



1 Ink Jet Recording Apparatus and a Method
 for Installing Ink Jet Recording Head

BACKGROUND OF THE INVENTION

5 Field of the Invention

 The present invention relates to an ink jet recording apparatus using the ink jet recording method whereby to perform recording by ejecting ink, and a method for installing ink jet recording head.

10 Related Background Art

 A number of printers, facsimile apparatuses, word processors, and other information apparatuses are being developed today. As these apparatuses, the ink jet recording method is widely used because it is capable of providing a high resolution, a high speed recording as well as a compact fabrication and a low cost. Among many other advantages, its capability of being fabricated compactly and operated at a low running cost are particularly significant.

20 As shown in Fig. 20, there has hitherto been a method wherein a head cartridge 1801 integrally structured with a recording head 1801a and an ink tank 1801b filled with ink is exchangeably mounted on a mounting unit 1802 of an apparatus. However, this
25 method has a drawback that its running cost is high because the recording head in this case is an article of consumption. Also, the recording head 1801a is



1 yet to reach its life when ink has been consumed
completely. This is a waste because a recording head
1801a which is still usable for recording is
discarded.

5 There is also a method wherein a recording
head 1901 and an ink tank 1903 are structured
separately and are exchangeable mounted on the
mounting unit 1903 of an recording apparatus
individually as shown in Fig. 21, for example.

10 However, with this method, it is necessary to provide
the ink supply passage 1904 on the recording apparatus
in order to supply ink in the ink tank to the
recording head. As a result, the cost is inevitably
increased and this also hinders making the apparatus
15 compact. Moreover, when ink tank containing ink
materials of different colors are utilized, ink
mixture takes place in the ink passages in a
recording apparatus even if the recording heads 1901
and ink tanks 1902 are replaced. In order to avoid
20 this mixture, it is necessary to the recording heads
1901, ink tanks 1902 and ink supply passages 1904 are
mounted on the mounting units 1903 separately for
each color.

Also, as shown in Fig. 22, for example, there
25 is a method wherein a recording head 1701 is
connected and fixed to the mounting unit 1702 of a
recording apparatus while an ink tank 1703 is

1 exchangeable connected to the foregoing recording
head 1701. This method, however, makes it difficult
to replace the recording heads with ease when the
recording head is damaged. Also, when ink tanks
5 having ink materials of different colors, there will
take place a mixture of ink in the recording head.
Accordingly, recording heads 1701 must be provided
in the mounting unit 1702 separately for each color
of ink.

10

SUMMARY OF THE INVENTION

The present invention is designed in
consideration of the above-mentioned problems. It
is an object of the invention to provide an ink jet
15 recording apparatus capable of reducing the running
cost, replacing ink tanks and recording heads with
ease, preventing ink from being scattered when the
recording heads are replaced, and replacing ink
colors simply without any mixtures.

20 It is another object of the present invention
to provide an ink jet recording apparatus capable of
coupling the recording head and carriage reliably
when the recording head is mounted on the carriage,
at the same time keeping the easiness with which to
25 replace the ink tanks and recording heads.

It is still another object of the present
invention to provide an ink jet recording apparatus

1 wherein the positioning precisions of the ink tank
and recording head do not affect each other when the
ink tank and recording head are mounted and fixed to
a carriage while keeping the easiness with which to
5 replace the ink tanks and recording heads.

An embodiment of the present invention is
characterized by having ink passage means enabling
the ink tank and recording head to be coupled each
other and detached from each other, and coupling
10 means enabling the recording head and the recording
apparatus to be connected with each other and
detached from each other.

According to such an embodiment, it is
possible to reduce the running cost because the
15 recording heads and ink tanks can be thus be replaced
selectively, leading to an improvement of operational
economy.

Also, the recording heads and ink tanks can
be replaced integrally; hence enabling the
20 maintenance of the recording heads and ink tanks
having different ink colors. In this way, it is
possible to change ink colors simply with the
replacement of these heads and ink tanks thus
maintained.

25 Furthermore, since the recording heads and
ink tanks can be replaced on a carriage, the
operativity is improved while preventing ink from

1 being scattered.

Moreover, there is less opportunity to touch the recording head by hand directly. Therefore, it is possible to prevent dust particles and air to be
5 mixed with ink; thus enabling the recording reliability to be enhanced.

According to another embodiment of an ink jet recording apparatus of the present invention, there are provided an ink passage coupling unit to allow
10 the ink tank and recording head to be connected with each other and detached from each other as well as a coupling unit to allow the recording head and the mounting unit to be connected with each other and detached from each other, the ink passage coupling
15 unit being structured to make it possible to couple the ink tank and recording head at least in two directions or more.

According to such an embodiment, the recording head can be mounted irrespective of the
20 mounting directions of the ink tank; hence enabling the selections of the ink ejection direction with the result that the installation direction of the apparatus is not restricted. This will provide a flexibility for the purpose.

25 Also, since the ink tank is mounted on the carrier, there is no need for the provision of any ink supply tubes and others. This will enable a

1 compact fabrication of the apparatus. In addition,
when ink is completely consumed, it will suffice only
if ink tanks are replaced, not the cartridge where
the head is fabricated integrally therewith. Thus,
5 the running cost can be reduced.

Also, when either one of the recording head
and the ink tank should be replaced, it is good
enough to replace only the one of them which requires
the replacement. This will improve the operational
10 economy.

Also, when recording heads are replaced,
it is easy to separate the carrier and head. This
will make the replacement easier.

Moreover, it is possible to use one kind of
15 recording head for various modes of head cartridge,
which enables its application to many different types
of recording apparatuses. Hence, the versatility is
enhanced to provide a desirable efficiency.

According to another embodiment of an ink jet
20 recording apparatus of the present invention, an ink
jet recording apparatus which performs recording by
ejecting ink is characterized in that a recording
head and an ink tank are separable and exchangeable,
and that the foregoing recording head can be coupled
25 to a carriage which carries the recording head in a
given direction by pressing the foregoing recording
head.

