INK-SUPPLIED PRINTER AND INK SUPPLY TANK

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.

In addition, the invention relates generally to an ink tank cartridge for an ink jet printer, and more particularly, to a replenishable ink tank cartridge which supplies ink to a recording head of an ink jet recording apparatus or the like, a replenishment pack, a replenishment tool, an ink injection device, a replenishment set, and a method of replenishing an ink tank with ink.

Various kinds of ink tanks for ink jet printers are known from the prior art. For example, Japanese Patent Publication (Kokai) No. SHO.63-87242 discloses an ink tank in which ink absorbing members made of a porous material are respectively housed in a plurality of chambers. Japanese Patent Publication (Kokai) No. HEI.6-40043 discloses an ink tank in which a sealed container is divided by a partition so that a chamber housing an ink absorbing member, and an ink chamber storing only ink are juxtaposed.

In the ink tanks of above-mentioned prior art examples, the ink tanks can store a large quantity of ink so

that ink may be supplied to a recording head for a long print head life. When the previously charged ink is consumed, however, such an ink tank must be replaced with a fresh one. Replacement of the cartridge is cumbersome and has the additional disadvantage that the replacement process may cause the user's hands or the like to be soiled with ink. Furthermore, the disposal of depleted ink tanks involves large costs and causes environmental pollution.

Accordingly, it is desired provide an ink tank cartridge for an ink jet printer which may be reused, refilled quickly and cleanly upon depletion of ink from the ink tank and which overcomes the other limitations of the prior art.

SUMMARY OF THE INVENTION

Generally speaking, in accordance with the invention, an ink tank for an ink jet printer which may be refilled quickly and cleanly, and thereafter be reused by the user and a method for refilling the tank is provided. The ink tank is constructed with its interior divided by one or more partitions into a plurality of chambers where at least one of these chambers houses an ink absorbing member. The ink tank is also formed with a lid, a portion of which may be opened at least above the chambers the ink absorbing member.

In another embodiment, an ink supply hole is formed in the lid of the tank to allow for refill of the tank through the use of an ink injection device. In a preferred embodiment the partition detachably attaches to the container.

An ink replenishment pack houses an ink absorbing member, the ink absorbing member absorbing ink and being in a compressed state within the pack. The pack includes at least a top wall and bottom wall and has a first through hole formed in the top wall and second through hole formed in the

bottom wall. A respective replenishment pack may contain an absorbing member of different color ink than another replenishment pack, the replenishment pack being detachably attached within a chamber. The ink absorbing member has a larger volume than the capacity of the chamber.

At least one of the chambers within the container does not house an ink absorbing member. A openable replenishment hole is formed in the lid in a portion corresponding to the empty chamber. An ink supply port member having a through hole is disposed at the bottom of the chamber and protrudes into the chamber housing the ink absorbing member. The ink absorbing member is resiliently pressed by the ink supply port member to partially increase the compressibility of a portion of the absorbing member in the vicinity of an ink supply port. A projection extends from the lid and presses the ink absorbing member toward the ink supply port. An ink injection device has a container for holding ink to be injected into an ink tank. The container allows for visible observation of the ink. A scale indicative of a quantity of consumed ink is formed on the container portion. A needle is coupled to the container. A scale indicating penetration depth of the needle is formed on the needle. The ink jet injection device, when combined with a replenishment pack or ink absorbing member, forms an ink replenishment set for recording apparatus.

The ink cartridge is replenished by opening the lid and removing the ink absorbing member. The container is rotated so that the ink absorbing member containing chamber is positioned above a second chamber. An ink absorbing member is loaded in the first chamber and ink is supplied to the ink absorbing member. The lid uses the ink injection device and the first chamber is then closed.

In a preferred embodiment there may be a plurality of chambers having ink absorbing members and the ink absorbing

members have a larger volume than the capacity of the chamber.

In a preferred embodiment, the supply needle of the replenishment tool is passed through an air vent hole of the lid of a first chamber of an ink tank, the ink tank having a plurality of chambers divided by a partition and the chambers partially communicate with each other via a communicating hole. The needle of the ink injection device pierces the ink absorbing member, a releasable seal disposed adjacent and the ink second chamber not having the absorbing member is removed to open an air supply hole the ink absorbing member being replenished with the ink from this chamber. The empty chamber, without the absorption member, may also be replenished by the injection device through a replenishment formed in the lid above the empty chamber.

