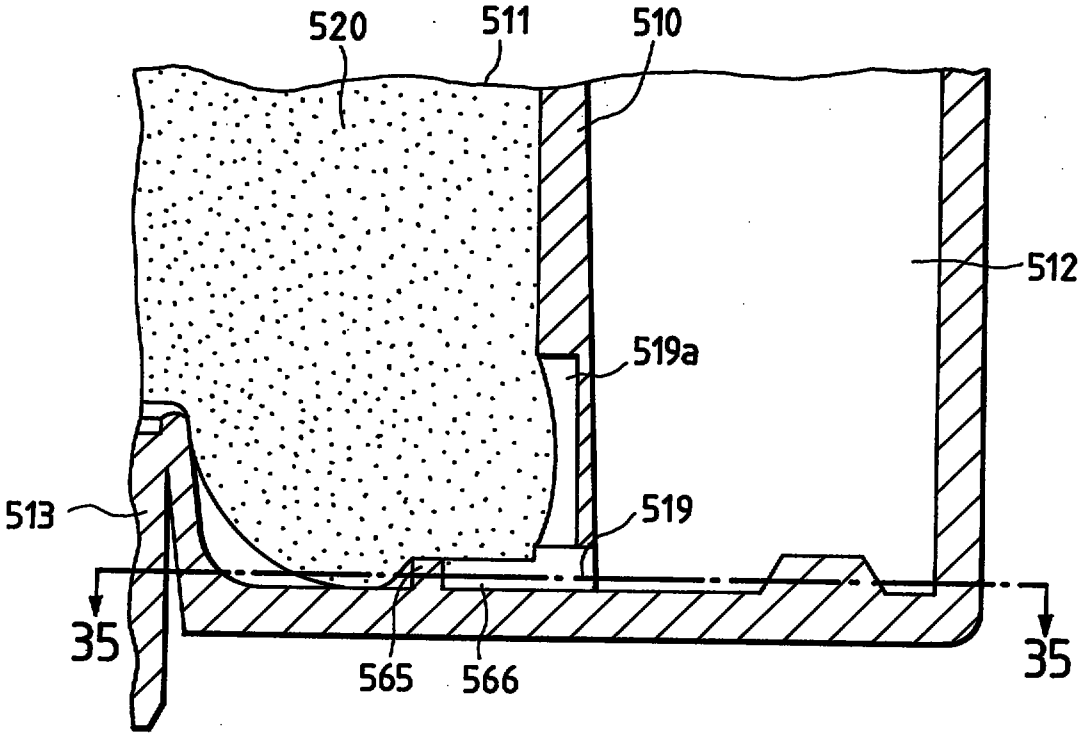

FIG. 14

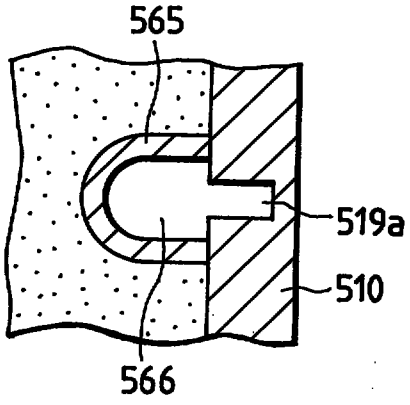

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FIG. 17

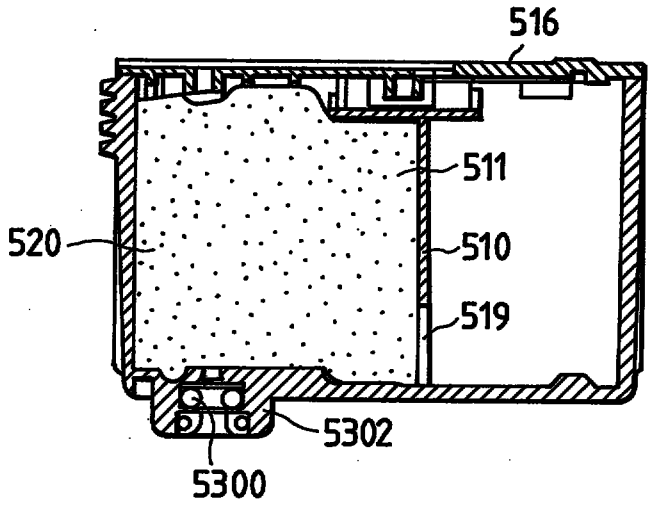
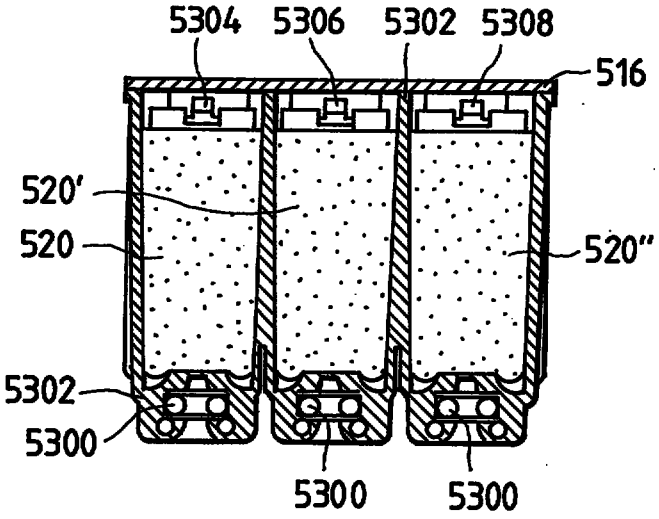


FIG. 18



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REPLACEMENT SHEETS SG
☑ Description : paged ..1. to paged ..21.
☑ Claim(s) : paged ..22. to paged ..37.
☑ Drawing(s) : paged ..1. to paged ..11.
☑ Abstract : paged ..1. to paged .....
DATE OF RECEIPT 25 MAR 1996

INK-SUPPLIED PRINTER AND INK SUPPLY TANK

PF 13 dated 25.

BACKGROUND OF THE INVENTION

The present invention relates generally to an ink-supplied printer being supplied with ink from an ink supply tank and more particularly to an ink supply tank which allows for the continuous supply of ink to the printer head while avoiding adverse effects from temperature, atmospheric changes or vibrations. The present invention allows for a larger volume of ink in the ink supply tank and allows for a greater percentage of the ink in the tank to be transferred to the printer head. Also, the present invention comprises a tank with transparent sides so the user is able to easily determine the remaining quantity of ink, and also means for dampening of the unwanted movement of ink within the ink supply tank.

This invention also relates to an ink cartridge for an ink jet printer in which an ink jet recording head, and an ink cartridge are mounted on a movable carriage, and in particular an ink jet cartridge in which upon depletion of the ink from the old cartridge, is replaced with a new ink cartridge.

A prior art ink jet printer in which an ink containing unit and an ink jet recording head are mounted on a carriage is disclosed in European Patent Publication No. 581,531. In the disclosed printer, in order to prevent printing failures caused by variation of the ink level or air bubbles due to movement of the ink cartridge, which is caused by the movement of the carriage, the ink container is divided into two regions. A first region of the container adjacent the recording head houses ink impregnated in a porous member, and a second region contains liquid ink without a porous member. This structure enables the ink to be conducted to the recording head via the porous member so that the problems

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arising from movement of the ink in the cartridge are prevented from occurring to a certain extent.

The porous member is held in fluid communication with the recording head by a projecting member which is inserted through a hole formed in the side portion of the container. However, such a structure cannot be applied to a recording head in which air bubbles must be stopped from entering a pressure chamber, such as that for an ink jet printer in which a piezoelectric vibrator is used as an actuator for ink ejection.

Accordingly, a ink jet printer which solves the above-mentioned problems is derived.

SUMMARY OF THE INVENTION

Generally speaking, in accordance with the present invention, there is provided an ink-supplied printer. Ink is supplied to a printer head by an ink supply system, including an ink tank having an ink supply port and a pair of side walls. An ink absorbing member is contained therein adjacent the ink supply port which occupies less than the total volume of the ink tank. The walls of the ink supply tank may be transparent so the user can more easily determine the amount of ink remaining in the ink supply tank.

An ink receiving and transferring member terminating in an ink port may extend into the ink tank, in which case the ink absorbing member abuts and is locally compressed by the ink receiving and transmitting member. The ink receiving and transmitting member has a capillary ink path communicating with the printer head and is supplied with ink from the ink absorbing member.

More specifically an ink cartridge is formed of a ink chamber for storing ink and a foam chamber for receiving a porous member for absorbing ink. A partition

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separates the ink chamber from the foam chamber and has a hole therein so that the foam chamber is in fluid communication with the ink chamber. The ink cartridge is also formed with an ink supply port. A funnel shaped packing member is disposed within the supply port and supplies ink to a recording head by generation of a pressure difference through the porous member. The packing member is disposed facing upward in the ink supply port. The packing member is resilient.

When an ink supply needle of the recording head is inserted into the ink supply port, the tip of the needle resiliently contacts with the packing member. Since the packing member has a funnel-like shape which opens upward, the packing member is easily deformed so as to follow the ink supply needle. Furthermore, the packing member is caused to closely contact with the needle by its resiliency. Therefore, a relative misalignment between the ink supply needle and the ink supply port can be accommodated so that the ink supply port is securely sealed.

Accordingly, it is an object of the invention to provide an improved ink cartridge for an ink jet printer.

It is an object of the present invention to provide a high-quality and highly reliable ink-supplied printer of a simple construction which is capable of supplying a stable and appropriate quantity of ink from an ink tank to a printer head and is less subject to the influence of environmental changes such as temperature or atmospheric variations.

It is a further object of the invention to provide a cartridge for an ink jet printer which can be mounted using minimal force and with a large tolerance for misalignment of the ink supply needle, which can cooperate with a recording head to attain a sufficient hermetic seal, while producing a dead space as small as possible.

Yet another object of the invention is to prevent air bubbles from entering the

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recording head while maintaining a negative pressure in the chamber containing the porous member.

Still other objects, features and advantages of the present invention will become more apparent from the following description when taken in conjunction with the accompanying drawings in which preferred embodiments of the present invention are shown by way of illustrative example and not in a limiting sense.

The invention accordingly comprises the several steps and relation of one or more of such steps with respect to each of the others, and the apparatus embodying features of construction, combinations of elements and arrangement of parts which are adopted to effect such steps, all as exemplified in the following detailed disclosure, and the scope of the invention will be indicated in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

For a full understanding of the invention, reference is had to the following description taken in connection with the accompanying drawings, in which:

FIG. 1 is a schematic view showing an ink supply system of an ink-jet type recording apparatus according to one embodiment of the present invention;

FIG. 2 is a cross-sectional view of a multi-color ink jet printer cartridge constructed in accordance a first embodiment of the invention;

FIG. 3 is a cross-sectional view of the first embodiment rotated 90° from the view in FIG. 2;

FIG. 4 is a perspective view showing the ink cartridge of FIGS. 2 and 3 with the lid removed;

FIG. 5 is a perspective view showing a single color ink cartridge constructed in accordance with a second embodiment of the invention;

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FIG. 6(a) is a top plan view of the lid of FIG. 2;

FIG. 6(b) is a top plan view showing the lid with a seal affixed thereto;

FIG. 7(a) is a cross-sectional view showing a packing member with an ink supply needle inserted therein in accordance with the invention;

FIG. 7(b) is a cross-sectional view of the packing member prior to insertion;

FIG. 8 is a graph showing the relationships of the ink consumption, the pressure level, and the amount of ink remaining in an ink chamber;

FIG. 9 is a partial cross-sectional view of the ink cartridge showing the boundary between ink and foam chambers in accordance with a third embodiment of the invention;

FIG. 10 is a partial cross-sectional view of the ink cartridge showing the boundary between ink and foam chambers in accordance with a fourth embodiment of the invention;

FIG. 11 is a partial cross-sectional view of the boundary between ink and foam chambers of an ink cartridge constructed in accordance with a fifth embodiment of the invention;

FIG. 12 is a cross-sectional view taken along line 33-33 of FIG. 11;

FIG. 13 is a partial cross-sectional view showing the boundary between ink and foam chambers of an ink cartridge constructed in accordance with a sixth embodiment of the invention;

FIG. 14 is a cross-sectional view taken along line 35-35 of FIG. 13;

FIG. 15 is a cross-sectional view showing an ink cartridge constructed in accordance with a seventh embodiment of the invention;

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FIG. 16 is a cross-sectional view showing an ink cartridge constructed in accordance with a eighth embodiment of the invention;

FIG. 17 is a cross-sectional view showing an ink cartridge for an ink jet printer constructed in accordance with a ninth embodiment of the invention; and

FIG. 18 is a cross-sectional view of the ninth embodiment of the invention rotated 90° from FIG. 17.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A printer head according to the present invention may be used in four-color printer plotter or color image printer and has four-color ink systems and ink jets corresponding respectively to four ink colors. The four-color printer plotter employs black, red, green and blue inks, and moves the head or a sheet of print paper or both and then ejects ink as in a conventional ink jet print head, corresponding to a desired one of the colors against the print paper at a prescribed position thereon to form an ink dot. Desired characters and figures can thus be recorded by repeating the above cycle. The present invention is applicable to ink jet printers of all varieties, including print heads using heat from heated resistors or the like or the displacement of piezoelectric or with transducers to project a drop of ink from a chamber upon application of a print signal. The ink supply tanks according to the invention can supply ink continuously to said chambers through capillary paths.

In a color image printer using inks of four colors, that is, black, red, green and blue, a sheet of print paper is scanned by a printer head in a direction perpendicular to the direction of feed of the print paper to form one-dot line in one scanning stroke, and the print paper is fed along by line pitches to record images. In seven-color printers, inks of four colors, that is, black, yellow, magenta and cyan, are used, and the colors of red,

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green and blue are formed on a sheet of print paper by superimposing inks of two out of the three desired colors other than black, thereby recording color images of seven colors.

The present invention is concerned primarily with the printer head, and in particular with the ink tanks, and detailed description of the overall printer construction will be given only by way of a single example.

Fig. 1 is a schematic view showing an ink supply system of an ink-jet type recording apparatus according to one embodiment of the present invention.

A print head unit 1 of an ink-jet type is connected to an ink tank 3 through a connecting member 2. Ink is supplied from the ink tank 3 to the print head unit 1 through a hollow needle 2a and an ink supply passage 2b of the connecting member 2, so that the print head unit 1 emits ink droplets in accordance with print signals.

The apparatus shown in Fig. 1 also includes a cap member 4 disposed at non-printing area, which cap member comes into abutment against the nozzle plate of the print head unit 1 by a drive mechanism (not shown) for preventing the nozzle openings from drying. The cap member 4 is connected through a tube 8 to a suction pump 5 which is operated by a control device 6 to suck ink from the print head unit 1 through the cap member 4. The apparatus shown in Fig. 1 is also provided with an effluent tank 7 connected to an outlet port of the suction pump 5 through a tube 9.