1 According to such an embodiment, irrespective
of whether the recording head is coupled to the ink
tank or not, the recording head⁹ is pressed against
the carriage directly without any intervention of
5 other members. As a result, the accuracy with which
to position the recording head and carriage is highly
improved. At the same time, the contacting
reliability of the electrical connection to supply
power from the recording apparatus to the recording
10 head is remarkably improved to obtain an ink jet
recording apparatus of an ink tank/head exchangeable
type having a remarkable reliability and extremely
high recording quality.

 According to another ink jet recording
15 apparatus embodying the present invention, an ink jet
recording apparatus which performs recording by
ejecting ink is structured to separate the ink tank
and recording head and is characterized by allowing
the foregoing ink tank and recording to be mounted
20 on a carriage by separate means, respectively.

 . With such an embodiment as this, it becomes
possible to mount a most suitable ink tank without
degrading the accuracy with which to mount a
recording head to the carriage because the recording
25 head and the exchangeable ink tank are arranged
independent of each other thereby to enable the
implementation of an ink jet recording apparatus

1 demonstrating a desirable recording quality as well
as a remarkable reliability, which can be operated
at a low running cost.

Another ink jet recording apparatus embodying
5 the present invention is characterized in the
following:

(1) A member is arranged to mount an ink jet
cartridge in a carrier detachably and hold it in the
carrier for the foregoing ink jet cartridge.

10 (2) In an ink jet recording apparatus, an
ink jet cartridge is partitioned for a recording head
and an ink tank which are structured separably, a
recording head is provided with a member to mount
the recording head in a carrier detachably and to
15 hold it in the carrier.

(3) In the ink jet cartridge described in
Paragraph (2), an ink tank is provided with a member
to mount the ink tank in the carrier detachably and
hold it in the carrier.

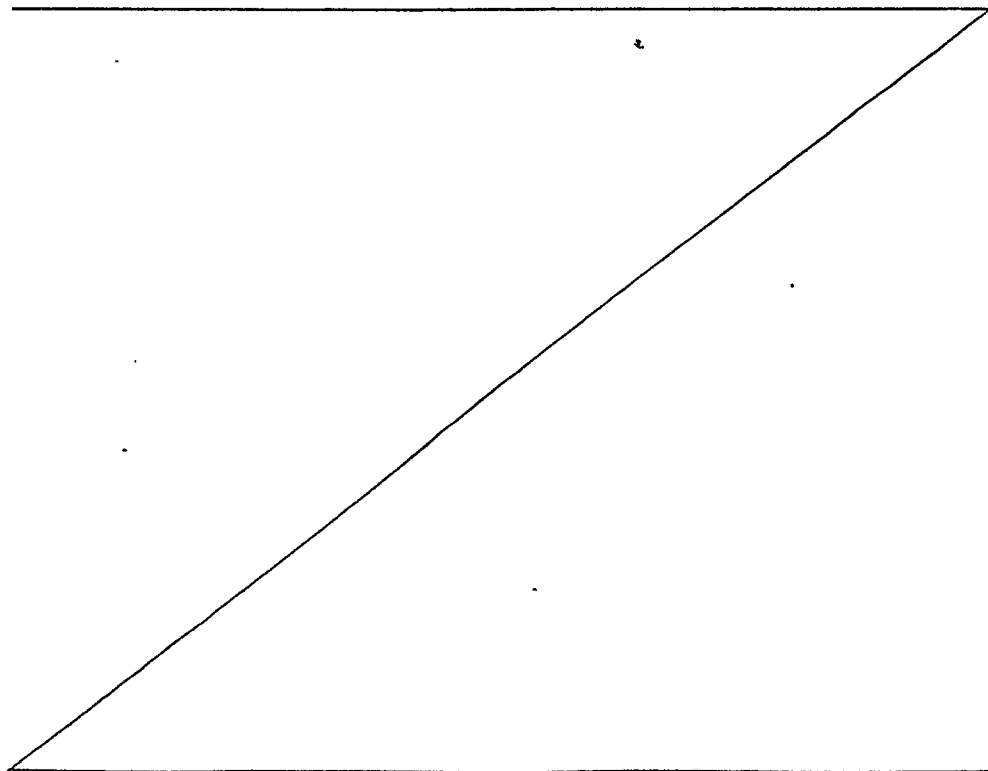
20 With such an embodiment as this, there is
arranged on an ink jet cartridge a member to mount
the ink jet cartridge in a carrier detachably and
hold it the carrier. Accordingly, it becomes
unnecessary for the carrier to be provided with such
25 a member; hence enabling the finished product to be
made compact with a simple structure and an enhanced
operativity.

1 According to another embodiment of an ink
jet recording apparatus of the present invention,
there are provided for an ink jet recording
apparatus which performs recording by ejecting
5 ink onto a recording medium, a carriage for mounting
the foregoing recording head, which travels along
the foregoing recording medium; and an ink tank
detachably mountable in the foregoing recording
head, and such an ink jet recording apparatus is
10 characterized in that means for regulating the
direction in which the foregoing ink tank approaches
the recording head is arranged for the foregoing
carriage or ink tank or the carriage and ink tank.

15

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25



1 According to such an embodiment as this,
there is arranged means for regulating the direction
in which the foregoing tank ⁹approaches the recording
head for the carriage and/or ink tank thereby to
5 prevent the ink tank from causing any damage to the
recording head even when an extra force is exerted
by an operator when mounting the ink tank or the ink
tank is pressed by mistake because the ink tank is
controlled before the ink tank imparts such a
10 pressure to the recording head.

 Another ink jet recording apparatus embodying
the present invention is characterized in that the
head is provided with an ink supply inlet to supply
ink to an ink cartridge, and a member to position the
15 head and ink cartridge, and that the ink supply inlet
is cylindrically shaped with a desirable sealing
capability while a separate member is provided for
positioning the ink cartridge and head.