In another embodiment, the partition forming the chambers is removed and an ink absorbing member is then loaded therein.

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 printer head and is less subject to the influence of environmental changes such as temperature or atmospheric variations.

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

It is another object of the invention to provide a system having an ink tank which can be refilled, prolonging the life of the ink tank.

Yet another object of the invention is to prevent the environment from being polluted by providing a replenishable ink tank.

Another object of the invention is to provide an ink tank in which only the chamber housing an ink absorbing member can be opened, and the ink absorbing member and other chambers in the tank can be replenished with ink.

A further object of the invention to provide an ink tank in which a plurality of chambers of the ink tank respectively house ink absorbing members and the ink absorbing members can be replenished with ink.

A still further object of the invention is to provide an ink tank in which a partition of the ink tank is detachably and slidably attached so that the quantity of absorbed ink contained therein can be adjusted.

Yet another object of the invention is to provide an ink tank in which an ink absorbing member is loaded in a compressed state.

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Still another object of the invention is to provide a replenishment pack in which an ink absorbing member is housed in a storage unit and the ink absorbing member can be used to replenish a depleted ink absorbing member in a clean manner.

Yet a further object of the invention is to provide a replenishment tool for an ink tank which can separately replenish a plurality of chambers of the ink tank.

Still a further object of the invention is to provide a replenishment set which comprises a set of ink injection devices and an ink absorbing member.

Yet another object of the invention is to provide a method for replenishing a plurality of chambers within an ink tank.

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 an ink tank constructed in accordance with a first embodiment of the invention;

FIG. 3 is a cross-sectional side view of the ink tank of FIG. 2;

FIGS. 4(a), 4(b) and 4(c) are schematic diagrams illustrating the steps of supplying ink to an ink tank in accordance with the first embodiment of the invention;

FIG. 5 is a cross-sectional view of an ink tank constructed in accordance with a second embodiment of the invention;

FIG. 6 is a schematic diagram illustrating the steps of supplying ink to the ink tank of FIG. 5;

FIG. 7 is a cross-sectional view of an ink tank constructed in accordance with a third embodiment of the invention;

FIGS. 8(a) and 8(b) are schematic diagrams illustrating the steps of supplying ink to the ink tank of FIG. 7;

FIG. 9 is a cross-sectional view of an ink tank constructed in accordance with a fourth embodiment of the invention;

FIG. 10 is a schematic diagram illustrating the steps of supplying ink to the ink tank of FIG. 9;

FIG. 11 is a cross-sectional view of an ink replenishment pack constructed in accordance with the invention;

FIG. 12 is a perspective view depicting the ink replenishment pack of FIG. 11 showing the ink port in phantom;

FIG. 13 is a cross-sectional view of an ink replenishment tool and an ink tank constructed in accordance with a fifth embodiment of the invention;

FIG. 14 is a cross-sectional view of an ink tank constructed and being replenished in accordance with a sixth embodiment of the invention;

FIG. 15 is a side elevational view of an ink injection device constructed in accordance with the invention;

FIG. 16 is an enlarged fragmented side elevational view of a supply needle of the ink injection device of FIG. 15;

FIG. 17 is a top plan view of an ink replenishment set constructed in accordance with the invention; and

FIG. 18 is a cross-sectional view taken along line 39-39 of 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, 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 a described in European Patent Publications Nos. 581,531, 609,863, 584,823 and so on.

Reference is next made to FIGS. 2 and 3 which depict an ink tank 1000 constructed in accordance with a first embodiment of the invention having a partition 610 disposed in a container 601 so as to form first and second chambers 611 and 612. In the ink tank 1000, two compartment walls 613A and 613B extend in a direction perpendicular to partition 610 and are situated so as to form three adjacent equal first chambers 611A, 611B, and 611C commonly referred to as 611, one second chamber 612A, 612B and 612C associated respectively with each first chambers 611A, 611B and 611C is provided, but not shown in FIG. 3. The structure and operation of compartments 611A-611C are identical and a

representative compartment 611 will be described below for ease of description.