The recording head may be of any structure such as described in European Patent Publication Nos. 581,531, 609,863, 584,823 and so on.

The ink cartridge is configured so as to be mounted with a small force and with accommodating a misalignment of a certain degree. Reference is first made to FIGS. 2 and 3 which depict an ink cartridge constructed in accordance with a first embodiment of the invention. A main container 501, is divided into three compartments 504, 505, and

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506 by partitions 502 and 503 as shown in FIG. 3. Each of the three compartments 504, 505, and 506 is divided by a center partition wall 510 into foam chambers 511, 511' or 511" housing a respective porous member 520, 520' or 520" and ink chambers 512, 512' or 512" which are adapted to contain liquid ink. Foam chambers 511, 511', 511" are dimensioned to receive a respective porous member 520, 520' 520".

The volume of each of porous members 520, 520' and 520" is selected so as to be larger than the capacity of each of the respective foam chambers 511, 511' or 511", so as to be compressed while being retained in the respective foam chamber in a preferred embodiment. The ratio of the capacities of each foam chamber 511, 511' or 511" and each ink chamber 512, 512' or 512" is selected so that each foam chamber 511, 511' or 511" is dimensioned to hold 20 to 30% more ink than the respective ink chamber 512, 512' or 512".

When inks of three colors are contained within a single cartridge as in FIGS. 2 - 4, it may be difficult to see if different amounts of ink remain in the chambers, which may be caused by unbalanced consumption of the different color inks. When ink of one color is depleted, and the user wishes to dispose of the cartridge, the user need not unnecessarily worry about any remaining ink of the other colors in the cartridge leaking. When a cartridge of the invention is disposed of, ink is prevented from flowing out of the cartridge because ink of each color is absorbed by each respective porous member, thereby protecting the environment from any leakage of ink.

Ink supply ports 513, 513' and 513" (not shown), chamber 511 being exemplary of each chamber 511, 511' and 511", are formed in main container 501 within a respective foam chamber 511, 511', 511". Each ink supply port 513, 513' and 513" is adapted to engage with a respective ink supply needle (not shown) of the recording head

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which are inserted at the lower end of each of the foam chambers 511, 511' and 511".

Referring now to FIG. 2 and 3, the upper end of the main container 501 is sealed by a lid 516. Two ink filling ports 514 and 515 are formed at positions on lid 516 corresponding to foam chamber 511. Similarly, as shown in FIG 6(a), each chamber 511, 511' and 511" includes corresponding ink filling ports 514 and 515, 514' and 515', and 514" and 515". Projections 516a and 516b, FIG. 2, are integrally formed with the inner surface of lid 516 and are positioned in foam chamber 511, so as to surround filling ports 515 and 514, respectively. Porous member 520 is compressed by projections 516a and 516b against the bottom wall of foam chamber 511 in which ink supply port 513 is formed. Projections 516a' and 516b', and 516a" and 516b" are similarly formed in the inner wall of lid 516, and are positioned in foam chambers 511' and 511", which contain ink supply ports 513' and 513", respectively as shown in FIG. 3.

Projection 516a which opposes ink supply port 513 is formed with its lower tip located at a position lower than the lower tip of projection 516b, whereby the position of porous member 520 in the vicinity of ink supply port 513 is compressed to the greatest extent.

Protrusion portions 522, 522' and 522" (collectively "522"), which cooperate with lid 516 to compress porous members 520, 520' and 520" respectively are formed on the bottom of each of foam chambers 511, 511' and 511". Recesses 523, 523' and 523" (collectively "523"), which define spaces having a fixed opening area, are formed at the upper end of respective protrusion portions 522. Through holes 524, 524' and 524" (collectively "524") are disposed within the respective protrusion portions 522. One end of each through hole 524 is in fluid communication with the spaces defined by recesses 523 and the other end with a respective packing (collectively "530"), which will be

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hereinafter described. Filters 525, 525' and 525" (not shown) (collectively "525") are fixed to the upper end of recesses 523 respectively.

Packing members 530 of which only 530 is shown, are disposed at the lower end of ink supply ports 513, 513' and 513" respectively and are made of a resilient material such as rubber. Packing members 530, are configured as a funnel-shaped packing which opens upward. The lower ends of tubular portions 531 are thicker than the other portions. The respective upper peripheral edges 533 of taper portions 532 of respective packing members 530 contact with step portions 513a of respective ink supply ports 513, 513' and 513". Each packing member 530 is formed with protrusions 535 received by groove portion 527 within the inner wall of ink supply port 513. The boundary between tubular portions 531 and taper portions 532, are configured as thin connection portions 534.

In this design, packing members 530 are fixed by tubular portions 531 to respective ink supply ports 513. Additionally, upward movement of upper peripheral edges 533 is prevented by respective step portions 513a. Thus, even when the respective ink supply needle is inserted or extracted, packing members 530 are adequately fixed to ink supply ports 513. Since taper portions 532 serve to attain the hermetic seal between the packing member of the respective ink supply port 513 and the ink supply needle by the respective thin connection portions 534, the taper portions can be moved somewhat without causing deformation. Consequently, the air tight seal between the respective packing member and ink supply needle can be maintained while accommodating a relative misalignment between the respective ink supply needle and ink supply port.

Communicating holes 519, 519' and 519" are formed in center partition wall 510, which separates foam chambers 511, 511' and 511" from ink chambers 512, 512' and

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512" respectively. Slots 519a, 519a' 519a" which extend to a predetermined height are formed to be in communication with communicating holes 519, 519' and 519" respectively for gas-liquid replacement. Between each respective pair of foam and ink chambers 511 and 512, 511' and 512', and 511" and 512", porous members 520, 520' and 520" are housed in the foam chambers 511, 511' and 511" respectively in such a manner that each porous member is held against the respective communicating hole 519, 519' or 519". Ribs 518, 518' and 518" are formed on a back wall 501a of container 501 within a respective ink chamber 512, 512' and 512". An individual communication hole is formed between each respective chamber pair 511, 512, and extend along only a portion of the length of partition 510 formed thereat.

In a second embodiment of the invention an ink cartridge is utilized for a single color ink. A cartridge 5100 for a single color, or black ink can be made smaller in size than that for color inks, but the ink chamber 5112 for black ink would have a larger capacity than each of the corresponding chambers for a color ink. According to the second additional embodiment of the invention, a cartridge for black ink is shown in FIG. 5 having a partition wall 5117 formed within a container 5100 so as to extend between center partition wall 5110 which separates a foam chamber 5111 from a ink chamber 5112 and a side wall 5100a of main container 5100, thereby dividing ink chamber 5112 into two cells 5112a and 5112b. This structure prevents container 5100 from being deformed by a negative pressure produced during the ink filling process which will be hereinafter described, or by an external pressure during usage, thereby preventing any ink from leaking. Cells 5112a and 5112b are retained in fluid communication with foam chamber 5111 via a communicating hole 5119 in center partition 5110 which extends along only a portion of the length of partition 5110. In addition, a communicating hole may be formed

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in the lower portion of partition wall 5117.

On the inner face of wall 5100a, which can easily be seen when the cartridge is mounted on a carriage, a plurality of ribs 5118 are formed which extend vertically along inner face 5100a. These ribs allow ink to flow more easily down along wall 5100a, and the user can easily recognize the amount of ink remaining in the cartridge by seeing the ink level.

Reference is now made to FIGS. 6(a) and 6(b) which depict lid 516 constructed in accordance with the first additional embodiment of the invention. Ink filling holes 514, 514' and 514", and 515, 515' and 515" are formed in the regions of lid 516 corresponding to the placement of porous members 520, 520' and 520" within container 501. Air communicating ports 541, 541' and 541" are connected to ink filling holes 514, 514' and 514" via grooves 540, 540' and 540", respectively.

When a seal 542 for covering ink filling holes 514, 514' and 514", 515, 515' and 515", and air vent ports 541, 541' and 541" is fixed to the upperside of lid 516, FIG. 6(b), after ink foam chambers 511, 511' and 511" are filled, grooves 540, 540' and 540" form capillary tubes with seal 542. A tongue piece 545 of seal 542, which protrudes from lid 516, is formed with a neck portion 543 disposed in seal 542 at a midpoint of the route of air vent ports 541, 541' and 541". When tongue piece 545 is peeled from lid 516, tongue piece 545 is easily separated from seal 542. This in turn exposes air vent ports 541, but no other portions of the underside of seal 542.

In a preferred embodiment, seal 542 is formed with patterns such as characters and illustrations printed on its main portion 544 which permanently seals grooves 540, 540' and 540". Patterns, colors, or other printing different from that printed on main portion 544 of seal 542 may be placed on tongue piece 545 which is connected to main

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portion 544 of seal 542 via neck portion 543.

For example, in a further preferred embodiment, the main portion 544 of seal 542 has a blue background, black characters and other illustrations printed thereon. The background color of tongue piece 545 is a color such as yellow or red which contrasts with the background color of main portion 544. Characters and illustrations are printed on the background in colors which are mainly black or blue. In this way, main portion 544 and tongue piece 545 are distinguished from each other in color and pattern. Consequently, it is possible to call the user's attention to the need for the removal of tongue piece 545.

Each of ink supply ports 513, 153' and 513" are sealed by a film 546 (FIG. 2), and ink filling needles are hermetically inserted into the ink filling holes 514, 514' and 514" and 515, 515' and 515" respectively. The first of filling holes 514, 514' and 514" is connected to evacuating means, and the second of the filling holes 515, 515' and 515" is closed.

The evacuating means reduces the pressure in each of foam chambers 511, 511' and 511" and in each of ink chambers 512, 512' and 512". When the pressure is reduced to a predetermined value, the evacuating operation is stopped and the first filling hole is closed. Thereafter, the second filling hole is placed in fluid communication with a measuring tube filled with ink. Ink contained in the measuring tube is drawn into the evacuated container and is then absorbed by respective porous member 520, 520' and 520" and thereafter flows into ink chamber 512, 512' or 512" via communicating holes 519, 519' or 519" respectively.

After the specified amount of ink flows into the appropriate ink chamber, seal 542 is fixed to the outer surface of lid 516 so that the ink filling holes 514, 514' and 514" and 515, 515' and 515", grooves 540, 540' and 540", and communicating ports 541, 541'

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and 541" are sealed under reduced pressure. Seal 542 thereafter maintains the reduced pressure states of foam chambers 511, 511' and 511" and ink chambers 512, 512' and 512".

Before use of the cartridge, tongue piece 545 of seal 542 is then peeled off so that tongue piece 545 is broken at neck portion 543 and is separated from main portion 544. Thus, ink filling holes 514, 514' and 514" are placed in fluid communication with air vent ports 541, 541' and 541" via grooves 540, 540' and 540". Also, foam chambers 511, 511' and 511" are placed in fluid communication with air vent ports 541, 541' and 541" and therefore ambient air, via grooves 540, 540' and 540". Thus, while the ink is prevented from evaporating, the ink cartridge is ventilated.

Reference is now made to FIGS. 7(a) and 7(b), wherein an ink supply port 513 of the ink cartridge is positioned so as to be aligned with an ink supply needle 550 of the recording head. Thereafter the ink cartridge is pushed toward the recording head upon insertion of the ink cartridge. A taper portion 551 of ink supply needle 550 passes through a film seal 546 and engages the hole of packing member 530 as shown in FIG. 7(a). Since packing member 530 opens upward, packing member 530 allows ink supply needle 550 to pass therethrough while packing member 530 is resiliently deformed by taper portion 551 of ink supply needle 550.

When the cartridge is used, ink supply needle 550 passes through packing member 530. The resiliency of connection portion 534 of packing member 530 enables taper portion 532 to engage ink supply needle 550. Even if ink supply needle 550 of the recording head and the center of packing 530 are somewhat misaligned, ink supply port 513 and ink supply needle 550 are hermetically sealed.

To conduct ink into the recording head after the ink cartridge is mounted, or

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to recover the ink ejection performance, a negative pressure is applied to the recording head and through ink supply needle 550 so that ink in the cartridge flows through ink supply needle 550 and into the recording head. Because of the pressure difference, this high negative pressure applied to the cartridge causes taper portion 532 of packing member 530, which hermetically seals and isolates the cartridge from ambient air, to deform upward in FIG. 7(a) toward the interior of the ink cartridge. Thus, the pressure difference aids in causing taper portion 532 of packing member 530 to be resiliently pressed against ink supply needle 550, and thereby aids in hermetically sealing the ink cartridge.

Even if ink supply needle 550 is not positioned completely through packing member 530, the resilient force in taper portion 532 of packing member 530 allows taper portion 532 to remain in contact with ink supply needle 550 as long as the tapered portion 551 of ink supply needle 550 remains in contact with taper portion 532 as shown in FIG. 7(b). Consequently, it is possible to secure the air tightness of packing member 530 and ink supply needle 550 even if the needle is not properly inserted.

Since the tip of ink supply needle 550 is sealed upon contact with packing member 530, the dead space in the cartridge can be made very small, and any air bubbles which may be produced by the piston effect upon insertion of the cartridge onto the recording head are prevented from entering the cartridge.

When a negative pressure is applied from the nozzle openings of the recording head, ink absorbed by porous member 520 flows into the recording head via through hole 524 and through holes 552 of ink supply needle 550. When ink of a predetermined amount is consumed from porous member 520 and the ink level in porous member 520 is reduced, the pressure of ink chamber 512 overcomes the holding force of porous member 520 in the vicinity of communicating hole 519, so that air bubbles enter ink chamber 512

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via communicating hole 519. Consequently, the pressure in a ink chamber 512 is increased and ink therefore flows into a foam chamber 511.

The ink flowing into foam chamber 511 is absorbed by porous member 520 and causes the ink level in foam chamber 511 to be raised. At the instant when the ink holding force of porous member 520 in the vicinity of communicating hole 519 is balanced with the pressure in ink chamber 512, the flow of ink from ink chamber 512 into foam chamber 511 is stopped.

The graph of FIG. 8 illustrates this process. In the figure, the letter F indicates the pressure level in porous member 520 of foam chamber 511, and the letter G indicates the ink level in ink chamber 512. When a predetermined amount of ink w1 which was initially contained in porous member 520 is consumed so that the ink level in porous member 520 is reduced to a predetermined value at which the pressure in ink chamber 512 overcomes the ink holding force of porous member 520 in the vicinity of communicating hole 519, ink gradually flows in a stepwise manner from ink chamber 512 into the foam chamber 511. This process occurs until the balance between the pressure of the ink chamber 512 and the ink holding force of porous member 520 in the vicinity of communicating hole 519 is restored. As a result, although the ink level in ink chamber 512 is gradually reduced, the ink level in porous member 520 can be maintained at a substantially constant level so that ink is supplied to the recording head by a constant pressure difference at a constant rate.