 According to another embodiment of an ink jet
20 recording apparatus of the present invention, there
are provided for an ink jet recording apparatus which
performs recording by a recording head ejecting ink
droplets onto a recording medium, a carriage for
mounting the foregoing recording head, which travels
25 along the foregoing recording medium, and an ink tank
detachably mountable in the foregoing recording head,
wherein means for controlling the mounting direction

1 of foregoing ink tank on the carriage only one way is
arranged for the foregoing carriage or ink tank or
the carriage and ink tank.

According to such an embodiment as this,
5 means for controlling the mounting direction of the
ink tank on the carriage only one way is provided
thereby to avoid making any mistakes in deciding on
the mounting direction of the ink tank with respect
to the carriage as well as preventing any damage to
10 the recording head due to any erroneous mounting of
the ink tank.

According to another embodiment of an ink
jet recording apparatus of the present invention, an
ink jet recording apparatus in which an ink tank is
15 coupled to the a recording head when the recording
head is mounted in the recording apparatus, it is
characterized in that an indicator is provided to
indicate that the recording head and ink tank has
been correctly coupled.

20 According to such an embodiment as this, it
is possible to couple the ink tank and recording head
assuredly by conducting the coupling operation until
positioning indications or positioning couplers
provided for the ink tank and recording are matched
25 or actuated.

Another ink jet recording apparatus embodying
the present invention is characterized in the

1 following:

(1) an absorbent is provided in the vicinity of the area where the recording head of the foregoing ink jet cartridge and the ink tank are coupled.

5 (2) a groove is provided in the vicinity of the area where the recording head of the foregoing ink jet cartridge and the ink tank are coupled.

(3) a hydrophilic or water repellent treatment is given to the vicinity of the area where
10 the recording head of the foregoing ink jet cartridge and the ink tank are coupled.

According to such an embodiment as this, it is possible to prevent ink leakage and ink splashing by providing the absorbent, groove, and hydrophilic
15 and/or water repellent treatment. Thus, an ink jet recording apparatus can be provided so as to contribute to the enhancement of the reliability and safety of a finished product.

In another ink jet recording apparatus
20 embodying the present invention in which recording is performed by ejecting ink onto a recording medium, such an ink jet recording apparatus is characterized in that there are provided a recording head to eject ink; an ink tank which contains ink to be supplied
25 to the foregoing recording head and is detachable together with the foregoing recording head with respect to the foregoing ink jet recording apparatus,

1 the ink tank being interrelatedly detachable with
the foregoing recording head; detecting means to
detect whether the ink tank is mounted in the ink jet
recording apparatus or not; and controlling means to
5 control the recording operation of the ink jet
recording apparatus on the basis of the detected
results of the aforesaid detecting means.

Also, it should more preferably be
characterized that the aforesaid detection means
10 serves dually as detecting means to detect the amount
of ink in the aforesaid ink tank.

According to such an embodiment as this, it
becomes possible to suppress any recording operation
in the ink jet recording apparatus when the ink tank
15 is not mounted; thus enabling the prevention of an
exhaustion of ink or the like in the midway of
recording operation.

Also, even when an empty ink tank is
erroneously mounted for recording, such an operation
20 can be prevented; thus making it possible to prevent
air from being mixed into the recording head or ink
leakage from the recording head.

BRIEF DESCRIPTION OF THE DRAWINGS

25 Fig. 1 is a perspective view schematically
illustrating an embodiment of an ink jet recording
apparatus according to the present invention.

1 Fig. 2 is a schematic partial enlargement
perspectively illustrating the embodiment.

 Fig. 3 is a cross-sectional view of a partial
enlargement of the embodiment.

5 Fig. 4 is a perspective view schematically
illustrating a first mode of an exchangeable type
according to the embodiment.

 Fig. 5 is a perspective view schematically
illustrating a second mode of an exchangeable type
10 according to the embodiment.

 Fig. 6 is a schematic plan view illustrating
the way in which pressure is exerted by the
embodiment.

 Fig. 7 is a perspective view schematically
15 illustrating the entire body of a recording apparatus
for an ink jet recording apparatus embodying the
present invention.

 Fig. 8 is a cross-sectional view showing an
exchangeable ink tank according to the embodiment.

20 Fig. 9 is a perspective view illustrating an
example of an ink jet recording apparatus to which
the present invention is applicable.

 Figs. 10A and 10B are schematic perspective
views illustrating an information processing
25 apparatus using an ink jet recording apparatus
according to the present invention.

 Fig. 11 is an electrical circuit diagram

1 showing an information processing apparatus using
an ink jet recording apparatus according to the
present invention.

Fig. 12 is a flowchart showing the recording
5 operation according to the embodiment.

Fig. 13 is a schematic plan view illustrating
another embodiment.

Fig. 14 is a schematic plan view illustrating
a second type according to another embodiment.

10 Figs. 15A, 15B, and 15C are schematically
cross-sectional views showing the structures of still
another embodiment.

Fig. 16 is a schematically cross-sectional
view showing the structure of the embodiment shown
15 in Fig. 15.

Figs. 17A and 17B are schematically cross-
sectional views showing the structure of a further
embodiment.

Figs. 18A and 18B are schematic plan views
20 showing still a further embodiment.

Fig. 19 is an electrical circuit diagram
showing the structure of still another embodiment.

Fig. 20 is a schematically cross-sectional
view illustrating a prior art.

25 Fig. 21 is a schematically cross-sectional
view illustrating a prior art.

Fig. 22 is a schematically cross-sectional

1 view illustrating a prior art.

Fig. 23 is a schematically cross-sectional
view illustrating the state where an exchangeable
recording head and exchangeable ink tank according
5 to another embodiment are mounted on a carriage.

Fig. 24 is a schematically cross-sectional
view illustrating a mounting sequence.

Fig. 25 is a schematically cross-sectional
view illustrating an exchangeable tank.

10 Fig. 26 is a schematically cross-sectional
view illustrating the state where an exchangeable
recording head and exchangeable ink tank according
to another embodiment are mounted on a carriage.

Fig. 27 is a schematically cross-sectional
15 view illustrating a mounting sequence for an
recording head and an exchangeable ink tank.

Fig. 28 is a view illustrating the coupling
of an recording head and exchangeable ink tank.