Ink absorbing members 615A, 615B, and 615C (collectively 615) are housed in a respective first chamber 611. In each of the ink absorbing members, yellow, magenta, or cyan ink is absorbed by the associated ink absorbing member 615. Each ink absorbing member 615 is a porous member which may be formed, for example, by foaming a polyurethane material. Each ink absorbing member 615 has a volume which is larger than the capacity of the respective first chamber 611 and is therefore housed in the respective first chamber 611 under compression. An associated ink supply port member 620A, 620B or 620C (collectively 620) is disposed in a bottom of first chamber 611.

First chamber 611 is provided with ink supply port member 620 through which an ink supply needle of a recording head (as shown in FIG. 1) passes and is engaged. Ink supply port member 620 is formed with a tubular shape. Top 622 of ink supply port member 620 which is covered by a filter 621 pushes against ink absorbing member 615 so as to slightly compress the ink absorbing member in the vicinity of ink supply port member 620, thereby enhancing the capillary force by which the ink flows. A packing member 624 having an opening 624' is fitted into a though hole 623 of ink supply port member 620 through which the ink supply needle is passed and forms a liquid tight seal with packing member 624. Additional ink is stored in each of second chambers 612A, 612B and 612C (collectively 612) which communicate with first chambers 611 respectively via slit-like communicating holes 610 formed in the lower portion of partition 610. A rib 614 extends around container 601.

A lid 630 is placed on the top opening of container 601. Lid 630 hermetically seals second chambers 612 and can be bent along a hinge type portion 631 in order to open lid

630. An engaging portion 632 is formed in the periphery of lid 630 and is directed inward. Engaging portion 632 detachably engages with rib 614 formed at the top of container 601 and is directed outward, whereby the top openings of first chamber 611 can be selectively closed.

An air vent hole 633 is formed in lid 630 so that ambient air of a quantity corresponding to the quantity of consumed ink flows into container 601.

In FIG. 2, reference numerals 634a and 634b designate the pressers which extend vertically from the inner face of lid 630 which compress ink absorbing member 615 against ink supply port 620. (Each chamber 611A, 611B and 611C have corresponding pressers 634a and 634b. This configuration will be generally described, but is applicable to each of the similar containers.) When the top opening of container 601 is closed by lid 630, pressers 634a and 634b are urged so as to partially press down on ink absorbing member 615. Presser 634a which opposes ink supply port member 620 is longer than presser 634b which is positioned away from ink supply port member 620. These pressers cooperate with ink supply port member 620 to further compress the portion of ink absorbing member 615 adjacent ink supply port member 620.

During printing, the method of use of ink tank 1000 is similar to that of prior art ink tanks. However, when ink in container 601 is depleted as a result of the printing operation, the ink tank of the invention may be refilled, rather than being discarded. The process of refilling container 601 with ink will be hereinafter described in connection with FIGS. 4a-4c.

When the ink cartridge is to be refilled, lid 630 is manually pulled up in the direction of arrow a_1 and opened about hinge type portion 631, which functions as the fulcrum, so that inward engaging portion 632 of lid 630 is disengaged from outward rib 614 of container 601. Thereafter lid 630 is

moved as indicated by the phantom line in FIG. 2 to open compartment 611A. Thereafter, the depleted ink absorbing member 615A may be extracted from first chamber 611A in the direction of arrow b_1 if necessary.

Next, container 601 is rotated in the direction of arrow c_1 by 90° so that first chamber 611 is positioned above second chamber 612 as shown in FIG. 4(b). Thereafter, by using an injection device 4000, ink is filled in second chamber 612 via communicating hole 610' of partition 610 in the direction of arrow d_1.

As is shown in FIG. 15, an injection device 4000 includes a container 4100, which may be transparent, and a scale 4200 may be formed thereon. Thus, the user can see the quantity of ink being injected into second chamber 612. A needle portion 4300 is coupled to container portion 4100 and is in fluid communication therewith.

Thereafter, ink absorbing member 615A is inserted into first chamber 611A, and ink is injected into ink absorbing member 615A by the injection device 4000 as shown in FIG. 4(c). If ink absorbing member 615A was not initially removed, ink would be refilled in both chambers while ink absorbing member 615A was still in first chamber 611A. This process would be repeated for each chamber 611 needing replenishing.

Finally, lid 630 is swung in the direction of arrow f_1, and inward engaging portion 632 is engaged with the outward rib 614 so as to restore the ink tank to its state shown in FIG. 2, thereby completing the work of refilling fresh ink.