After a predetermined amount of ink w2 is consumed by the recording head, no ink will remain in ink chamber 512, but the amount of ink contained in porous member 520 will be at a level equal to the level when ink was intermittently being supplied to foam chamber 511 from ink chamber 512. Therefore, printing can be continued using the

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amount of ink absorbed in porous member 520, although no further ink is available in ink chamber 512 to replenish the ink supply into porous member 520. After a predetermined amount of ink w3 is consumed during printing, the ink supply in porous member 520 will be depleted, and the ink cartridge will no longer support printing.

During the entire printing operation from when all the ink contained in ink chamber 512 has been absorbed in porous member 520 until the ink is depleted, a constant amount of ink is supplied to the recording head. The depletion of ink from ink chamber 512 indicates the impending depletion of ink in the ink tank cartridge. If a fresh cartridge is inserted at this stage, it is possible to ensure a constant supply of ink to the recording head without interruption.

As described above, the inner space of the ink cartridge of the invention must be maintained at a negative pressure during the printing process. In addition to the achievement of the above-described hermetic seal between the ink supply port and the ink supply needle, the transfer of ink from ink chamber 512 to the foam chamber 511 must be performed properly to ensure a constant flow of ink to the recording head. Hereinafter, the structure for controlling the supply of ink from ink chamber 512 to foam chamber 511 will be described.

Reference is now made to FIG. 9 which depicts the boundary between foam chamber 511 and ink chamber 512 in a third additional embodiment of the invention. Like numerals are utilized to indicate like structures, the primary difference between this embodiment and the first additional embodiment being a step portion formed in hole 519.

A step portion 560 is formed in communicating hole 519. A portion 563 of the base of ink chamber 512 is higher than that of foam chamber 511, step portion 560 being the dividing point. A groove 561 connecting the foam and the ink chamber is

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formed in the lower part of step portion 560.

Porous member 520 is in contact with communicating hole 519 and is received by step portion 560 so that the portion of porous member 520 in the vicinity of communicating hole 519 is compressed, whereby the required pressure difference between ink chamber 512 and foam chamber 511 via communicating hole 519 can be attained. When the ink level of ink chamber 512 is reduced to a low level, groove 561 enables ink from ink chamber 512 to be collected and then absorbed by porous member 520 in foam chamber 511. Consequently, all of the ink in ink chamber 512 can be supplied to the recording head for printing without wasting any ink.

Reference is now made to FIG 10, which depicts an ink cartridge constructed in accordance with a fourth embodiment of the invention. Again, like numerals are used to indicate like structures, the primary difference between this embodiment and the first additional embodiment is the different leveled bottoms of the respective chambers.

The bottom face 564 of ink chamber 512 is higher than the bottom face 567 of foam chamber 511, thereby forming a step portion 562. Step portion 562 receives the lower portion of porous member 520 so that the portion of porous member 520 in the vicinity of communicating hole 519 is compressed. When required, a slope 563 which is directed from the ink chamber 512 to the form chamber 511 may be formed to aid in the supply of ink. Since slope 563 allows ink in ink chamber 512 to flow more easily toward foam chamber 511, irrespective of the inclination of the carriage, ink from ink chamber 512 can be constantly supplied to the recording head.

Reference is now made to FIGS. 11 and 12 which depict an ink jet cartridge constructed in accordance with a fifth additional embodiment of the invention. Like structures are indicated by like reference numerals, the primary difference between this

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embodiment and the first additional embodiment is the formation of a through hole. This embodiment is the same as shown in FIGS. 4 and 5.

Groove 519a (FIGS. 4 and 5) is formed in the face of center partition 510 separating foam chamber 511 from ink chamber 512. Groove 519a is formed in the face of partition 510 on the side of the foam chamber 511 and is in communication with the upper portion of communicating hole 519 of center partition 510 within the respective chambers 511, 512. In order to allow air to pass from ink chamber 512 to foam chamber 511 and to retain these chambers in fluid communication with each other, a through hole 519b is formed in the lower end of the groove 519a. Thus, the upper portion of porous member 520 which exhibits a relatively small capillary force is maintained in fluid communication with communicating hole 519 via the space formed by thin groove 519a. Therefore, ink can be smoothly replaced with air so that ink in ink chamber 512 constantly flows into foam chamber 511, thereby preventing too much or not enough ink from being supplied.

Reference is now made to FIGS. 13 and 14 which depict an ink cartridge constructed in accordance with a sixth additional embodiment of the invention. Like numerals are utilized to depict like structures, the primary difference being the use of a projection into foam chamber 511.

A horseshoe-shaped projection 565 is formed on the bottom of foam chamber 511 as is shown in FIG. 14. Projection 565 ensures a space in the vicinity of communicating hole 519 so that ink from ink chamber 512 can easily flow into foam chamber 511.

As described above, foam chamber 511 and ink chamber 512 are separated from each other by the single center partition 510. In seventh or eighth additional

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embodiments of a single-color ink cartridge, as shown in FIGS. 15 and 16 respectively, an ink chamber 571 may be formed so as to surround two or three sides of a foam chamber 570, and a communicating hole 573 may be formed in at least one of the walls 572 separating the foam chamber 570 from the ink chamber 571. An exit port 574 is positioned within foam chamber 570. An ink cartridge of this design can store an amount of ink which is relatively large as compared with the volume of the whole ink cartridge. Furthermore, because of the location of the chambers, the user can easily see if replacement of the ink cartridge is required because of depletion of the ink.

Reference is now made to FIGS. 17 and 18 wherein an ink jet printer cartridge constructed in accordance with a ninth additional embodiment of the invention is provided. This embodiment is similar to the first additional embodiment, the primary difference being the use of a resilient O-ring 5300 which is retained in contact with the peripheral face of an ink supply needle of the recording based upon insertion of the ink supply needle into the ink supply cartridge. However, this ink jet printer results in other problems solved by the first additional embodiment. A large frictional force may be produced when mounting the cartridge on the carriage and inserting the ink supply needle into the cartridge. This results in an extra strain on the recording head and the carriage. Furthermore, O-ring 5300 is supported at its periphery by the body 5302 of the cartridge. If there is a misalignment between the cartridge and the ink supply needle of the recording head upon insertion of the ink supply needle in the ink supply cartridge, it is very difficult to mount the cartridge. Furthermore, when a three color ink cartridge in which tanks 5304, 5306, and 5308 for the three color inks are integrated into one piece as shown in FIG. 18, it is extremely difficult to mount such a cartridge on the recording head if the cartridge and any of the ink supply needles are misaligned.

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It will thus be seen that the objects set forth above, among those made apparent from the preceding description are efficiently attained and, since certain changes may be made in carrying out the above construction and method set forth without departing from the spirit and scope of the invention, it is intended that all matter contained in the above description and shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall there between.

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CLAIMS

WHAT IS CLAIMED IS:

1. An ink tank cartridge for an ink-jet type recording apparatus, comprising:

a plurality of first chambers;

a plurality of second chambers, each second chamber being adjacent to and associated with a first chamber;

a plurality of partition walls disposed in said cartridge, each said partition being formed with a communicating hole formed therein disposed between said associated chambers, said communicating hole being positioned in the vicinity of the bottom of the said partition wall and extending only a portion of the width of said partition wall as viewed in the direction of said bottom of said partition wall; and

a plurality of ink supply ports, each extending through a wall of a respective one of said plurality of second chambers, said plurality of ink supply ports supplying ink to the exterior of said cartridge, all of said first chambers and associated second chambers being formed as an integral unit.

2. The ink cartridge of claim 1, and including a porous member in each of said second chambers positioned to deliver ink to its associated ink supply port and an air vent port communicating between each said second chamber and the exterior of said cartridge at a location spaced from said ink supply port and communicating hole.

3. The ink cartridge of claim 2, wherein the porous member associated with each second chamber and the associated first chamber contain ink different from the ink in the other first and second chambers.

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4. The ink tank cartridge of claim 2, wherein the porous member in each said second chamber and the associated first chamber contain ink, the pressure in each of said first chambers and each of said associated second chambers being at a value less than atmospheric pressure.

5. The ink tank cartridge of claim 4, wherein a pressure balance between each of the said first chambers and each of said associated second chambers is maintained by the surface tension of each of said associated porous members in the vicinity of each of said associated communicating holes, each said porous member resiliently contacting said associated communicating hole, said pressure balance maintaining ink in each of said respective first chambers.

6. The ink tank cartridge of claim 5, wherein each said porous member, associated first and second chambers, partition wall, communication hole ink supply port and air vent port are positioned and dimensioned so that when said ink impregnated in each of said associated porous members is at least partially transmitted through said ink supply port, said pressure balance between said associated chambers is no longer maintained and ink is supplied from the first chamber to the associated porous member in the associated second chamber as required until the pressure balance is restored.

7. The ink tank cartridge of claim 6, further comprising an associated step portion formed at a lower portion of each of said communicating holes, a groove connecting said associated first and second chambers being formed in said ink cartridge below said associated step portion.

8. The ink tank cartridge of claim 6, further comprising a protrusion portion formed on an inner surface of said partition wall in each of said second chambers, each said protrusion portion maintaining a space about said associated communicating hole

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to aid in the flow of ink therethrough.

9. The ink tank cartridge of claim 6, further comprising a step portion formed below each of said communicating holes in said partition wall.

10. The ink tank cartridge of claim 9, wherein the part of each of said step portions adjacent said associated first chamber is higher than the part adjacent said associated second chamber.

11. The ink tank cartridge of claim 6, further comprising a respective vertically extending thin groove formed in each said partition wall above each communicating hole and on the side of the associated second chambers, each of said grooves being in fluid communication with each associated communicating hole, each of said grooves aiding in the flow of air and ink between said associated first and second chambers.

12. The ink tank cartridge of claim 2, further comprising a projection formed on an inside wall of each of said second chambers disposed on a surface of said second chamber opposite said associated ink supply port, said projections compressing said associated porous members against said associated ink supply ports.

13. The ink tank cartridge of claim 12, wherein each said ink supply port includes a projection including its entrance projecting into said second chamber.

14. The ink tank cartridge of claim 12, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

15. The ink tank chamber of claim 2, wherein the volume of each of said porous members is larger than the capacity of each of said associated second chambers.

16. The ink tank cartridge of claim 2, further comprising at least one

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chamber partition wall, said chamber partition wall extending from each said partition wall and dividing said first chamber into a plurality of such chambers while permitting communication between each such chamber and the associated second chamber through the associated communicating hole.

17. The ink tank cartridge of claim 6, further comprising a respective vertically extending rib formed on an inner surface of said first chamber, each of said ribs assisting in the flow of ink.

18. The ink tank cartridge of claim 1, wherein said first chamber and said second chamber are maintained at a pressure less than atmospheric pressure and said ink cartridge further comprises a plurality of air vent ports formed in a surface of said cartridge, each having an air-impermeable sealing member for selectively sealing said air vent ports when said ink cartridge is not in use and unsealing said air vent ports when said ink cartridge is to be used.

19. The ink tank cartridge of claim 18, wherein each of said air vent ports is formed in part as a groove on the outside surface of a wall of said second chamber.

20. The ink tank cartridge of claim 18, wherein said outside surface is of a top lid.

21. The ink tank cartridge of claim 18, wherein said sealing member comprises a main portion, and a tongue piece which is removably connected to said main portion via a neck portion.

22. The ink tank cartridge of claim 21, wherein at least one of different patterns and colors are printed on said main portion and said tongue piece, said neck portion acting as a boundary between said main portion and said tongue piece.

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23. The ink tank cartridge of claim 18, further comprising at least one chamber partition wall extending from each partition, said chamber partition walls dividing each said first chambers into a plurality of sub-chambers.

24. The ink tank cartridge of claim 18, further comprising a projection formed on an inside wall of each of said second chambers disposed on a surface of said second chamber opposite said associated ink supply port, said projections compressing said associated porous members against said associated ink supply ports.

25. The ink tank cartridge of claim 24, wherein each said ink supply port includes a portion including its entrance projecting into said second chamber.

26. The ink tank cartridge of claim 24, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

27. The ink tank cartridge of claim 18, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

28. The ink tank cartridge of claim 18, further comprising a respective vertically extending rib formed on an inner face of each of said first chambers, each of said ribs assisting in the flow of ink.

29. The ink tank cartridge of claim 18, wherein each said air vent port is formed in part as a meandering groove.

30. The ink tank cartridge of claim 1 wherein said second chamber is a foam chamber and said first chamber is an ink chamber.

31. The ink tank cartridge above of claim 1, wherein said cartridge is constructed to be removably mounted on said recording apparatus so that one of a plurality

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of ink supply needles of said apparatus is received in each ink supply port.

32. An ink-jet type recording apparatus for outputting ink onto a recording medium, comprising:

a recording head for ejecting ink; and

a multi-color ink tank cartridge removably mountable onto said recording head of said ink-jet type recording apparatus for delivery of ink thereto said ink tank cartridge, including:

a plurality of first chambers;

a plurality of second chambers, each second chamber being adjacent to and associated with a first chamber;

a plurality of partition walls disposed in said cartridge, each said partition being formed with a communicating hole formed therein disposed between said associated chambers, said communicating hole being positioned in the vicinity of the bottom of said partition wall and extending only a portion of the width of said partition wall as viewed in the direction of said bottom of said partition wall; and

a plurality of ink supply ports, each extending through a wall of a respective one of said plurality of second chambers, said plurality of ink supply ports supplying ink to the exterior of said cartridge, all of said first chambers and associated second chambers being formed as an integral unit.

33. The ink-jet type recording apparatus of claim 32, and including a porous member in each of said second chambers positioned to deliver ink to its associated ink supply port and an air vent port communicating between each said second chamber and the exterior of said cartridge at a location spaced from said ink supply port and communicating hole.

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34. The ink-jet type recording apparatus of claim 33, wherein the porous member associated with each second chamber and the associated first chamber contain ink different from the ink in the other first and second chambers.

35. The ink-jet type recording apparatus of claim 33, wherein the porous member in each said second chamber and the associated first chamber contain ink, the pressure in each of said first chambers and each of said associated second chambers being at a value less than atmospheric pressure.

36. The ink-jet type recording apparatus of claim 35, wherein a pressure balance between each of said first chambers and each of said associated second chambers is maintained by the surface tension of each of said associated porous members in the vicinity of each of said associated communicating holes, each said porous member resiliently contacting said associated communicating hole, said pressure balance maintaining ink in each of said respective first chambers.