Fig. 29 is a view illustrating the recording
20 head according to the embodiment shown in Fig. 26
viewed from the direction in which ink is ejected.

Fig. 30 is a schematically cross-sectional
view illustrating the state where an exchangeable
recording head and exchangeable ink tank according
25 to still another embodiment are mounted on a
carriage.

Fig. 31 is a partially sectional view

1 illustrating the embodiment shown in Fig. 30 viewed
from the direction in which ink is ejected.

Fig. 32 is a schematically cross-sectional
view illustrating an exchangeable ink tank.

5 Fig. 33 is a schematically cross-sectional
view illustrating the state where an exchangeable
recording head and exchangeable ink tank according to
still another embodiment are mounted on a carriage.

Fig. 34 is a schematically cross-sectional
10 view illustrating a mounting sequence for an
recording head and an exchangeable ink tank.

Fig. 35 is a partially sectional view
illustrating the embodiment shown in Fig. 33 viewed
from the direction in which ink is ejected.

15 Fig. 36 is a schematically perspective view
illustrating another embodiment.

Fig. 37 is a schematically perspective view
illustrating the state where the head cartridge shown
in Fig. 36 is mounted on a carrier.

20 Fig. 38 is a cross-sectional view
schematically showing the coupling portion of the
ink passage shown in Fig. 36.

Figs. 39A and 39B are cross-sectional views
illustrating the structure of another embodiment.

25 Fig. 40 is a schematically perspective view
illustrating the structure of still another
embodiment.

1 Fig. 41 is a schematically perspective view
illustrating the structure of a further embodiment.

 Fig. 42 is an exploded view illustrating a
carrier and ink jet cartridge according to another
5 embodiment.

 Fig. 43 is a view illustrating the operation
of an ink jet cartridge mounting and holding lever.

 Fig. 44 is an exploded view illustrating a
carriage and ink jet cartridge according to still
10 another embodiment.

 Fig. 45 is an exploded view illustrating a
carriage and ink jet cartridge according to a further
embodiment.

 Fig. 46 is an exploded view illustrating the
15 ink jet cartridge shown in Fig. 45.

 Fig. 47 is an exploded view illustrating a
carrier and ink jet cartridge according still a
further embodiment.

 Fig. 48 is a schematically perspective view
20 illustrating a carriage before an ink tank is
mounted.

 Fig. 49 is a schematically perspective view
illustrating the carriage after the ink tank is
mounted.

25 Fig. 50 is a schematically perspective view
illustrating a carriage before an ink tank is
mounted.

1 Fig. 51 is a schematically perspective view
illustrating the carriage after the ink tank is
mounted.

5 Fig. 52 is a schematic view illustrating the
positional relations between an recording head, ink
tank groove, and the boss of a carriage lever.

Fig. 53 is a schematically perspective view
illustrating an ink tank.

10 Fig. 54 is a side-view schematically
illustrating an ink tank.

Fig. 55 is a schematically perspective view
illustrating a carriage before an ink tank is
mounted.

15 Fig. 56 is a schematically perspective view
illustrating the carriage after the ink tank is
mounted.

Fig. 57 is a schematically perspective view
illustrating an ink tank.

20 Fig. 58 is a schematically perspective view
illustrating a carriage before an ink tank is
mounted.

Fig. 59 is a schematically perspective view
illustrating the carriage after the ink tank is
mounted.

25 Figs. 60A and 60B are schematic views
illustrating another embodiment.

Fig. 61 is a schematic view illustrating

1 still another embodiment.

Fig. 62 is a schematic view illustrating a further embodiment.

Fig. 63 is a schematically perspective view
5 illustrating a carriage before an ink tank is mounted.

Fig. 64 is a schematically perspective view illustrating the carriage while the ink tank is being mounted.

10 Fig. 65 is a schematically perspective view illustrating the carriage after the ink tank is mounted.

Fig. 66 is a schematically perspective view illustrating an ink tank.

15 Fig. 67 is a schematically perspective view illustrating a carriage before an ink tank is mounted.

Fig. 68 is a schematically perspective view illustrating the carriage while the ink tank is being
20 mounted.

Fig. 69 is a schematically perspective view illustrating the carriage after the ink tank is mounted.

Fig. 70 is a schematically perspective view
25 illustrating an ink tank.

Fig. 71 is a side view schematically illustrating the ink tank.

1 Fig. 72 is a schematically perspective view
illustrating a carriage before an ink tank is
mounted.

 Fig. 73 is a schematically perspective view
5 illustrating the carriage after the ink tank is
mounted.

 Fig. 74 is a schematically perspective view
illustrating an ink tank.

 Fig. 75 is a schematically perspective view
10 illustrating a carriage before an ink tank is
mounted.

 Fig. 76 is a schematically perspective view
illustrating the carriage after the ink tank is
mounted.

15 Fig. 77 is a schematically perspective view
illustrating the state where an ink jet recording
head and ink tank according to another embodiment are
parted.

 Fig. 78 is a schematically perspective view
20 illustrating the state where the ink jet recording
head and ink tank are being coupled.

 Fig. 79 is a schematically perspective view
illustrating the state where the ink jet recording
head and ink tank are coupled.

25 Fig. 80 is a schematic view illustrating the
state where a head cartridge is being mounted on a
carrier.

1 Fig. 81 is a schematic view illustrating the
state where a head cartridge is being mounted on a
carrier.

 Fig. 82 is a schematic view illustrating the
5 state where the head cartridge is mounted on the
carrier.

 Fig. 83 is a schematically perspective view
illustrating the state where a recording head and
ink tank according to still another embodiment is
10 parted.

 Fig. 84 is a schematic view illustrating the
state where the recording head and ink tank are
coupled.

 Fig. 85 is a schematically perspective view
15 illustrating the state an recording head and ink tank
according to still another embodiment are coupled.

 Fig. 86 is a schematically perspective view
illustrating another way in which the recording head,
ink tank, and carrier are coupled.

20 Fig. 87 is a partially perspective view
schematically illustrating the structure of a carrier
and ink jet cartridge according to another
embodiment.