Reference is now made to FIGS. 5 and 6 depicting an ink tank constructed in accordance with a second embodiment of the present invention. Like reference numerals denote like elements as those of the first embodiment, and as such will not be described again here. The primary difference

being a through hole for feeding ink into the interior of the ink tank.

A through hole 616A is formed in a side wall 616 of compartment 611A of an ink tank 2000 and a seal 617 is applied thereto. During the refilling process, lid 630 is opened, the depleted ink absorbing member 615A is removed, the new ink absorbing member 615A is replaced in the tank, and lid 630 is closed, as described above.

Next, ink is filled into the ink absorbing member 615A as described below. First, seal 617 is removed. Ink tank 2000 is then rotated by 90° so that first chamber 611 is above second chamber 612 as shown in FIG. 6, thereby affording access to an open through hole 616A. The supply needle 4300 of injection device 4000 is inserted into compartment 611A via through hole 616A, and ink is thereafter injected into the tank. In a preferred embodiment, the tip of the supply needle 4300 is first positioned in the vicinity of communicating hole 610' and ink is injected into second chamber 612. Thereafter, supply needle 4300 is slightly retracted and ink is injected into ink absorbing member 615A, so that ink is effectively supplied to first and second chambers 611A and 612. The through hole 616A is then closed by seal 617. In an alternative embodiment, a rubber sheet having a large resilient recovering force may be used in place of seal 617. Supply needle 4300 would then pierce through the sheet and supply ink to the ink tank. Therefore, seal 617 would not need to be removed and replaced in through hole 616A.

If ink absorbing member 615A does not need to be replaced with a fresh ink absorbing member, ink may be supplied to replenish the ink tank via through hole 616A by using injection device 4000 while lid 630 remains closed on the top of container 601.

Reference is now made to FIGS. 7 and 8(a) and (b) which depict an ink tank 5000 constructed in accordance with a third embodiment of the invention. Like elements are given like reference numerals, and are not described here again.

A container 6100 is divided into first and second chambers 6120 and 6120A by a partition 6110 and chambers 6120 and 6120A house ink absorbing members 6200 and 6300, respectively. A lid 6130 is detachably fixed to the top opening of container 6100 so that first and second chambers 6120 and 6120A are opened at the same time. An engaging portion 6132 which is formed in the periphery of lid 6130 and directed inward is detachably engaged with a rib 6140 which is formed on container 6100 and directed outward.

To refill the ink tank, inward engaging portion 6132 is disengaged from outward rib 6140, and lid 6130 is removed from the top of container 6100 as shown in phantom. Depleted ink absorbing members 6200 and 6300 are extracted from first and second chambers 6120 and 6120A, and fresh ink absorbing members 6200 and 6300 are then loaded into chambers 6120 and 6120A respectively. If either of the depleted ink absorbing members 6200 or 6300 is not damaged and can be reused, then that ink absorbing member need not be replaced.

As in the first embodiment, the depleted ink tank 5000 may not have an ink absorbing member in second chamber 6120A. Also, during the refilling process ink absorbing member 6300 in second chamber 6120A may also be replaced, if necessary.

Next, refilling the ink tank shown in FIGS. 7 and 8 will be described.

In ink tank 5000 after the ink is depleted, inward engaging portion 6132 is disengaged from outward rib 6140, and lid 6130 is pulled up in the direction of arrow a_3 (FIG. 8(a)) so that lid 6130 is removed from container 6100. This

movement of lid 6130 opens first and second chambers 6120 and 6120A of container 6100.

Ink absorbing members 6200 and 6300 are then extracted from first and second chambers 6120 and 6120A in the direction of arrow b_3 (FIG. 8(a)) if necessary. Fresh ink absorbing members 6200 and 6300 are then forcedly pushed into first and second chambers 6120 and 6120A in the direction of arrows c_3 and d_3 so as to be housed in chambers 6120 and 6120A under compression (FIG. 8(b)).

A sufficient amount of ink is thereafter injected into ink absorbing members 6200 and 6300 by using injection device 4000. Finally, lid 6130 is lowered in the direction of arrow e_3 so as to contact with the top opening of container 6100. Inward engaging portion 6132 is engaged with outward rib 6140, thereby sealing lid 6130 and completing the refilling process.