37. The ink-jet type recording apparatus of claim 36, wherein each said porous member, associated first and second chambers, partition wall, communication hole ink supply port and air vent port are positioned and dimensioned so that when said ink impregnated in each of said associated porous members is at least partially transmitted through said ink supply port, said pressure balance between said associated chambers is no longer maintained and ink is supplied from the first chamber to the associated porous member in the associated second chamber as required until the pressure balance is restored.

38. The ink-jet type recording apparatus of claim 37, further comprising a respective vertically extending thin groove formed in each said partition wall above each communicating hole and on the side of the associated second chambers, each of said

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grooves being in fluid communication with each associated communicating hole, each of said grooves aiding in the flow of air and ink between said associated first and second chambers.

39. The ink-jet type recording apparatus of claim 33, further comprising a projection formed on an inside wall of each of said second chambers disposed on a surface of said second chamber opposite said associated ink supply port, said projections compressing said associated porous members against said associated ink supply ports.

40. The ink-jet type recording apparatus of claim 39, wherein each said ink supply port includes a projection including its entrance projecting into said second chamber.

41. The ink-jet type recording apparatus of claim 39, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

42. The in-jet type recording apparatus of claim 33, wherein the volume of each of said porous members is larger than the capacity of each of said associated second chambers.

43. The ink-jet type recording apparatus of claim 33, further comprising at least one chamber partition wall, said chamber partition wall extending from each said partition wall and dividing said first chamber into a plurality of such chambers while permitting communication between each such chamber and the associated second chamber through the associated communicating hole.

44. The ink-jet type recording apparatus of claim 37, further comprising a respective vertically extendng rib formed on an inner surface of said first chamber, each of said ribs assisting in the flow of ink.

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45. The ink-jet type recording apparatus of claim 32, wherein said first chamber and said second chamber are maintained at a pressure less than atmospheric pressure and said ink cartridge further comprises a plurality of air vent ports formed in a surface of said cartridge, each having an air-impermeable sealing member for selectively sealing said air vent ports when said ink cartridge is not in use and unsealing said air vent ports when said ink cartridge is to be used.

46. The ink-jet type recording apparatus of claim 45, wherein each of said air vent ports is formed in part as a groove on the outside surface of a wall of said second chamber.

47. The ink-jet type recording apparatus of claim 45, wherein said outside surface is of a top lid.

48. The ink-jet type recording apparatus of claim 45, wherein said sealing member comprises a main portion, and a tongue piece which is removably connected to said main portion via a neck portion.

49. The ink-jet type recording apparatus of claim 48, wherein at least one different patterns and colors are printed on said main portion and said tongue piece, said neck portion acting as a boundary between said main portion and said tongue piece.

50. The ink-jet type recording apparatus of claim 45, further comprising at least one chamber partition wall extending from each partition, said chamber partition walls divididng each said first chambers into a plurality of sub-chambers.

51. The ink-jet type recording apparatus of claim 45, further comprising a projection formed on an inside wall of each of said second chambers disposed on a surface of said second chamber opposite said associated ink supply port, said projections compressing said associated porous members against said associated ink supply ports.

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52. The ink-jet type recording apparatus of claim 51, wherein each said ink supply port includes a portion including its entrance projecting into said second chamber.

53. The ink-jet type recording apparatus of claim 51, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

54. The ink-jet type recording apparatus of claim 45, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

55. The ink-jet type recording apparatus of claim 45, further comprising a respective vertically extending rib formed on an inner face of each of said first chambers, each of said ribs assisting in the flow of ink.

56. The ink-jet type recording apparatus of claim 45, wherein each said air vent port is formed in part as a meandering groove.

57. The ink-jet type recording apparatus of claim 32, wherein said second chamber is a foam chamber and said first chamber is an ink chamber.

58. The ink-jet type recording apparatus of claim 32, wherein said cartridge is constructed to be removably mounted on said recording apparatus so that one of a plurality of ink supply needles of said apparatus is received in each ink supply port.

59. A system for supplying ink to an ink-jet type recording apparatus and outputting ink onto a recording medium, said system comprising:

a recording head for ejecting ink; and

a multi-color ink tank cartridge removably mountable onto said recording head of said ink-jet type recording apparatus, for delivery of ink thereto said ink

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tank cartridge, including:

a plurality of first chambers;

a plurality of second chambers, each second chamber being adjacent to and associated with a first chamber;

a plurality of partition walls disposed in said cartridge, each said partition being formed with a communicating hole formed therein disposed between said associated chambers, said communicating hole being positioned in the vicinity of the bottom of said partition wall and extending only a portion of the width of said partition wall as viewed in the direction of said bottom of said partition wall; and

a plurality of ink supply ports, each extending through a wall of a respective one of said plurality of second chambers, said plurality of ink supply ports supplying ink to the exterior of said cartridge, all of said first chambers and associated second chambers being formed as an integral unit.

60. The system of claim 59, and including a porous member in each of said second chambers positioned to deliver ink to its associated ink supply port and an air vent port communicating between each said second chamber and the exterior of said cartridge at a location spaced from said ink supply port and communicating hole.

61. The system of claim 60, wherein the porous member associated with each second chamber and the associated first chamber contain ink different from the ink in the other first and second chambers.

62. The system of claim 60, wherein the porous member in each said second chamber and the associated first chamber contain ink, the pressure in each of said first chambers and each of said associated second chambers being at a value less than atmospheric pressure.

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63. The system of claim 62, wherein a pressure balance between each of said first chambers and each of said associated second chambers is maintained by the surface tension of each of said associated porous members in the vicinity of each of said associated communicating holes, each said porous member resiliently contacting said associated hole, said pressure balance maintaining ink in each of said respective first chambers.

64. The system of claim 63, wherein each said porous member, assocated first and second chambers, partition wall, communicating hole ink supply port and air vent port are positioned and dismensioned so that when said ink impregnated in each of said associated porous members is at least partially transmitted through said ink supply port, said pressure balance between said associated chambers is no longer maintained and ink is supplied from the first chamber to the associated porous member in the associated second chamber as required until the pressure balance is restored.

65. The system of claim 64, further comprising a respective vertically extending thin groove formed in each said partition wall above each communicating hole and on the side of the associated second chambers, each of said grooves being in fluid communication with each associated communicating hole, each of said grooves aiding in the flow of air and ink between said associated first and second chambers.

66. The system of claim 60, further comprising a projection formed on an inside wall of each of said second chambers disposed on a surface of said second chamber opposite said associated ink supply port, said projections compressing said associated porous members against said associated ink supply ports.

67. The system of claim 66, wherein each said ink supply port includes a projection including its entrance projecting into said second chamber.

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68. The system of claim 66, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

69. The system of claim 60, wherein the volume of each of said porous members is larger than the capacity of each of said associated second chambers.

70. The system of claim 60, further comprising at least one chamber partition wall, said chamber partition wall extending from each said partition wall and dividing said first chamber into a plurality of such chambers while permitting communication between each such chamber and the associated second chamber through the associated communicating hole.

71. The system of claim 64, further comprising a respective vertically extending rib formed on an inner surface of said first chamber, each of said ribs assisting in the flow of ink.

72. The system of claim 59, wherein said first chamber and said second chamber are maintained at a pressure less than atmospheric pressure and said ink cartridge further comprises a plurality of air vent ports formed in a surface of said cartridge, each having an air-impermeable sealing member for selectively sealing said air vent ports when said ink cartridge is not in use and unsealing said air vent ports when said ink cartridge is to be used.

73. The system of claim 72, wherein each of said air vent ports is formed in part as a groove on the outside surface of a wall of said second chamber.

74. The system of claim 72, wherein said outside surface is of a top lid.

75. The system of claim 72, wherein said sealing member comprises a main portion, and a tongue piece with is removably connected to said main portion via a

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neck portion.

76. The system of claim 75, wherein at least one of different patterns and colors are printed on said main portion and said tongue piece, said neck portion acting as a boundary between said main portion and said tongue piece.

77. The system of claim 72, further comprising at least one chamber partition wall extending from each partition, said chamber partition walls dividing each said first chambers into a plurality of sub-chambers.

78. The system of claim 72, further comprising a projection formed on an inside wall of each of said second chambers disposed on a surface of said second chamber opposite said associated ink supply port, said projections compressing said associated porous members against said associated ink supply ports.

79. The system of claim 78, wherein each said ink supply port includes a projection including its entrance projecting into said second chamber.

80. The system of claim 78, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

81. The system of claim 72, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

82. The system of claim 72, further comprising a respective vertically extending rib formed on an inner face of each of said first chambers, each of said ribs assisting in the flow of ink.

83. The system of claim 72, wherein each said air vent port is formed in part as a meandering groove.

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84. The system of claim 59, wherein said second chamber is a foam chamber and said first chamber is an ink chamber.

85. The system of claim 59, wherein said cartridge is constructed to be removably mounted on said recording apparatus so that one of a plurality of ink supply needles of said apparatus is received in each ink supply port.

86. A method for providing ink to an ink-jet type recording head, comprising the steps of:

providing an ink tank cartridge having a plurality of first chambers adapted to store ink and a plurality of second chambers adapted to receive a respective porous member impregnated with ink;

separating each of said first and second chambers from each other by use of a partition wall;

communicating ink between said associated first and second chambers through a communicating hole adjacent the bottom of said partition and extending only a portion of the width of said partition wall as viewed in the direction of said bottom of said partition wall, withdrawing ink from each porous member in each second chamber through an ink supply port extending through a wall of each second chamber; and

providing ambient air to each second chamber at a location spaced from said ink supply port.

87. The method of claim 86, further comprising the steps of:

maintaining the pressure in each of said first and second chambers below normal atmospheric pressure;

maintaining a pressure balance between each pair of associated first and second chambers by the surface tension of said porous member in the vicinity of said

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communicating hole;

the withdrawal of ink from a porous member through an associated ink supply port upsetting the pressure balance between said associated first and second chambers so that ink flows from said first chamber to said second chamber until said pressure balance is restored.

88. The method of claim 86, further comprising the steps of:

forming air vents at least in part as winding grooves in a surface of said ink cartridge to protect said ink against evaporation.

89. The method of claim 88, further comprising the steps of:

sealing said grooves with a seal member;

removing a portion of said seal to place the interior of said ink supply tank in fluid communication with ambient air through said winding grooves.