 Fig. 88 is a partially perspective view
25 schematically illustrating the structure of a carrier
and ink jet cartridge according to still another
embodiment.

1 Fig. 89 is a partially perspective view
schematically illustrating the structure of an ink
jet cartridge according to a further embodiment.

5 Fig. 90 is a partially perspective view
schematically illustrating the structure of the ink
jet cartridge.

Fig. 91 is a partially perspective view
schematically illustrating the structure of an ink
cartridge according to another embodiment.

10 Fig. 92 is a partially perspective view
schematically illustrating the structure of an ink
cartridge according to still another embodiment.

15 Fig. 93 is a block diagram showing the setup
for an ink tank detection according to a further
embodiment.

Fig. 94 is a block diagram showing the setup
for an ink tank detection according to still a
further embodiment.

20 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, with reference to the
accompanying drawings, the description will be made
in detail of the embodiments according to the present
invention.

25 Fig. 1 is a schematically perspective view
illustrating the recording head unit and carrier unit
of a recording apparatus embodying the present

1 invention. In Fig. 1, a reference numeral 1
designates a recording head which ejects ink in
accordance with electric signals; 2, an ink tank
containing ink to supply it to the recording head 1;
5 102, a carrier provided for the recording apparatus
body to hold the recording head 1 and ink tank 2;
106, a head lever to hold or release the recording
head 1; 107, an ink tank lever to mount or demount
the ink tank 2; and 108, a head fixing spring to fix
10 the recording head 1 to the carrier 102. With these
components, the recording head unit and carrier unit
are constituted.

Fig. 2 is a schematically perspective view
illustrating the recording head 1 and ink tank 2
15 according to the embodiment of the present invention.
In Fig. 2, a reference numeral 10 designates the ink
supply inlet which serves as the ink passage for ink
to be supplied from the ink tank 2 to the recording
head 1; 11, an ink supply outlet to supply ink from
20 the ink tank 2 to the recording head 1; 12, coupling
nails to guide and hold the recording head 1 and ink
tank 2 when integrally coupled; 13, coupling nail
guiding grooves to engage with the coupling nails 12;
and 14, ink tank holding grooves to hold the ink tank
25 2 when the ink tank 2 and recording head 1 are
mounted or demounted. With these elements, a head
cartridge 101 is constituted.

1 The recording head 1 comprises a substrate on
which are formed a plurality of electrothermal
transducers to generate thermal energy to be utilized
for ejecting ink and a driving circuit to drive them;
5 discharging ports and liquid passages corresponding
to each of the above-mentioned plural electrothermal
transducers; and further a ceiling board laminated
thereon to constitute a common liquid chamber
conductively connected to each of the liquid
10 passages. Then, the recording head thus structured
is mounted on the apparatus in such a manner that the
discharging port surface having the discharging ports
of the head are placed to face a recording medium.

 The ink tank 2 is a tank which holds ink
15 therein and supplies it to the recording head 1
appropriately in order to refill the ink which has
been consumed by recording. If two single bodies
constitute an ink tank, the ink supply outlet 11 is
sealed by sealing means (not shown) to prevent any
20 ink leakage therefrom. This sealing means is
automatically or manually released when the ink tank
is coupled to the recording head 1 to enable the ink
supply. Also, it may be possible to arrange a
mechanism so that air is introduced from the outside
25 as the volume of ink is being reduced by the ink
consumption. Further, it may be possible to provide
a mechanism in the inside to keep a pressure exerted

1 slightly negative on the ink to be supplied to the
recording head for the purpose of improving the
printing quality as well as preventing any ink
leakage.

5 The recording head 1 and ink tank 2 are used
for a recording apparatus in operation in a form of
a cartridge 101 which is integrally fabricated with
them. Now, the description will be made of the way
in which to integrate them.

10 Fundamentally, the recording head 1 and ink
tank 2 are integrated by coupling the ink supply
inlet 10 and ink supply outlet 11. Therefore, this
portion is carefully arranged to prevent ink leakage
from or air intake into the ink passages. In the
15 present embodiment, as shown in Fig. 13A, a method
is adopted to utilize the resiliency of a mold member
for the purpose. In other words, the ink supply
inlet hole 10a and the ink supply outlet hole 11a are
formed cylindrically and then the inner diameter of
20 the ink supply outlet 11a is slightly smaller than
the outer diameter of the ink supply inlet hole 10a.
Thus, when the ink supply inlet hole 10a is pressed
into the ink supply outlet hole 11a, these two holes
are tightly integrated while being slightly deformed
25 in the radial direction. Also, the coupling portion
is not necessarily of a mold member, but it will
suffice only if the material has a sealing

1 capability. The other coupling methods will be
described later.

5 In the integration of the recording head 1
and ink tank 2, while it is good enough to couple the
ink supply inlet 10 and ink supply outlet 11 as
described above, the coupling is intensified in the
present embodiment by providing the coupling nails 12
and coupling nail guiding grooves 13 in order to
prevent them from being disengaged simply due to any
10 unexpected force that may be exerted when the head
cartridge 101 is handled or to facilitate the
integration. In other words, the coupling nails 12
formed integrally with the ink supply inlet 10 by
molding and capable of being resiliently deformed
15 are provided with protrusions at the leading ends,
and are fitted into the coupling nail guiding grooves
13 while being resiliently deformed by the portions
corresponding to the height of the protrusions. The
coupling is completed when the protrusions of the
20 coupling nails 13 reach the deepest portions arranged
in the rear sides of the coupling nail guiding
grooves 13.

Further, the coupling nails 12 serve as
guides so as to allow the ink supply inlet 10 and ink
25 supply outlet 11 to be easily fitted when the
recording head 1 and ink tank 2 are coupled. In
other words, the coupling nails 12 are made longer

1 than the ink supply inlet 10 so that the coupling
nails 12 are to be in contact with the ink tank 2
before the ink supply inlet 10 reaches the ink supply
outlet 11. Here, the leading ends of the coupling
5 nails 12 are cut off diagonally. This diagonally
cut off portion serves as its guide in the direction
indicated by an arrow a in Fig. 2 to facilitate the
engagement with the coupling nail guiding grooves.
Also, the protrusions provided at the leading ends
10 of the coupling nails 12 are also cut off diagonally
to promote an easier engagement by serving as its
guide in the direction indicated by an arrow b in
Fig. 2.