Reference is now made to FIGS. 9 and 10 which depict an ink tank constructed in accordance with a fourth embodiment of the present invention. Like elements from previous embodiments being given like reference numerals, the primary difference being a removable partition for defining a single chamber. Ink tank 5000 includes a partition 6110' which separates a first chamber 6120 from a second chamber 6120A. Partition 6110' is detachably and slidably attached to container 6100 as indicated by the phantom line 6110". Partition 6110' can be removed to form a single chamber as a combination of chambers 6120 and 6120A.

As shown in FIG. 10, to refill the ink tank, after removing lid 6130, a depleted ink absorbing member 6400 is removed, and partition 6110' is also removed in the direction indicated by arrow g_4. Thereafter, an integrated ink absorbing member 6500 is loaded so as to fill container 6100. Ink is then injected into absorbing member 6500 by injection device 4000. Lid 6130 is then reattached.

Reference is now made to FIGS. 11 and 12 which depict a replenishment pack 7000 for use in conjunction with the ink tank of the fourth embodiment. Replenishment pack 7000 allows for clean handling of ink absorbing member 6500.

As shown FIGS. 11 and 12, replenishment pack 7000 includes a storage unit 6500 having at least a top wall 6511 and bottom wall 6514 and encloses an ink absorbing member 6500 impregnated with ink. Ink absorbing member 6500 has previously been compressed and is housed in cube-like hollow storage unit 6510, which is made of an air-impermeable material which is a lamination of thin plastic sheets or metallic foils by way of example. A through hole 6512 is formed in top wall 6511. Through hole 6512 can be opened by means of a releasable seal 6513. Similarly, a through hole 6515 is formed in a bottom wall 6514 and through hole 6515 can be opened by means of a releasable seal 6516.

Replenishment pack 7000 is employed in the following manner. Partition 6110' of ink cartridge 6000 is removed from container 6100, and releasable seals 6513 and 6516 are removed from the storage unit 6510. Storage unit 6510 is then loaded into container 6100 and is attached to ink supply port 620 to supply ink to the printer. Storage unit 6510 may be attached to ink supply port 620 by through hole 6515 formed in bottom wall 6514, and a filter 621 which is made of a flexible material such as plastic (for example, see the reference numeral 621 in FIG. 12) may be attached to the opening.

When compressing ink absorbing member 6500, the compression may be conducted on the whole of the member, or alternatively the compression may be conducted in a selective manner in the lateral directions or in the vertical directions.

A plural number of storage units 6510 may store a plurality of ink absorbing members 6500, respectively

absorbing inks of different colors such as yellow, magenta, and cyan. The storage units may selectively be attached and detached in the respective first chamber 611A, 611B, and 611C shown in FIG. 3.

Reference is now made to FIG. 13 which depicts an ink tank 8000 and ink replenishment tool 9000 constructed in accordance with a fifth embodiment of the invention. Like elements from previous embodiments are indicated by reference numerals.

An ink tank 8000 has a lid 1300 fixed to a container 1000. Container 1000 is divided into a first chamber 611 and a second chamber 612 which communicate with each other through a communicating hole 610'. An ink absorbing member 615 is disposed in first chamber 611. An air vent hole 1330 is formed in lid 1300.

A replenishment tool 9000 shown in FIG. 34 is used to refill container 1000. Replenishment tool 9000 includes a tank 9100 coupled to a supply needle 9200. An air supply hole 9300 is formed in the top of a replenishment tank 9100 from which a supply needle 9200 extends vertically down. Air supply hole 9300 is closed by a releasable seal 9400. To replenish ink, supply needle 9200 pierces into an ink absorbing member 615 in a first chamber 611. Thereafter, releasable seal 9400 is removed as indicated by the phantom line in FIG. 34 which opens air supply hole 9300, and allows air into tank 9100. Thus, the air entering supply needle 9200 will allow ink to be released through supply needle 9200, into ink absorbing member 615. In order to allow air in the interior of ink absorbing member 615 to escape when ink is being refilled, in a preferred embodiment a small gap is formed between air vent hole 1330 and supply needle 9200 or another air vent hole is provided in another portion of the lid 1300.