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FIG. 1

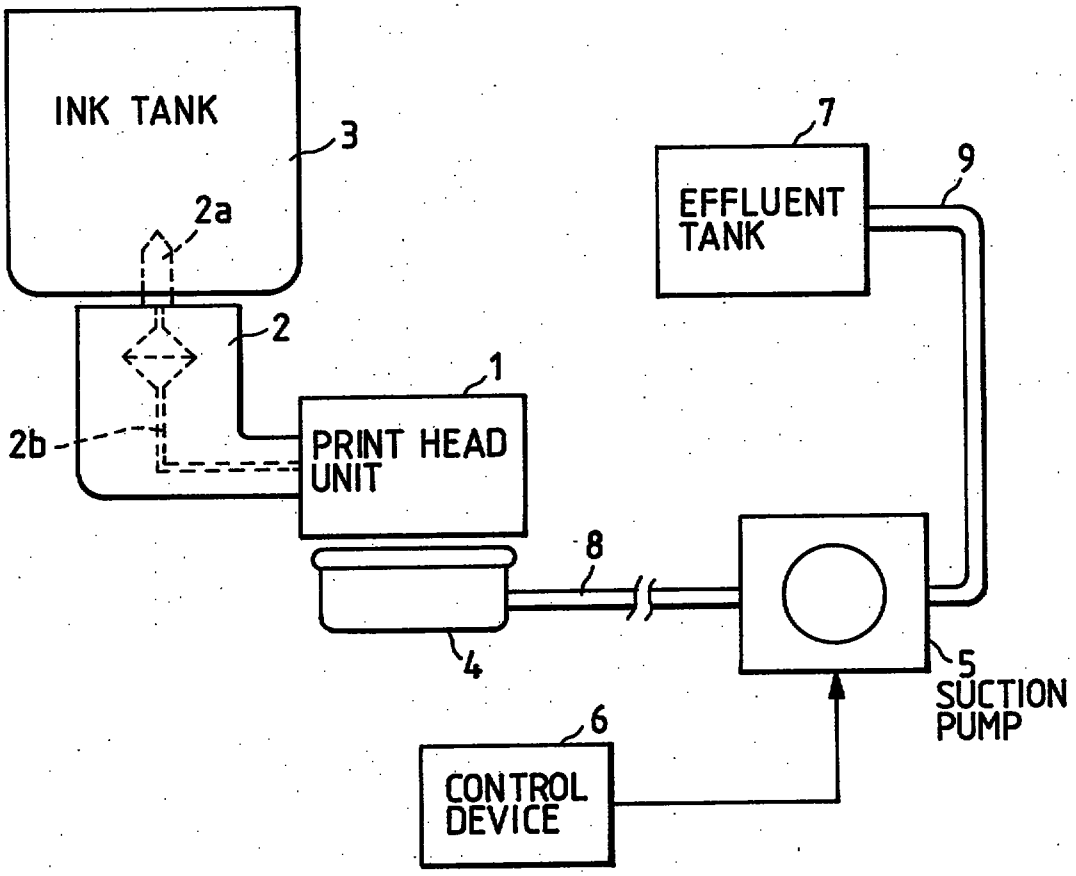

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FIG. 2

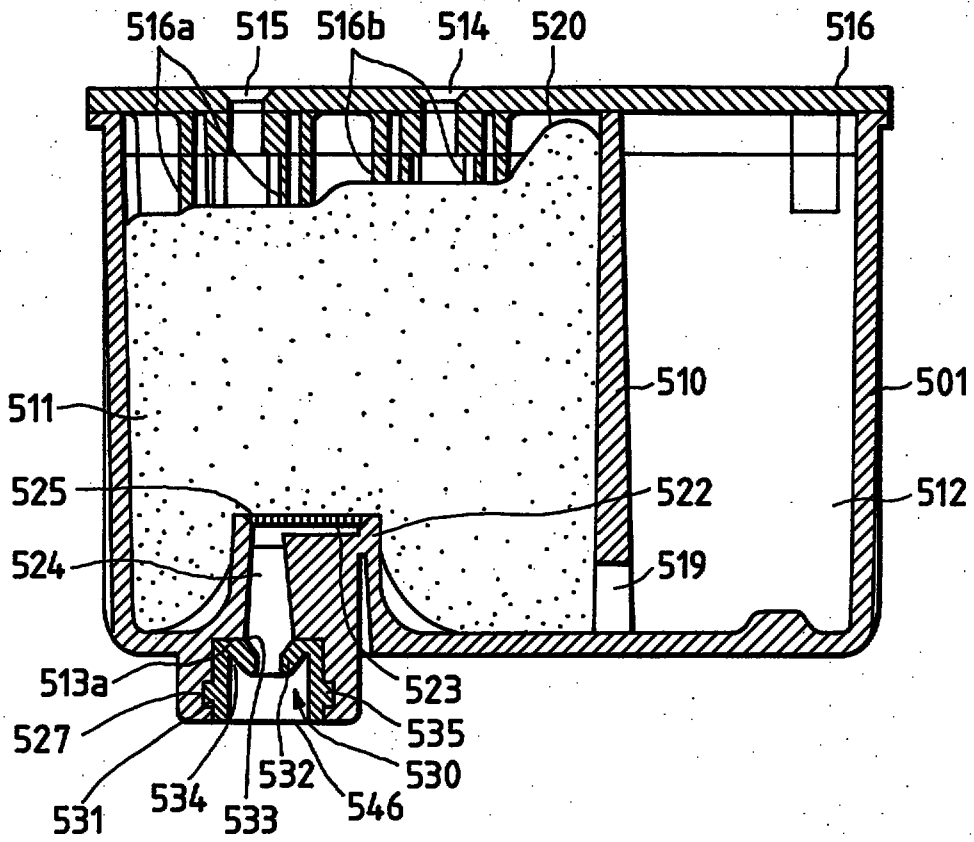

FIG. 3

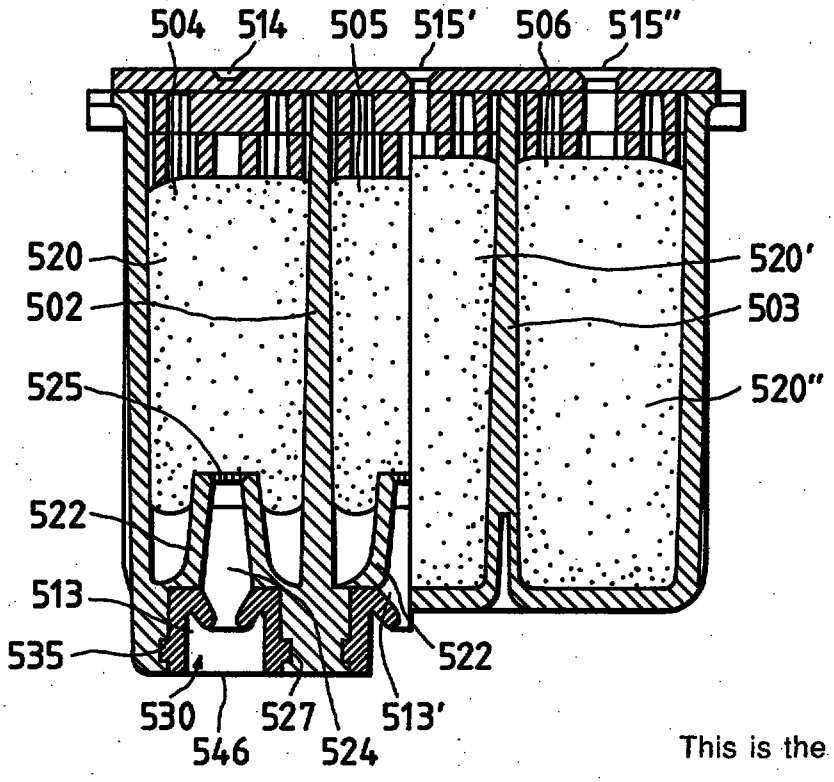

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FIG. 4

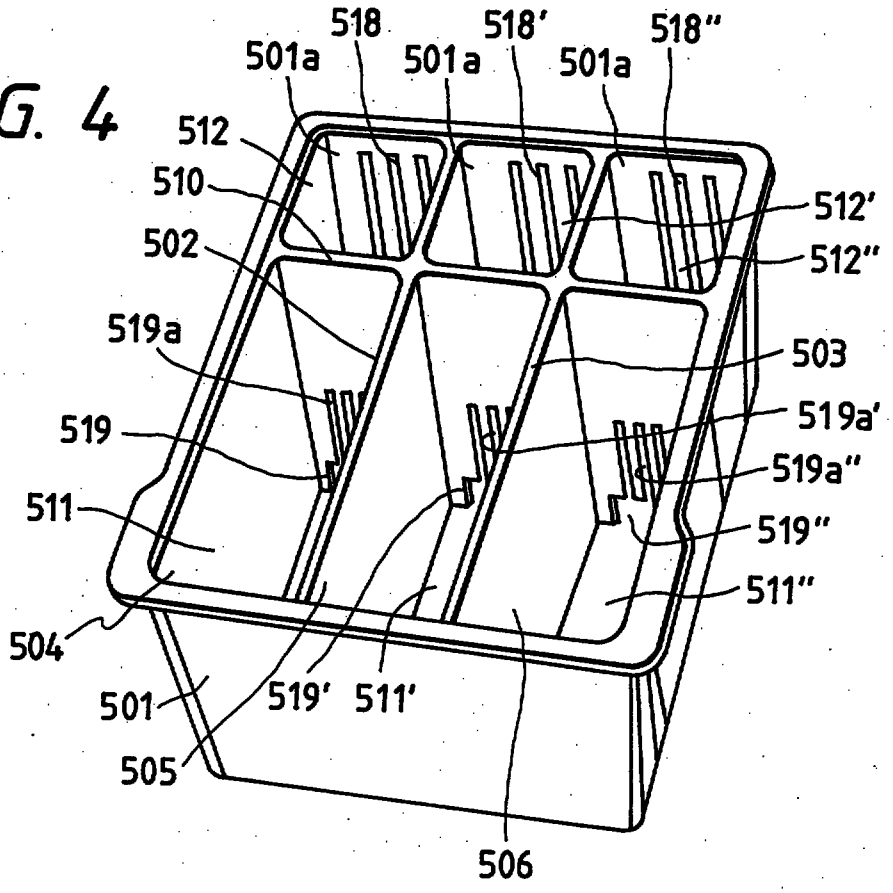

FIG. 5

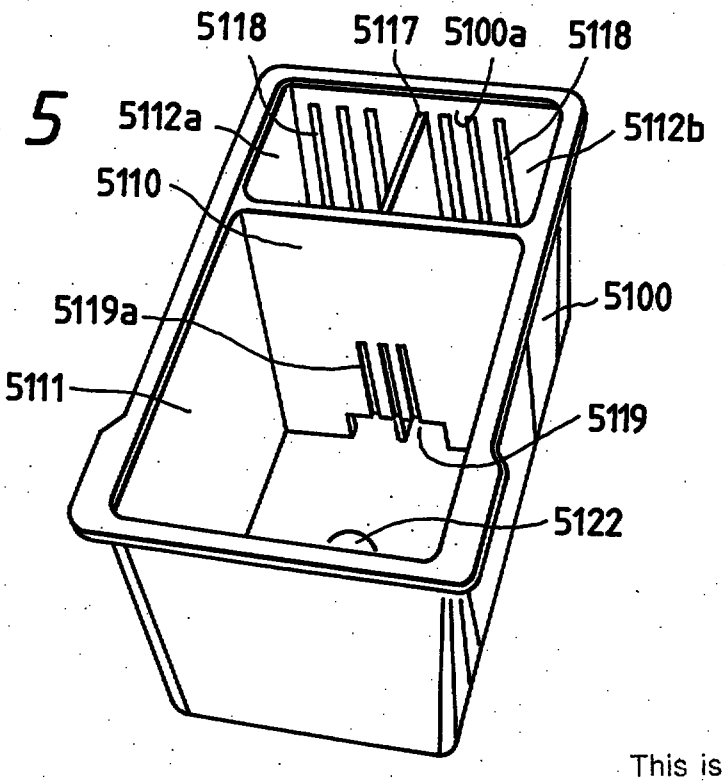

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FIG. 6 a

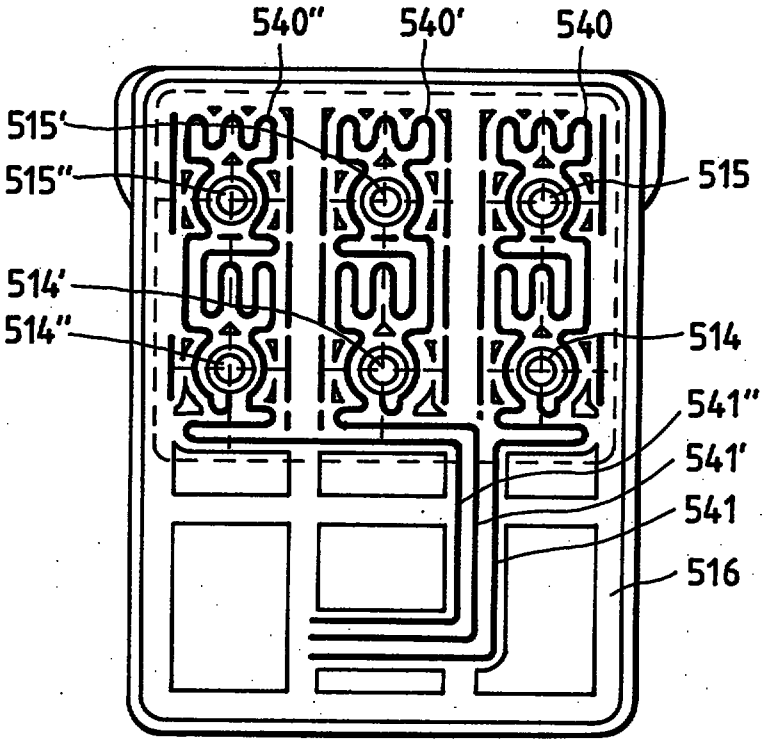

FIG. 6 b

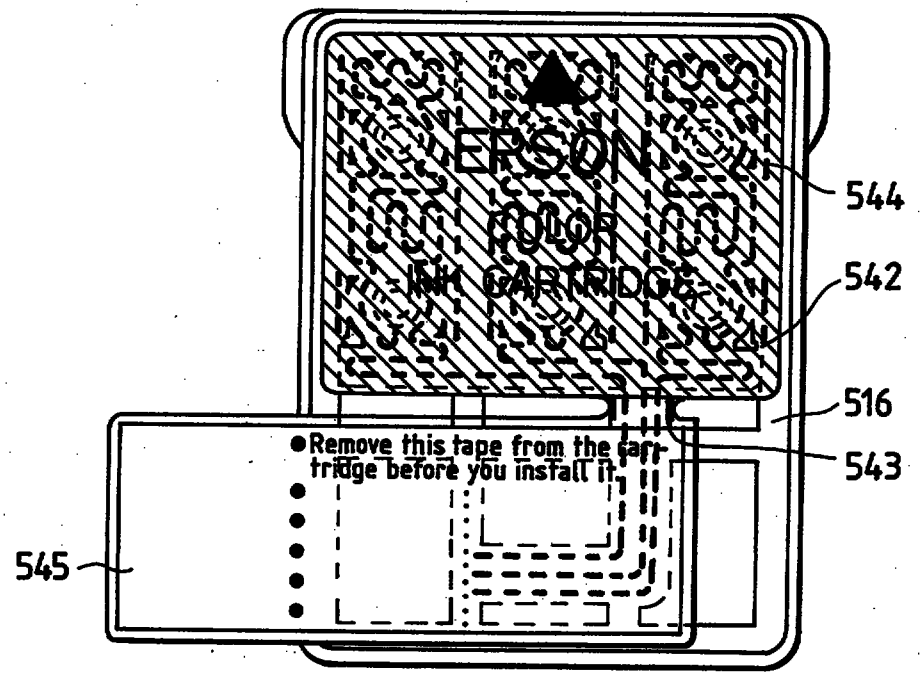

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FIG. 7 a

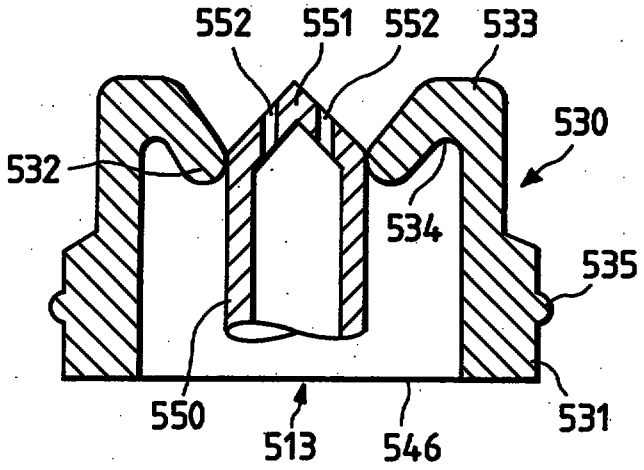

FIG. 7 b

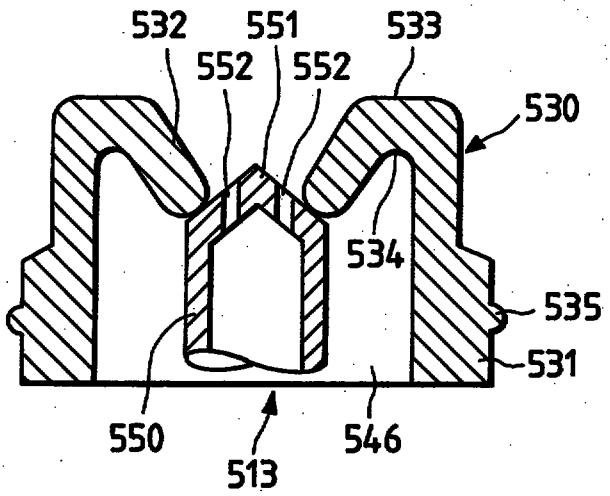

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FIG. 8