In this respect, while the coupling nails are
15 provided on the recording head side in the present
embodiment, its position is not confined thereto.
It may be possible to position them on the ink tank
2 side or on both sides of the recording head 1 and
ink tank 2.

20 Now, the description will be made of the
mechanical and electrical connections of the
recording head 1 to the carrier 102.

Fig. 3 is a cross-sectional view illustrating
the portion where the carrier 102 is coupled to the
25 recording head 1 viewed in the direction indicated
by an arrow a in Fig. 1, in which a reference

1 numeral 109 designates a positioning pin which is
fitted into a hole provided for the recording head 1
fixed to the carrier 102 to set the position in the
vertical direction in Fig. 3 and in the direction
5 perpendicular to the plane thereof; 110, a stopper
fixed to the carrier 102 to receive the recording
head 1 which is pressed in the direction indicated by
an arrow a in Fig. 3; 401, a flexible cable
electrically connecting the recording apparatus body
10 and the recording head 1; 111, a pad placed between
the flexible cable 401 and the carrier 102 to support
the flexible cable 401 resiliently; and 15, a contact
provided for the recording head 1 and electrically
connected to a heater unit in the recording head 1.

15 The recording head 1 is pressed in the
direction indicated by an arrow a by means of the
head fixing spring 108 through a lever which is not
shown. Its position is unambiguously fixed by the hole
provided for the recording head 1, the positioning
20 pin 109, and the intervention of the stopper 110.
In this way, the recording head 1 and carrier 102 are
mechanically coupled.

Also, there are arranged a plurality of
electrically contacting points on the contact 15 of
25 the recording head 1 and the end of the flexible
cable 401 in the positions opposite to each other.
By pressing them with a given pressure, the recording

1 apparatus body and the recording head 1 are
electrically connected. At this juncture, the plural
electrically contacting points⁹ must be in contact
under compression. To this end, the pad 111 made of
5 a resilient material is inserted in the compressing
portion so as to press those contacting points
evenly. The material of the pad 111 is silicon
rubber, for example, and it is arranged that the
reaction force exerted thereby when depressed is made
10 much smaller than the force exerted by the head
fixing spring 108 which presses the recording head 1.

Particularly, the electrical contact provided
for the flexible cable 401 may be extruded when
configured in order to cause the reaction force to be
15 concentrated when depressed so that the connection is
made reliably.

In this respect, the electrical or mechanical
connections are arranged on the recording head side
in the present embodiment, but irrespective of this
20 arrangement, the connections may be arranged on the
ink tank 2 side or on both sides of the recording
head 1 and ink tank 2. Also, it may be possible to
arrange the electrical connections and the mechanical
connections separately on either side, respectively.

25 Now, the description will be made of the
handling of the recording head 1 and ink tank 2,
that is, the method to replace an exhausted ink tank

1 2 with a new ink tank 2 or to replace the recording
head 1 which is disabled to be used any more due to
some causes.

As a first mode, the fixation between the
5 recording head 1 and carrier 102 is released. From
the carrier 102, the recording head 1 and ink tank 2
are removed as they are still in a coupled state.
Then, in a state where they are detached from the
carrier 102 (hereinafter referred to as off carrier
10 condition), the recording head 1 and ink tank 2 are
separated or coupled.

Fig. 4 is a schematically perspective view
illustrating the state where the recording head 1 and
ink tank 2 are removed from the carrier 102 as they
15 are still in a coupled condition. In this case, the
head lever 106 is pulled up from the state as shown
in Fig. 1 to the position shown in Fig. 4A rotatively
in the direction indicated by an arrow a. Thus, the
pressure exerted to the recording head 1 by the head
fixing spring 108 is released. At this juncture, the
20 recording head 1 and ink tank 2 are shifted in the
direction indicated by an arrow b as they are still
in a coupled condition by a lever (not shown)
arranged in the carrier 102. This causes the
25 engagement between the positioning pin 109 and the
hole of the recording head 1 to be disengaged; hence
enabling the recording head 1 and ink tank 2 to be

1 shifted in the direction indicated by an arrow c in
Fig. 4 as they are still in a coupled state, and to
be in the off carrier condition⁹. In the off carrier
condition, a force is given in a direction opposite
5 to the direction in which the recording head 1 and
ink tank 2 are coupled to separate them and replace
the one which requires the replacement. Then, by
the coupling method described earlier, both of them
are integrated and mounted in the carrier 102 in the
10 reversed order to terminate the replacement
operation.

In this respect, the head lever 106 is used
to release the pressure exerted on the recording head
1 in the present embodiment, but irrespective of this
15 method, it may be possible to make an arrangement so
that the lever which presses the recording head 1 can
be shifted directly. Also, irrespective of the
method wherein the head fixing spring 108 is used to
press the recording head for its fixation, it may be
20 possible to use a latch hook or the like having a
spring capability for the head fixation.

Furthermore, it may be possible to mount or
demount the recording head 1 and ink tank 2 in the
coupled state by holding the recording head 1
25 directly against the pressure exerted by such a
pressing means.

When the first mode is adopted, the following

1 effects are obtainable:

When either one of the recording head and ink tank must be replaced, it is possible to replace only the one which needs the replacement. Therefore,
5 the operational economy is improved.

Also, the recording head 1 and ink tank 2 can be replaced as they are in the coupled condition. The recording heads and ink tanks having different colors can be retained as they are in the off
10 carrier condition. Therefore, it becomes simple to change recording colors.

As a second mode, the recording head 1 and ink tank 2 are separated on the carrier 102 while the recording head 1 and carrier are still fixed
15 (hereinafter referred to as on carrier condition).