When degassed ink is employed, ink can be supplied into container 1000 more effectively since while falling by gravity the ink will absorb any small air bubbles contained in ink absorbing member 615. Thus, ink can be supplied which will enhance the reliability of the recording head. In a preferred embodiment, an amount of ink which is approximately smaller than half of the capacity of the first chamber 611 should be supplied.

Reference is now made to FIG. 14 which depicts an ink tank constructed in accordance with a sixth embodiment of the invention. Like elements from previous Embodiments are indicated by like reference numerals, the primary difference between this embodiment and ink tank 8000 being a replenishment hole in the lid over the second chamber.

An ink tank 10000 has a first chamber 611 of container 1000 which houses an ink absorbing member 615. In order to directly supply ink to a second chamber 612 which is adjacent first chamber 611 and does not house ink absorbing member 615, a replenishment hole 2410 is formed in a lid 2400 fixed to container 1000. Replenishment hole 2410 is selectively closed in an openable manner by a releasable seal 2420. When ink tank 10000 is to be refilled, replenishment hole 2410 is opened by removing releasable seal 2420. Thereafter, supply needle 4300 of injection device 4200 is passed through replenishment hole 2410 and ink is supplied to second chamber 612. In a preferred embodiment, it is preferable to form a small gap between replenishment hole 2410 and supply needle 4300 or form an air vent hole 10100 in a portion of lid 2400 of second chamber 612 to allow air to escape during replenishment.

In place of the releasable seal 2420, a rubber sheet having a large resilient recovering force may be used. Supply needle 4300 would then pierce through the rubber sheet as shown in FIG. 35 and ink would be supplied.

Reference is now made to FIGS. 15 and 16 which depict previously mentioned injection device 4000 which has a syringe-like shape. A scale 4200 is formed on the container portion 4100 of injection device 4000, and scales M_1 to M_7 are formed on supply needle 4300 along the longitudinal direction thereof as shown in FIG. 16. When using injection device 4200, the quantity of ink being supplied can be monitored by viewing the scale 4200. The depth that supply needle 4300 has been inserted into an ink absorbing member can be detected by means of the scales M_1 to M_7 so that ink is injected to the ink absorbing member at the desired depth. Therefore, ink can be absorbed effectively throughout the entire volume of the ink absorbing member. Preferably, the injection device 4000 is filled with ink which has been previously degassed, and is wrapped and stored in an air-impermeable material such as aluminum or an aluminum laminate before being used in the replenishment process. This improves print quality by removing any air bubbles which might remain in the ink absorbing member. As required, degassed ink is stored in a storage pack (not shown) which is made of a gas-impermeable material. A number of storage packs and an associated empty injection device 4000 may be supplied as an ink refill kit.

Reference is now made to FIGS. 17 and 18 which depict an ink replenishment set 11000 constructed in accordance with the invention. In ink replenishment set 11000, inks of different colors are respectively filled in each of a plurality of ink injection devices 4000A, 4000B, 4000C described in FIG. 36. The injection devices are arranged on a base plate 11100. An ink absorbing member 12000 may also be placed on base plate 11100. These components may be covered by a cover sheet 11200 having recesses 11300 to 11600 which correspond to the outer shapes of injection devices 4000 and ink absorbing member 12000, thereby constituting the

ink replenishment set 11000. When the set is to be used, cover sheet 11200 is removed from base plate 11100, one of the injection devices 4000 and the ink absorbing member 12000 are taken out from the recess and are used to replenish ink.

Further, ink injection device 4000 containing ink and ink absorbing member 12000 may be separately packed in separate ink replenishment sets rather than packed in a single ink replenishment set. If the black ink tank and the color ink tanks have different volumes, a number of ink absorbing members may be provided, each corresponding to the volume of the associated ink tank. These different ink absorbing members may be provided in the same or different ink replenishment sets. The corresponding ink injection devices would also have an amount of ink sufficient to replenish the associated ink tank and ink absorbing member.

As shown above, the ink injection device may be provided with ink already contained therein. However, it is also possible to provide a storage pack with ink contained therein, and an empty ink injection device. These may be provided in the same or different replenishment sets. It is possible to provide any combination of ink, ink tanks, ink injection devices and ink absorbing members without departing from the spirit of the invention.

The invention as described above results in the following benefits:

(1) The ink tank can be reused.