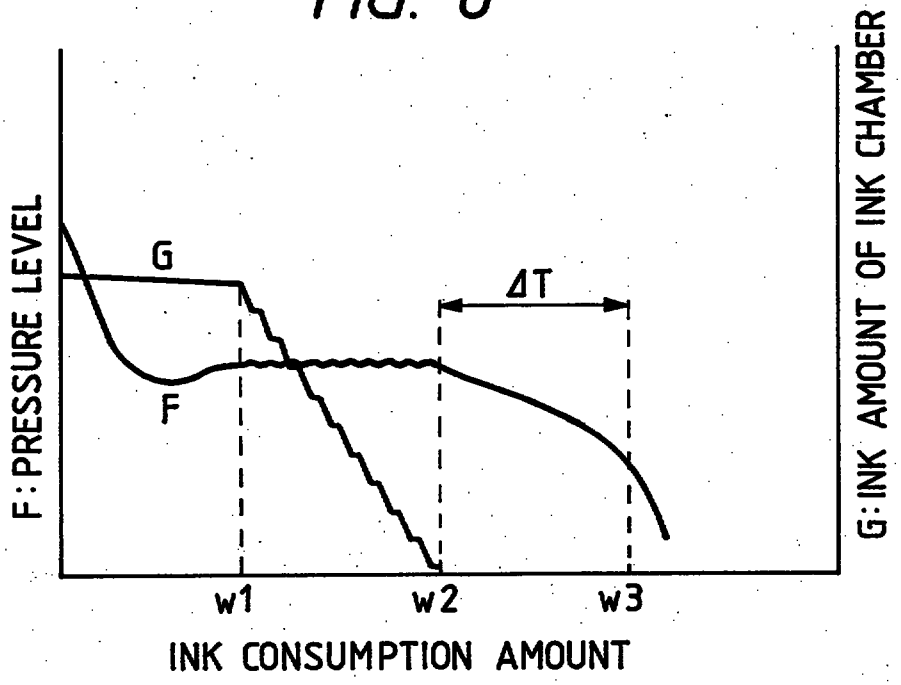

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FIG. 9

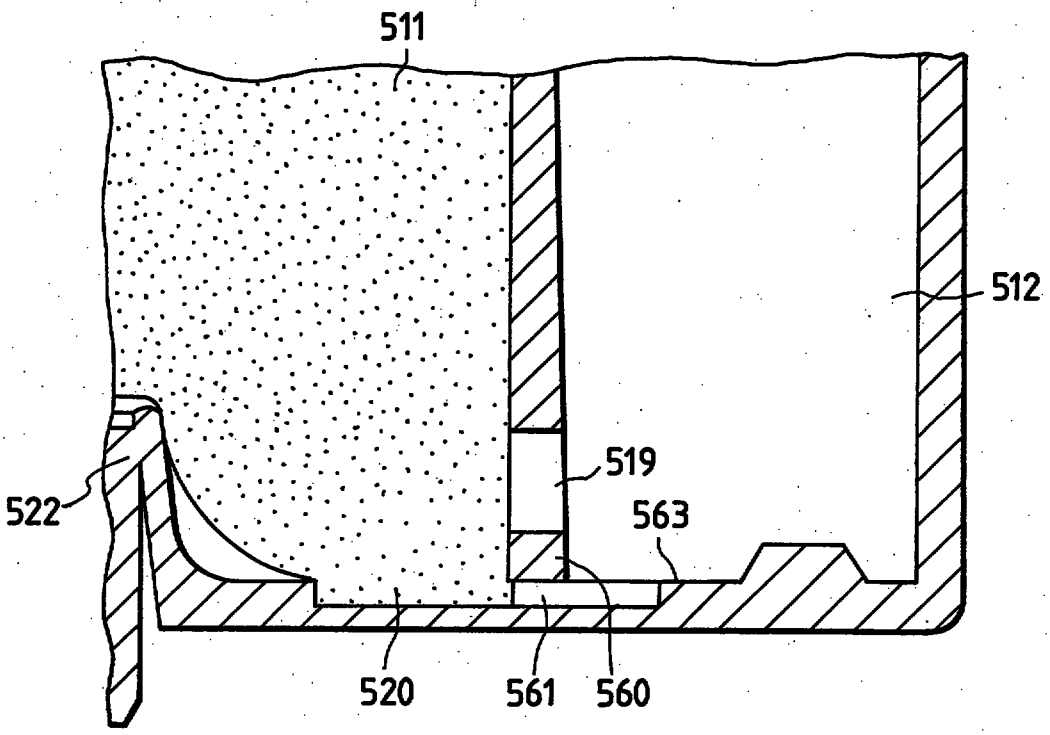

FIG. 10

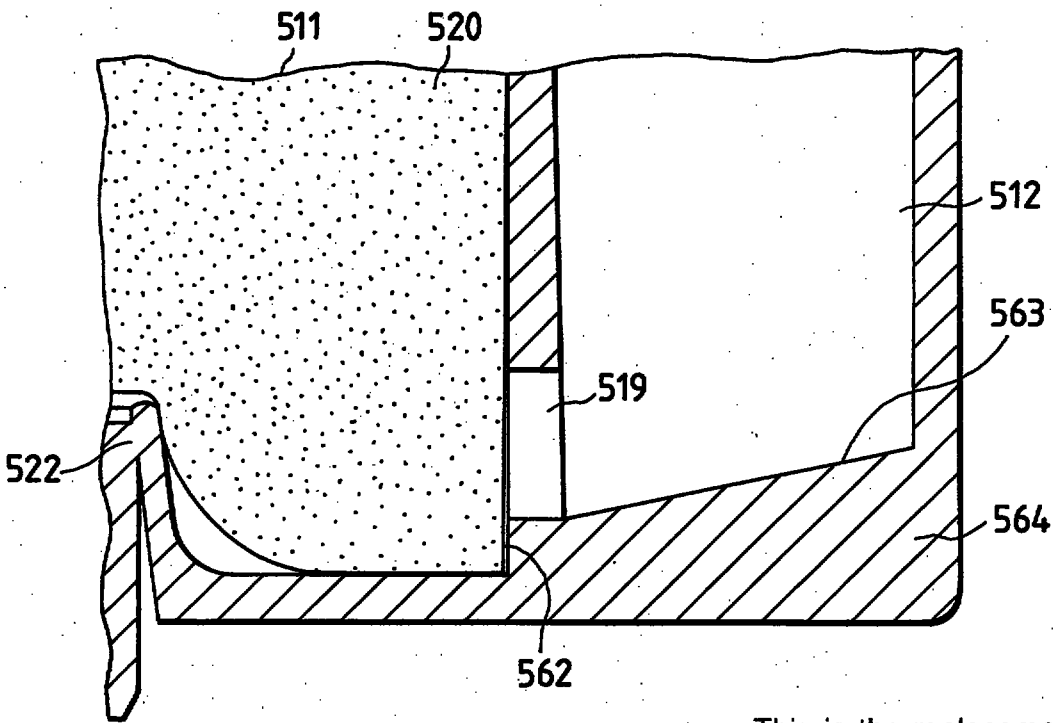

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FIG. 11

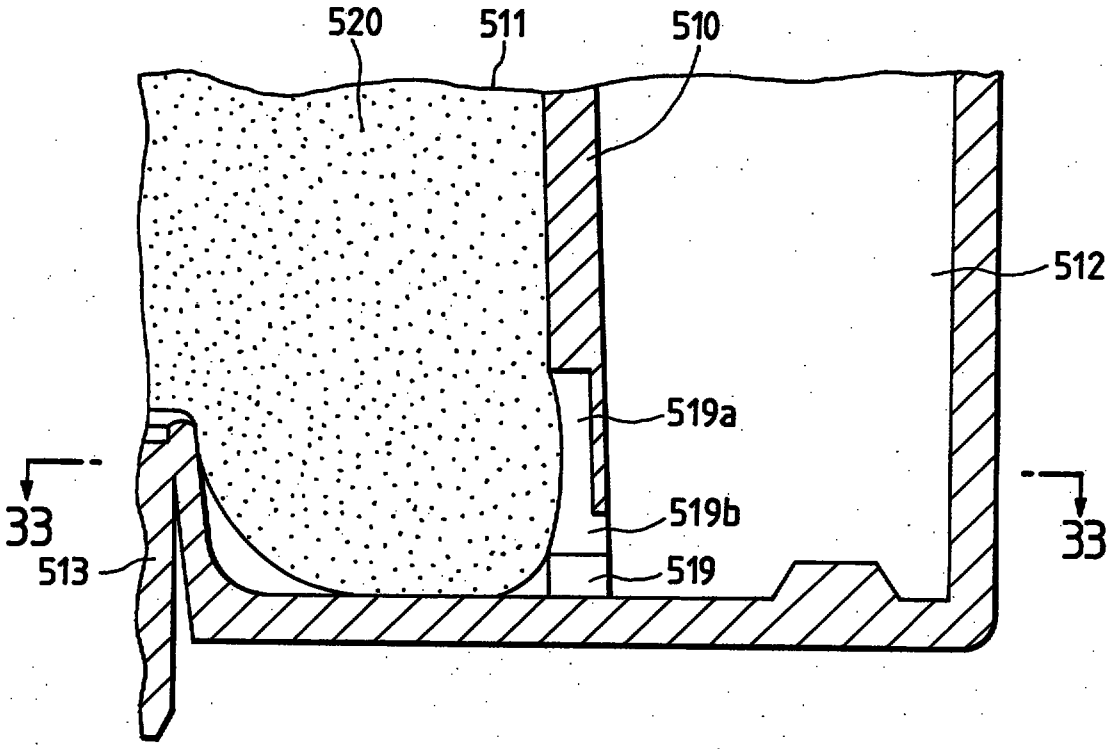

FIG. 12

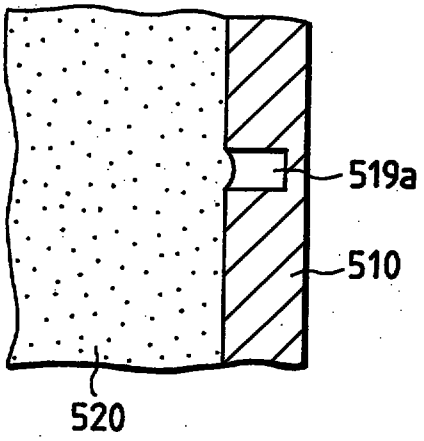

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FIG. 13

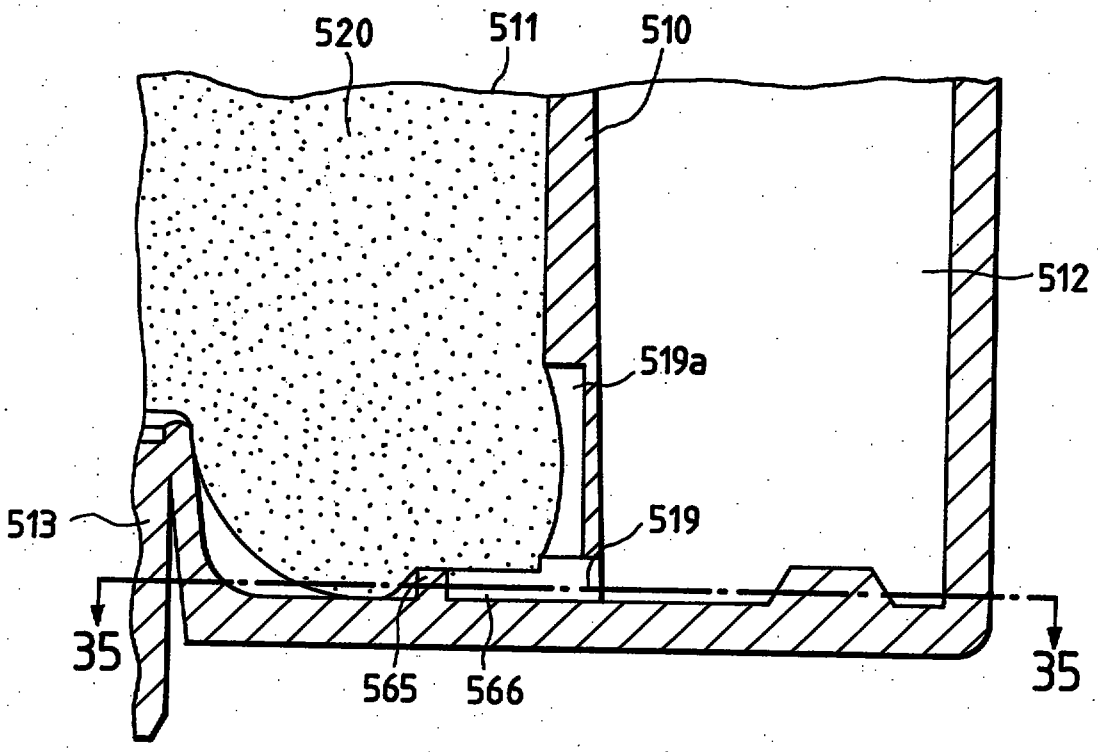

FIG. 14

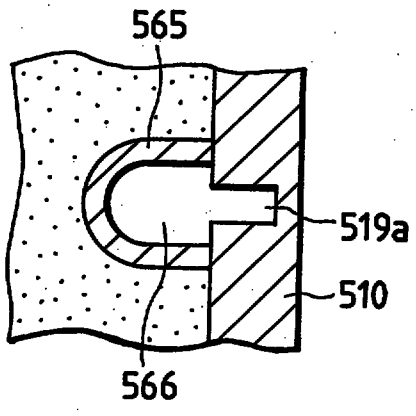

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FIG. 15

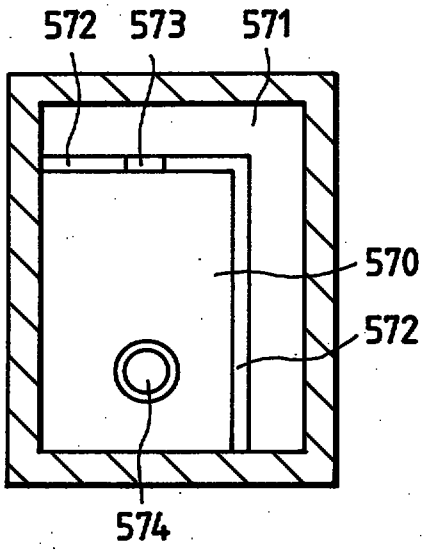

FIG. 16

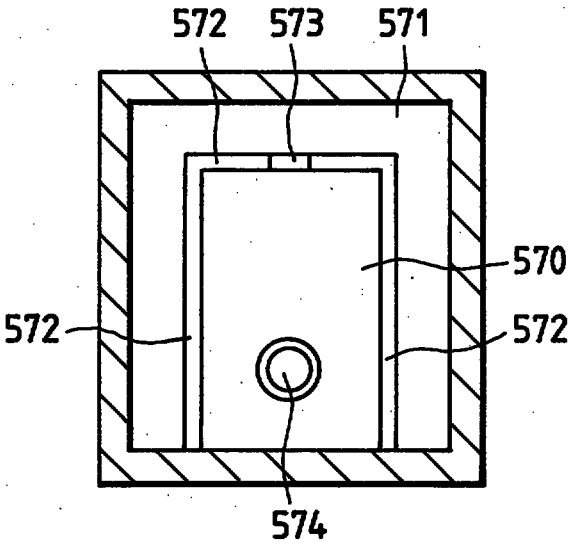

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FIG. 17

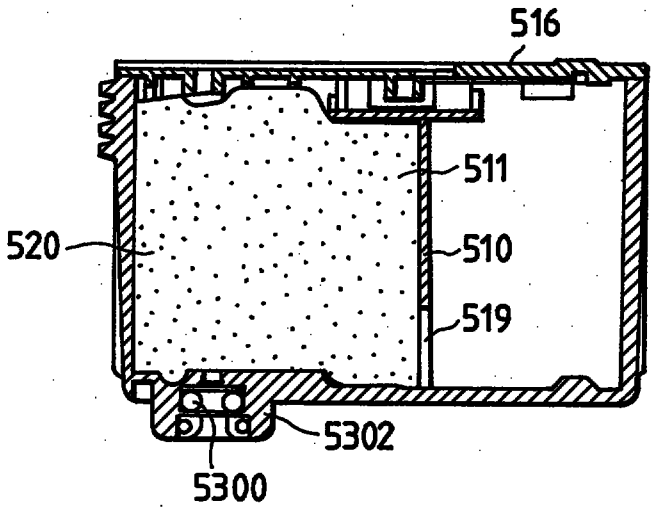
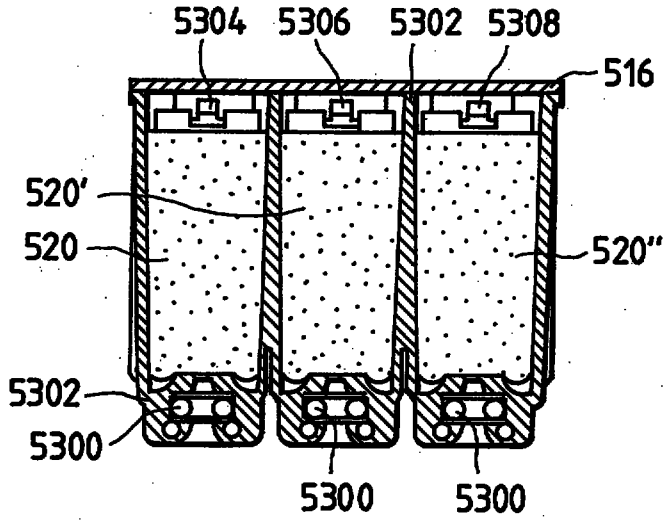