Fig. 5 is a schematically perspective view illustrating the state where the ink tank 2 is separated from the recording head 1 on the carrier 102. In this case, by pulling up the tank lever 107
20 from the state shown in Fig. 1 to the position shown in Fig. 5A rotatively in the direction indicated by an arrow a, a lever (not shown) arranged in the carrier 102 engages with the ink tank guide groove 14 which is provided on the side of the ink tank 2 and
25 is shifted in the direction indicated by an arrow b in Fig. 5. At this juncture, the fixation of the recording head 1 is in the same state as Fig. 1, and

1 it is not shifted together with the ink tank 2.
Accordingly, the engagement between the recording
head 1 and ink tank 2 are disengaged; thus enabling
them to be separated. Further, by allowing the ink
5 tank 2 to be shifted in the direction indicated by an
arrow c in Fig. 5, it can be removed from the carrier
102.

In this respect, if the recording head 1 is
resiliently pressed by the head fixing spring 108
10 as in the present embodiment, there is a possibility
that the head fixation is released depending on the
way the separating force is exerted. It is
preferable to arrange the structure as follows:

Fig. 6 is a schematic plan view showing the
15 way in which such a force is exerted. In Fig. 6,
the recording head 1 is pressed by a force f_1 exerted
by the head fixing spring 108 to the carrier 102.
Also, it is assumed that a force f_2 is needed to
disengage the coupling nails 12 and the ink supply
20 inlet 10 in order to separate the recording head 1
and ink tank 2. In this case, it is possible to
prevent the fixation of the recording head 1 to be
released in the separating operation by defining
the strengths of the forces as $f_1 > f_2$.

25 Here, in the present embodiment, the
separation is executed by exerting a force equivalent
to the force f_2 using a tank lever 107, but

1 irrespective of this method, it may be possible to
arrange the structure so that the ink tank 2 is
pulled up in the direction indicated by an arrow b in
Fig. 5 by holding it directly to separate the
5 recording head 1 and ink tank 2.

When the second mode is adopted, there are
the following effects in addition to those obtainable
in the first mode:

It is possible to control the speed with
10 which the ink tank is pulled out when it is separated
by designing the cam configuration of the tank lever
107; thus enabling the prevention of the ink
scattering from the ink supply inlet 10 and ink
supply outlet 11.

15 Also, there is no need for holding the
recording head 1 by hand directly. Accordingly,
there is no possibility that a hand touches the
vicinity of the ink ejection nozzles of the recording
head 1. Hence, it is possible to prevent any
20 unwanted contamination which may produce adverse
effects on printing.

Also, the portion where the force exerted
by the ink tank 2 can be specified. Therefore, it
will suffice only if such a portion is reinforced.
25 All the other portions can be structured thin to make
the ink tank lighter with a more ink containing
capability among other effects.

1 Subsequently, the description will be made of
the structure and operation of a recording apparatus
wherein the above-mentioned recording head 1, ink
tank 2, and carrier 102 are mounted.

5 Fig. 7 is a schematically perspective view
illustrating the outline of a recording apparatus
embodying the present invention.

 A carrier 102 with a head cartridge 101 being
mounted has a pin (not shown) to be engaged with the
10 spiral groove 105 of a lead screw 103 which is
interrelated with the normal and reverse rotations of
a carrier motor 402a and rotated through a
transmission mechanism (not shown). Thus, the
carrier is reciprocated in the directions indicated
15 by arrows a and b following the rotation of the lead
screw 103. Here, a reference numeral 104 designates
a slide shaft to regulate the rotation of the
carrier. Also, with a carrier sensor 510, the
carrier 102 establishes the position (home position)
20 in the directions indicated by arrows a and b. A
reference numeral 301 designates a recovery unit
which comprises a cap 302 facing the discharging
surface of the head cartridge 101 at a given position
(a home position, for example) outside the recording
25 area for the head cartridge 101, and a cap advance
and retraction driver (not shown) to keep the cap in
contact with the discharging surface to protect it

1 when recording is at rest or the like occasions.
Also, it is possible to arrange a pump to suck overly
viscous ink, dust particles, and air bubbles from the
discharging ports when the cap is in contact with the
5 discharging surface in order to maintain the ink
ejection conditions desirably, and a member to
contain such an unwanted ink thus sucked.

Furthermore, a wiper (not shown) is provided
to clean the vicinity of the discharging ports of the
10 head cartridge 101.

A reference numeral 201 designates a feed
roller to feed a recording medium 6 in the directions
indicated by an arrow c in Fig. 7 and 202, a pinch
roller to press the recording medium 6 against the
15 feed roller 201. The recording medium 6 is fed
intermittently in the directions indicated by an
arrow c in Fig. 7 while being pinched by a pair of
these rollers. The feed roller 201 is coupled to a
feeding motor 402b through a transmission mechanism
20 formed by a feed roller gear 205 and feed roller
idler gear 206 so as to receive the transmission of
the driving force. Also, pinch roller 202 is capable
of being in contact with or apart from the feed
roller 201 by the operation of a release lever 210.

25 A reference numeral 207 designates a platen
to regulate the recording surface of the recording
medium 6 to keep it flat. Also, it may be possible

1 to provide a member to prevent the recording medium
6 from being raised by pressing it against the platen
207.

A reference numeral 213 designates a
5 discharge roller which rotates in synchronism with
the feed roller 201 to deliver the recording medium
6 after recording in the directions indicated by an
arrow c in Fig. 7. There is provided a spur roller
214 at a position opposite to the discharge roller
10 213 through the recording medium 6. With those
rollers, the recording medium 6 is delivered outside
the printer after the recording is over.

As shown in Fig. 8, the recovery unit
comprises a cap 4021 to cap the discharging surface
15 4002c of the recording head 4002a; a pump unit 4023
which makes the inside of the cap negatively
pressurized to suck from the cap 4021 the waste ink
forcibly exhausted from the discharging surface 4002c
and forward it to a waste ink tube 4031d; and a
20 transmission mechanism (timing gear) 4024 consisting
of a known cam and gear mechanism to transmit driving
forces to the foregoing cap 4021 for its forward
and backward movement with respect to the discharging
surface 4002c as well as for the driving of the
25 foregoing pump unit 4023. To the aforesaid timing
gear 4024, the rotational driving force of the
carrier motor is transmitted through a carrier motor

1 pinion 4020.