Since ink or an ink absorbing member can easily be supplied to the chambers separated from each other by a partition in the container of the ink tank, the ink tank can be used over and over for a long time. Since the depleted ink tank is not required to be disposed of, moreover, the environment is prevented from being polluted. Therefore, the invention is highly effective.

(2) The ink replenishment process is conducted in a clean manner.

By opening the lid of the container of the ink tank, the ink absorbing member may be replenished with ink in a clean manner without staining anything outside the ink tank. Alternatively, since ink can be supplied by using the ink injection device or the ink replenishment tool without opening the lid of the container, the user is prevented from being soiled by the ink.

(3) The ink replenishment process is conducted efficiently.

A precise amount of ink can be supplied effectively to the chamber housing the ink absorbing member or ink, by using a replenishment pack, an injection device, or a replenishment set. Therefore, the efficiency of the replenishment work can be improved.

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.

CLAIMS :

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

a tank body having exterior walls;

a first chamber in said tank body defined in part by said exterior walls;

a second chamber in said tank body defined in part by said exterior wall;

an ink absorbing member stored in at least one of said first and second chambers;

a partition wall separating said first chamber from said second chamber;

at least one of said tank body exterior walls being formed with an ink injection port.

2. The ink tank cartridge of claim 1, wherein said ink injection port is formed in said first chamber which stores said ink absorbing member.

3. The ink tank cartridge of claim 1, wherein said ink injection port is formed in said second chamber.which is adapted to store ink and is free of an ink absorbing member, said partition wall permitting the passage of ink between said first and second chambers.

4. The ink tank cartridge of claim 1, further comprising an ink supply port extending through and projecting from a wall of said first chamber which contains an ink absorbing member, said ink supply port transmitting ink from said ink absorbing member, and said ink absorbing member being partially compressed by said ink supply port in the vicinity thereof.

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5. The ink tank cartridge of claim 4, further comprising a projection formed on an inside wall of said first chamber and being disposed on a surface of said first chamber opposite said ink supply port, said projection further aiding to compress said ink absorbing member against said ink supply port.

6. The ink tank cartridge of claim 4, wherein said cartridge is constructed to be removably mounted on said recording apparatus so that a needle thereof is received in said ink supply port.

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

a recording head for ejecting ink;

an ink tank cartridge being removably mountable onto said recording head of said ink-jet type recording apparatus, said ink tank cartridge further comprising:

a tank body having exterior walls;

a first chamber in said tank body defined in part by said exterior walls;

a second chamber in said tank body defined in part by said exterior walls, said second chamber being associated with said first chamber;

an ink absorbing member stored in at least one of said first and second chambers;

a partition wall separating said first chamber from said second chamber;

at least one of said tank body exterior walls being formed with an ink injection port; and

a seal member sealing said ink injection port and adapted to permit ink injection through said port.

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

a recording head for ejecting ink; and

an ink tank cartridge being removably mountable onto said recording head of said ink-jet type recording apparatus for delivery of ink thereto, said ink tank cartridge further comprising:

a tank body having exterior walls;

a first chamber in said tank body defined in part by said exterior walls;

a second chamber in said tank body defined in part by said exterior walls;

an ink absorbing member stored in at least one of said first and second chambers;

a partition wall separating said first chamber from said second chamber;

at least one of said tank body exterior walls being formed with an ink injection port; and

a seal member sealing said ink injection port and adapted to permit ink injection through said port.

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

a tank body having exterior walls;

a chamber for storing an ink absorbing member;

at least one of said tank body walls being formed with an ink injection port; and

a seal member sealing said ink injection port and adapted to permit ink injection through said port.

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

a recording head for ejecting ink; and

an ink tank cartridge being removably mountable onto said recording head of said ink-jet type recording apparatus for delivering ink thereto, said ink tank cartridge further comprising:

a tank body having exterior walls;

a chamber for storing an ink absorbing member;

at least one of said tank body walls being formed with an ink injection port; and

a seal member sealing said ink injection port and adapted to permit ink injection through said port.

11. A method of replenishing an ink tank cartridge for an ink-jet type recording device with ink, comprising the steps of:

housing an ink absorbing member in said chamber;

forming a sealable hole in a side wall of said ink tank cartridge in said chamber containing said ink absorbing member; and

injecting ink into said chamber with an ink injection divice through said sealable hole.

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