FIG. 18



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INK-SUPPLIED PRINTER AND INK SUPPLY TANK

ABSTRACT OF THE DISCLOSURE

An ink tank cartridge for an ink-jet type recording apparatus is provided. The ink tank cartridge comprises a plural number of first chambers and a plural number of second chambers adjacent to and associated with a first chamber, each pair of first and second chambers being formed as an integral unit. The ink tank cartridge also has a partition wall disposed in the cartridge which separates each second chamber from an associated first chamber, the two chambers communicating through a communicating hole positioned near the bottom of the partition wall disposed between the associated chambers. The communicating hole extends only a portion of the width that the partition wall. Finally, a plural number of ink supply ports, each extending through a wall of a respective one of the plural number of first chambers, supply ink to the exterior of the ink cartridge from each respective porous member of the plural number of porous members.

Figure 2

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REPLACEMENT SHEETS SG
☑ Description : paged 2 to paged 5a
☑ Claim(s) : paged 32 to paged 37
☐ Drawing(s) : paged ... to paged ...
☐ Abstract : paged ... to paged ...
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bubbles must be stopped from entering a pressure chamber, such as that for an ink jet printer in which a piezo-electric vibrator is used as an actuator for ink ejection.

Accordingly, an ink jet printer which solves the above-mentioned problems is derived.

Accordingly, it is an object of the invention to provide an improved ink cartridge for an ink jet printer.

It is an object of the present invention to provide a high-quality and highly reliable ink-supplied printer of a simple construction which is capable of supplying a stable and appropriate quantity of ink from an ink tank to a printer head and is less subject to the influence of environmental changes such as temperature or atmospheric variations.

It is a further object of the invention to provide a cartridge for an ink jet printer which can be mounted using minimal force and with a large tolerance for misalignment of the ink supply needle, which can cooperate with a recording head to attain a sufficient hermetic seal, while producing a dead space as small as possible.

Yet another object of the invention is to prevent air bubbles from entering the recording head while maintaining a negative pressure in the chamber containing the porous member.

Still other objects, features and advantages of the present invention will become more apparent from the following description when taken in conjunction with the accompanying drawings in which preferred embodiments of the present invention are shown by way of illustrative example and not in a limiting sense.

In accordance with a first aspect of the present invention there is provided an ink tank cartridge for an ink-jet type recording apparatus, comprising:

a plurality of first chambers;

a plurality of second chambers, each second chamber being adjacent to and associated with a first chamber;

a plurality of partition walls disposed in said cartridge, each said partition wall being formed with a communicating hole formed therein disposed between said

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associated chambers, said communicating hole extending along a relatively small portion of the bottom of said partition wall substantially away from the lateral extremes thereof, said second chamber communicating with said first chamber through said communicating hole;

a plurality of ink supply ports, each extending through a bottom wall of a respective one of said plurality of second chambers, said plurality of ink supply ports supplying ink to the exterior of said cartridge, all of said first chambers and associated second chambers being formed as an integral unit;

a porous member in each of said second chambers positioned to deliver ink to its associated ink supply port; and

an air vent port communicating between each said second chamber and the exterior of said cartridge at a location spaced from said ink supply port and communicating hole.

According to a second aspect of the present invention, there is provided an ink-get type recording apparatus for outputting ink onto a recording medium, comprising:

a recording head for ejecting ink; and

a multi-colour ink tank cartridge removably mountable onto said recording head of said ink-jet type recording apparatus for delivery of ink thereto, said ink tank cartridge, including:

a plurality of first chambers;

a plurality of second chambers, each second chamber being adjacent to and associated with a first chamber;

a plurality of partition walls disposed in said cartridge, each said partition wall being formed with a communicating hole formed therein disposed between said associated chambers, said communicating hole extending along a relatively small portion of the bottom of said partition wall substantially away from the lateral extremes thereof, said second chamber communicating with said first chamber through said communicating hole;

a plurality of ink supply ports, each extending through a bottom wall of a respective one of said plurality of second chambers, said plurality of ink supply ports

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supplying ink to the exterior of said cartridge, all of said first chambers and associated second chambers being formed as an integral unit;

a porous member in each of said second chambers positioned to deliver ink to its associated ink supply port; and

an air vent port communicating between each said second chamber and the exterior of said cartridge at a location spaced from said ink supply port and communicating hole.

According to a third aspect of the present invention, there is provided a system for supplying ink to an ink-jet type recording apparatus and outputting ink onto a recording medium, said system comprising:

a recording head for ejecting ink; and

a multi-colour ink tank cartridge removably mountable onto said recording head of said ink-jet type recording apparatus for delivery of ink thereto, said ink tank cartridge including:

a plurality of first chambers;

a plurality of second chambers, each second chamber being adjacent to and associated with a first chamber;

a plurality of partition walls disposed in said cartridge, each said partition wall being formed with a communicating hole formed therein disposed between said associated chambers, said communicating hole extending along a relatively small portion of the bottom of said partition wall substantially away from the lateral extremes thereof, said second chamber communicating with said first chamber through said communicating hole;

a plurality of ink supply ports, each extending through a bottom wall of a respective one of said plurality of second chambers, said plurality of ink supply ports supplying ink to the exterior of said cartridge, all of said first chambers and associated second chambers being formed as an integral unit;

a porous member in each of said second chambers positioned to deliver ink to its associated ink supply port; and

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an air vent port communicating between each said second chamber and the exterior of said cartridge at a location spaced from said ink supply port and communicating hole.

According to a fourth aspect of the present invention, there is provided a method for providing ink to an ink-jet type recording head, comprising the steps of:

providing an ink tank cartridge having a plurality of first chambers adapted to store ink and a plurality of second chambers adapted to receive a respective porous member impregnated with ink, each of said first and second chambers being separated from each other by a partition wall;

communicating ink between said associated first and second chambers through a communicating hole extending along a relatively small portion of the bottom of said partition wall substantially away from the lateral extremes thereof, said second chamber communicating with said first chamber through said communicating hole; withdrawing ink from each porous member in each second chamber through an ink supply port extending through a bottom wall of each second chamber; and

providing ambient air to each second chamber at a location spaced from said ink supply port.

According to a fifth aspect of the present invention, there is provided an ink tank for an ink-jet type recording apparatus, comprising:

a first chamber;

a second chamber adjacent to and associated with the first chamber;

a partition wall disposed in said cartridge and being formed with a communicating hole formed therein disposed between said associated chambers, said communicating hole extending along a relatively small portion of the bottom of said partition wall substantially away from the lateral extremes thereof, said second chamber communicating with said first chamber through said communicating hole;

an ink supply port extending through a bottom wall of said second chamber and supplying ink to the exterior of said cartridge, said first and second chambers being formed as an integral unit;

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a porous member in said second chamber positioned to deliver ink to the ink supply port; and

an air vent port communicating between said second chamber and the exterior of said cartridge at a location spaced from said ink supply port and communicating hole.

Referance is hereby made to co-pending applications 9519071.6 and 9519047.6 which both describe arrangements similar to those of the illustrated embodiments herein.

Generally speaking, there is provided an ink-supplied printer. Ink is supplied to a printer head by an ink supply system, including an ink tank having an ink supply port and a pair of side walls. An ink absorbing member is contained therein adjacent the ink supply port which occupies less than the total volume of the ink tank.

The walls of the ink supply tank may be transparent so the user can more easily determine the amount of ink remaining in the ink supply tank.

An ink receiving and transferring member terminating in an ink port may extend into the ink tank, in which case the ink absorbing member abuts and is locally compressed by the ink receiving and transmitting member. The ink receiving and transmitting member has a capillary ink path communicating with the printer head and is supplied with ink from the ink absorbing member.

More specifically an ink cartridge may be formed of an ink chamber for storing ink and a foam chamber for receiving a porous member for absorbing ink. A partition separates the ink chamber from the foam chamber and has a hole therein so that the foam chamber is in fluid communication with the ink chamber. The ink cartridge is also formed with an ink supply port. A funnel shaped packing member is disposed within the supply port and supplies ink to a recording head by generation of a pressure difference through the porous member. The packing member is disposed facing upward in the ink supply port. The packing member is resilient.

When an ink supply needle of the recording head is inserted into the ink supply port, the tip of the needle may resiliently contact the packing member. Since the packing member has a funnel-like shape which opens upward, the packing member is easily .....

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CLAIMS

1. An ink tank cartridge for an ink-jet type recording apparatus, comprising:

a plurality of first chambers;

a plurality of second chambers, each second chamber being adjacent to and associated with a first chamber;

a plurality of partition walls disposed in said cartridge, each said partition wall being formed with a communicating hole formed therein disposed between said associated chambers, said communicating hole extending along a relatively small portion of the bottom of said partition wall substantially away from the lateral extremes thereof, said second chamber communicating with said first chamber through said communicating hole;

a plurality of ink supply ports, each extending through a bottom wall of a respective one of said plurality of second chambers, said plurality of ink supply ports supplying ink to the exterior of said cartridge, all of said first chambers and associated second chambers being formed as an integral unit;

a porous member in each of said second chambers positioned to deliver ink to its associated ink supply port; and

an air vent port communicating between each said second chamber and the exterior of said cartridge at a location spaced from said ink supply port and communicating hole.

2. The ink cartridge of claim 1, wherein the porous member associated with each second chamber and the associated first chamber contain ink different from the ink in the other first and second chambers.

3. The ink tank cartridge of claim1 or claim 2, further comprising an associated step portion formed at a lower portion of each of said communicating holes, a groove connecting said associated first and second chambers being formed in said ink cartridge below said associated step portion.

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4. The ink tank cartridge of any one of the preceding claims, further comprising a protrusion portion formed on an inner surface of said partition wall in each of said second chambers, each said protrusion portion maintaining a space about said associated communicating hole to aid in the flow of ink therethrough.

5. The ink tank cartridge of any one of the preceding claims, further comprising a step portion formed below each of said communicating holes in said partition wall.

6. The ink tank cartridge of claim 5, wherein the part of each of said step portions adjacent said associated first chamber is higher than the part adjacent said associated second chamber.

7. The ink tank cartridge of any of the preceding claims, further comprising a respective vertically extending thin groove formed in each said partition wall above each communicating hole and on the side of the associated second chambers, each of said grooves being in fluid communication with each associated communicating hole, each of said grooves aiding in the flow of air and ink between said associated first and second chambers.

8. The ink tank cartridge of any of the preceding claims, further comprising a projection formed on an inside wall of each of said second chambers disposed on a surface of said second chamber opposite said associated ink supply port, said projections compressing said associated porous members against said associated ink supply ports.

9. The ink tank cartridge of claim 8, wherein each said ink supply port includes a projection including its entrance projecting into said second chamber.

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10. The ink tank cartridge of claim 8 or 9, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

11. The ink tank cartridge of any of the preceding claims, wherein the volume of each of said porous members is larger than the capacity of each of said associated second chambers.

12. The ink tank cartridge of any one of the preceding claims, further comprising a respective vertically extending rib formed on an inner surface of said first chamber, each of said ribs assisting in the flow of ink.

13. The ink tank cartridge of any of the preceding claims, further comprising a projection formed on an inside wall of each of said second chambers disposed on a surface of said second chamber opposite said associated ink supply port, said projections compressing said associated porous members against said associated ink supply ports.

14. The ink tank cartridge of any one of the preceding claims, wherein each said ink supply port includes a portion including its entrance projecting into said second chamber.

15. The ink tank cartridge of claim 13, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

16. The ink tank cartridge of any of claims 13 to 15, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

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17. The ink tank cartridge of any of claims 13 to 16, further comprising a respective vertically extending rib formed on an inner face of each of said first chambers, each of said ribs assisting in the flow of ink.

18. The ink tank cartridge of any one claims 13 to 17, wherein each said air vent port is formed in part as a meandering groove.

19. The ink tank cartridge of any one of the preceding claims, wherein said second chamber is a foam chamber and said first chamber is an ink chamber.

20. The ink tank cartridge above of any one of the preceding claims, wherein said cartridge is constructed to be removably mounted on said recording apparatus so that one of a plurality of ink supply needles of said apparatus is received in each ink supply port.

21. An ink-get type recording apparatus for outputting ink onto a recording medium, comprising:

a recording head for ejecting ink; and

a multi-colour ink tank cartridge removably mountable onto said recording head of said ink-jet type recording apparatus for delivery of ink thereto, said ink tank cartridge, including:

a plurality of first chambers;

a plurality of second chambers, each second chamber being adjacent to and associated with a first chamber;

a plurality of partition walls disposed in said cartridge, each said partition wall being formed with a communicating hole formed therein disposed between said associated chambers, said communicating hole extending along a relatively small portion of the bottom of said partition wall substantially away from the lateral extremes thereof, said second chamber communicating with said first chamber through said communicating hole;

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a plurality of ink supply ports, each extending through a bottom wall of a respective one of said plurality of second chambers, said plurality of ink supply ports supplying ink to the exterior of said cartridge, all of said first chambers and associated second chambers being formed as an integral unit;

a porous member in each of said second chambers positioned to deliver ink to its associated ink supply port; and

an air vent port communicating between each said second chamber and the exterior of said cartridge at a location spaced from said ink supply port and communicating hole.

22. The ink-jet type recording apparatus of claim 21 wherein the porous member associated with each second chamber and the associated first chamber contain ink different from the ink the other first and second chambers.

23. The ink-jet type recording apparatus of claims 21 or 22, further comprising a respective vertically extending thin groove formed in each said partition wall above each communicating hole and on the side of the associated second chambers, each of said grooves being in fluid communication with each associated communicating hole, each of said grooves aiding in the flow of air and ink between said associated first and second chambers.

24. The ink-jet type recording apparatus of any one of claims 21 to 23, further comprising a projection formed on an inside wall of each of said second chambers disposed on a surface of said second chamber opposite said associated ink supply port, said projections compressing said associated porous members against said associated ink supply ports.

25. The ink-jet type recording apparatus of claim 24, wherein each said ink supply port includes a projection including its entrance projecting into said second chamber.

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26. The ink-jet type recording apparatus of claim 24 or 25, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

27. The ink-jet type recording apparatus of any one of claims 21 to 26, wherein the volume of each of said porous members is larger than the capacity of each of said associated second chambers.

28. The ink-jet type recording apparatus of any one of claims 21 to 27, further comprising a respective vertically extending rib formed on an inner surface of said first chamber, each of said ribs assisting in the flow of ink.

29. The ink-jet type recording apparatus of any one of claims 21 to 28, further comprising a projection formed on an inside wall of each of said second chambers disposed on a surface of said second chamber opposite said associated ink supply port, said projections compressing said associated porous members against said associated ink supply ports.

30. The ink-jet type recording apparatus of claim 29, wherein each said air vent port is formed in part as a meandering groove.

31. The ink-jet type recording apparatus of any one of claims 21 to 30, wherein said second chamber is a foam chamber and said first chamber is an ink chamber.

32. The ink-jet type recording apparatus of any one of claims 21 to 31, wherein said cartridge is constructed to be removably mounted on said recording apparatus so that one of a plurality of ink supply needles of said apparatus is received in each ink supply port.

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33. A system for supplying ink to an ink-jet type recording apparatus and outputting ink onto a recording medium, said system comprising:

a recording head for ejecting ink; and

a multi-colour ink tank cartridge removably mountable onto said recording head of said ink-jet type recording apparatus for delivery of ink thereto, said ink tank cartridge including:

a plurality of first chambers;

a plurality of second chambers, each second chamber being adjacent to and associated with a first chamber;

a plurality of partition walls disposed in said cartridge, each said partition wall being formed with a communicating hole formed therein disposed between said associated chambers, said communicating hole extending along a relatively small portion of the bottom of said partition wall substantially away from the lateral extremes thereof, said second chamber communicating with said first chamber through said communicating hole;

a plurality of ink supply ports, each extending through a bottom wall of a respective one of said plurality of second chambers, said plurality of ink supply ports supplying ink to the exterior of said cartridge, all of said first chambers and associated second chambers being formed as an integral unit;

a porous member in each of said second chambers positioned to deliver ink to its associated ink supply port; and

an air vent port communicating between each said second chamber and the exterior of said cartridge at a location spaced from said ink supply port and communicating hole.

34. The system of claim 33, wherein the porous member associated with each second chamber and the associated first chamber contain ink different from the ink in the other first and second chambers.

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35. The system of claim 33 or claim 34, further comprising a respective vertically extending thin groove formed in each said partition wall above each communicating hole and on the side of the associated second chambers, each of said grooves being in fluid communication with each associated communicating hole, each of said grooves aiding in the flow of air and ink between said associated first and second chambers.

36. The system of any one of claims 33 to 35, further comprising a projection formed on an inside wall of each of said second chambers disposed on a surface of said second chamber opposite said associated ink supply port, said projections compressing said associated porous members against said associated ink supply ports.

37. The system of claim 36, wherein said ink supply port includes a projection including its entrance projecting into said second chamber.

38. The system of claims 36 or 37, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

39. The system of any one of claims 33 to 38, wherein the volume of each of said porous members is larger than the capacity of each of said associated second chambers.

40. The system of any one of claims 33 to 39, further comprising a respective vertically extending rib formed on an inner surface of said first chamber, each of said ribs assisting in the flow of ink.

41. The system of any one of claims 33 to 40, further comprising a projection formed on an inside wall of each of said second chambers disposed on a surface of said second chamber opposite said associated ink supply port, said projections compressing said associated porous members against said associated ink supply ports.

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42. The system of claims 41, wherein each said air vent port is formed in part as a meandering groove.

43. The system of any one of claims 33 to 42, wherein said second chamber is a foam chamber and said first chamber is an ink chamber.

44. The system of any one claims 33 to 43, wherein said cartridge is constructed to be removably mounted on said recording apparatus so that one of a plurality of ink supply needles of said apparatus is received in each ink supply port.

45. A method for providing ink to an ink-jet type recording head, comprising the steps of:

providing an ink tank cartridge having a plurality of first chambers adapted to store ink and a plurality of second chambers adapted to receive a respective porous member impregnated with ink, each of said first and second chambers being separated from each other by a partition wall;

communicating ink between said associated first and second chambers through a communicating hole extending along a relatively small portion of the bottom of said partition wall substantially away from the lateral extremes thereof, said second chamber communicating with said first chamber through said communicating hole; withdrawing ink from each porous member in each second chamber through an ink supply port extending through a bottom wall of each second chamber; and

providing ambient air to each second chamber at a location spaced from said ink supply port.

46. The method of claim 45, further comprising the step of:

forming air vents at least in part as winding grooves in a surface of said ink tank cartridge to protect said ink against evaporation.

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47. The method of claim 46, further comprising the steps of:

sealing said grooves with a seal member;

removing a portion of said seal to place the interior of said ink supply tank in fluid communication with ambient air through said winding grooves.

48. An ink tank cartridge for an ink-jet type recording apparatus, comprising:

a first chamber;

a second chamber adjacent to and associated with the first chamber;

a partition wall disposed in said cartridge and being formed with a communicating hole formed therein disposed between said associated chambers, said communicating hole extending along a relatively small portion of the bottom of said partition wall substantially away from the lateral extremes thereof, said second chamber communicating with said first chamber through said communicating hole;

an ink supply port extending through a bottom wall of said second chamber and supplying ink to the exterior of said cartridge, said first and second chambers being formed as an integral unit;

a porous member in said second chamber positioned to deliver ink to the ink supply port; and

an air vent port communicating between said second chamber and the exterior of said cartridge at a location spaced from said ink supply port and communicating hole.

49. The ink-jet type recording apparatus of claim 48, wherein at least one different patterns and colors are printed on said main portion and said tongue piece, said neck portion acting as a boundary between said main portion and said tongue piece.

50. The ink-jet type recording apparatus of claim 45, further comprising at least one chamber partition wall extending from each partition, said chamber partition walls dividing each said first chambers into a plurality of sub-chambers.

51. The ink-jet type recording apparatus of claim 45, further comprising a projection formed on an inside wall of each of said second chambers disposed on a surface of said second chamber opposite said associated ink supply port, said projections compressing said associated porous members against said associated ink supply ports.

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52. The ink-jet type recording apparatus of claim 51, wherein each said ink supply port includes a portion including its entrance projecting into said second chamber.

53. The ink-jet type recording apparatus of claim 51, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

54. The ink-jet type recording apparatus of claim 45, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

55. The ink-jet type recording apparatus of claim 45, further comprising a respective vertically extending rib formed on an inner face of each of said first chambers, each of said ribs assisting in the flow of ink.

56. The ink-jet type recording apparatus of claim 45, wherein each said air vent port is formed in part as a meandering groove.

57. The ink-jet type recording apparatus of claim 32, wherein said second chamber is a foam chamber and said first chamber is an ink chamber.

58. The ink-jet type recording apparatus of claim 32, wherein said cartridge is constructed to be removably mounted on said recording apparatus so that one of a plurality of ink supply needles of said apparatus is received in each ink supply port.

59. A system for supplying ink to an ink-jet type recording apparatus and outputting ink onto a recording medium, said system comprising:

a recording head for ejecting ink; and

a multi-color ink tank cartridge removably mountable onto said recording head of said ink-jet type recording apparatus, for delivery of ink thereto said ink

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tank cartridge, including:

a plurality of first chambers;

a plurality of second chambers, each second chamber being adjacent to and associated with a first chamber;

a plurality of partition walls disposed in said cartridge, each said partition being formed with a communicating hole formed therein disposed between said associated chambers, said communicating hole being positioned in the vicinity of the bottom of said partition wall and extending only a portion of the width of said partition wall as viewed in the direction of said bottom of said partition wall; and

a plurality of ink supply ports, each extending through a wall of a respective one of said plurality of second chambers, said plurality of ink supply ports supplying ink to the exterior of said cartridge, all of said first chambers and associated second chambers being formed as an integral unit.

60. The system of claim 59, and including a porous member in each of said second chambers positioned to deliver ink to its associated ink supply port and an air vent port communicating between each said second chamber and the exterior of said cartridge at a location spaced from said ink supply port and communicating hole.

61. The system of claim 60, wherein the porous member associated with each second chamber and the associated first chamber contain ink different from the ink in the other first and second chambers.

62. The system of claim 60, wherein the porous member in each said second chamber and the associated first chamber contain ink, the pressure in each of said first chambers and each of said associated second chambers being at a value less than atmospheric pressure.

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63. The system of claim 62, wherein a pressure balance between each of said first chambers and each of said associated second chambers is maintained by the surface tension of each of said associated porous members in the vicinity of each of said associated communicating holes, each said porous member resiliently contacting said associated hole, said pressure balance maintaining ink in each of said respective first chambers.

64. The system of claim 63, wherein each said porous member, assocated first and second chambers, partition wall, communicating hole ink supply port and air vent port are positioned and dismensioned so that when said ink impregnated in each of said associated porous members is at least partially transmitted through said ink supply port, said pressure balance between said associated chambers is no longer maintained and ink is supplied from the first chamber to the associated porous member in the associated second chamber as required until the pressure balance is restored.

65. The system of claim 64, further comprising a respective vertically extending thin groove formed in each said partition wall above each communicating hole and on the side of the associated second chambers, each of said grooves being in fluid communication with each associated communicating hole, each of said grooves aiding in the flow of air and ink between said associated first and second chambers.

66. The system of claim 60, further comprising a projection formed on an inside wall of each of said second chambers disposed on a surface of said second chamber opposite said associated ink supply port, said projections compressing said associated porous members against said associated ink supply ports.

67. The system of claim 66, wherein each said ink supply port includes a projection including its entrance projecting into said second chamber.

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68. The system of claim 66, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

69. The system of claim 60, wherein the volume of each of said porous members is larger than the capacity of each of said associated second chambers.

70. The system of claim 60, further comprising at least one chamber partition wall, said chamber partition wall extending from each said partition wall and dividing said first chamber into a plurality of such chambers while permitting communication between each such chamber and the associated second chamber through the associated communicating hole.

71. The system of claim 64, further comprising a respective vertically extending rib formed on an inner surface of said first chamber, each of said ribs assisting in the flow of ink.

72. The system of claim 59, wherein said first chamber and said second chamber are maintained at a pressure less than atmospheric pressure and said ink cartridge further comprises a plurality of air vent ports formed in a surface of said cartridge, each having an air-impermeable sealing member for selectively sealing said air vent ports when said ink cartridge is not in use and unsealing said air vent ports when said ink cartridge is to be used.

73. The system of claim 72, wherein each of said air vent ports is formed in part as a groove on the outside surface of a wall of said second chamber.

74. The system of claim 72, wherein said outside surface is of a top lid.

75. The system of claim 72, wherein said sealing member comprises a main portion, and a tongue piece with is removably connected to said main portion via a

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neck portion.

76. The system of claim 75, wherein at least one of different patterns and colors are printed on said main portion and said tongue piece, said neck portion acting as a boundary between said main portion and said tongue piece.

77. The system of claim 72, further comprising at least one chamber partition wall extending from each partition, said chamber partition walls dividing each said first chambers into a plurality of sub-chambers.

78. The system of claim 72, further comprising a projection formed on an inside wall of each of said second chambers disposed on a surface of said second chamber opposite said associated ink supply port, said projections compressing said associated porous members against said associated ink supply ports.

79. The system of claim 78, wherein each said ink supply port includes a projection including its entrance projecting into said second chamber.

80. The system of claim 78, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

81. The system of claim 72, wherein the volume of each of said porous members before placement in a second chamber is larger than the volume of the associated second chamber in which it is received.

82. The system of claim 72, further comprising a respective vertically extending rib formed on an inner face of each of said first chambers, each of said ribs assisting in the flow of ink.

83. The system of claim 72, wherein each said air vent port is formed in part as a meandering groove.

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84. The system of claim 59, wherein said second chamber is a foam chamber and said first chamber is an ink chamber.

85. The system of claim 59, wherein said cartridge is constructed to be removably mounted on said recording apparatus so that one of a plurality of ink supply needles of said apparatus is received in each ink supply port.

86. A method for providing ink to an ink-jet type recording head, comprising the steps of:

providing an ink tank cartridge having a plurality of first chambers adapted to store ink and a plurality of second chambers adapted to receive a respective porous member impregnated with ink;

separating each of said first and second chambers from each other by use of a partition wall;

communicating ink between said associated first and second chambers through a communicating hole adjacent the bottom of said partition and extending only a portion of the width of said partition wall as viewed in the direction of said bottom of said partition wall, withdrawing ink from each porous member in each second chamber through an ink supply port extending through a wall of each second chamber; and

providing ambient air to each second chamber at a location spaced from said ink supply port.

87. The method of claim 86, further comprising the steps of:

maintaining the pressure in each of said first and second chambers below normal atmospheric pressure;

maintaining a pressure balance between each pair of associated first and second chambers by the surface tension of said porous member in the vicinity of said

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communicating hole;

the withdrawal of ink from a porous member through an associated ink supply port upsetting the pressure balance between said associated first and second chambers so that ink flows from said first chamber to said second chamber until said pressure balance is restored.

88. The method of claim 86, further comprising the steps of:

forming air vents at least in part as winding grooves in a surface of said ink cartridge to protect said ink against evaporation.

89. The method of claim 88, further comprising the steps of:

sealing said grooves with a seal member;

removing a portion of said seal to place the interior of said ink supply tank in fluid communication with ambient air through said winding grooves.

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