Also, the pump unit 4023 comprises a plunger pump shown in Fig. 9, in which a reference numeral 4031 designates a cylinder having a cylindrical cylinder portion 4031a and a guide member (not shown) which guides a plunger 4022 which will be described later. Then, it is partially cut off in the axial direction to provide an ink passage; 4031b, a cap lever receptacle formed to allow the lever seal which will be described later to be inserted. Also, a reference numeral 4031c designates an ink suction inlet which is opened to a given position; 4031d, a waste ink tube the integrally formed leading end of which is inserted into a waste ink absorbent 4028; also, 4031e, a cap open and close protrusion which is pressed by the cap open and close cam 4024a of the timing gear 4024 to cause the cylinder 4031 to rotate to open and close the cap 4021.

A reference numeral 4022 designates a plunger comprising a operation shaft 4022a, a piston stopper 4022b, a piston receptacle 4022c, and a pump seal stopper 4022d. Then, a groove 4022e which serves as an ink passage is continuously formed on the aforesaid operation shaft 4022a. This groove is partially inserted into the aforesaid guide of the cylinder 4031 to hold the rotation of the plunger 4022. On the operation shaft 4022a, a lead groove

1 4022f is formed to control the reciprocation of the
plunger 4022. The protrusion (not shown) of a stroke
gear 4005 is inserted into this lead groove 4022b.
Then, by the normal and reverse rotations of the
5 stroke gear 4005, a desired stroking amount is given
to the plunger 4022 to generate the negative
pressure.

A reference numeral 4032 designates a piston
made of a rubber material such NBR. Its outer
10 diameter is made larger than the inner diameter of
the cylinder 4031 by a given amount, and it is
appropriately compressed when inserted into the
foregoing cylinder 4031; 4033, a pump seal made of a
rubber material such as silicon rubber or NBR, which
15 is inserted into the cylinder 4031. Its inner
diameter is made slightly smaller to obtain a given
pressure with respect to the plunger 4022 and,
further, it can reciprocate in the cylinder 4031 by
being pressed by the pump seal stopper 4022d of the
20 plunger 4022 and the piston receptacle 4022c. Also,
it may be possible to reduce the sliding friction
between the cylinder 4031 and plunger 4022 by
applying lubricant to the surface of the pump seal.

A reference numeral 4034 designates a cap
25 lever. An ink guide (not shown) biases the cap lever
seal which will be described later. The other
rotational shaft 4034a is rotatively mounted to the

1 hole 4031f of the cylinder 4031 by snap fitting,
and 4035, a cap lever seal to which the ink guide
of the aforesaid cap lever 4034^a is inserted by
compression. It is further inserted into the cap
5 lever receptacle 4031b of the cylinder 4031.

A reference numeral 4021 designates a cap
made of an annular chrolinated butyl rubber or some
other resilient material having a triangular cross-
section, and is mounted on the cap mounting unit
10 4034b of the foregoing cap lever 4034; also, 4042,
a preliminary discharging pad which is made of a
polymeric absorbent as the foregoing blade cleaner
4039. It is mounted on the foregoing cap lever 4034.
The aforesaid preliminary discharging pad is an
15 absorbent to absorb the ink preliminarily ejected
aside from the ordinary ink ejection for a printing
operation. This preliminary ink ejection is
conducted to prevent ink on the discharging surface
4002c from being dried in the printing operation.

20 Subsequently, the description will be made
of an information processing apparatus in which a
recording apparatus embodying the present invention
is incorporated. Its structure and electrical
circuitry will be described.

25 Fig. 10A is a schematically perspective view
illustrating the outer appearance of an information
processing apparatus 604 wherein a recording

1 apparatus embodying the present invention is
incorporated.

In Fig. 10A, a reference numeral 601
designates the above-mentioned printing unit; 602,
5 a key board provided with keys to input letters,
numerals, and other characters as well as keys to
give various instructions; and 603, an indication
unit provided with a display. Fig. 10B is a
schematically perspective-view illustrating the outer
10 appearance of an information processing apparatus
604 wherein a recording apparatus embodying the
present invention is incorporated. In Fig. 10B,
a reference numeral 605 designates a window provided
for replacing the foregoing recording head 1 and ink
15 tank 2; 606, a cover for the window 605 to cover it
except when the replacement operation is executed.
The window 605 is made large enough to provide a head
lever 601 and tank lever 605 to be operated when the
recording head 1 or ink tank 2 is replaced. A
20 reference numeral 607 designates a change over switch
for the intended replacement of the recording head
1 or ink tank 2. When the change over switch 607 is
turned on, a carrier motor 402a is driven to shift
the carrier 102 to the window position 605 from the
25 foregoing home position or the recording area. In
this position, when the replacement of the recording
heads 1 or ink tanks 2 is completed, the carrier 102

1 is shifted to its home position when a release switch
608 is turned on and then a recovery unit 301 is
actuated to execute the ink suction and ejection,
or wiping and other recovery operations. Thus, the
5 current status returns to the operation before the
change over switch 607 is turned on. Now, Fig. 11
is a block diagram showing the structure of electric
circuits for an information processing apparatus
according to the present embodiment.

10 In Fig. 11, a reference numeral 501
designates a controller to execute main controlling;
502, a CPU for a microcomputer mode to execute
certain procedures, for example; 503, RAM for
providing development and work areas for text data
15 and image data; 504, ROM for storing programs
corresponding to the aforesaid procedures; 505, a
timer for the CPU 502 to work out execution cycles
and for the printing unit 601 to work out the timing
required when a recording operation is executed;
20 and 506, an interface unit to connect signals from
the CPU 502 to the peripheral apparatuses.

Also, a reference numeral 507 designates a
controller for the printing unit 601; 508, a head
driver to transmit recording signals and electric
25 power to the head cartridge 101; 509a and 509b,
motor drivers to transmit signals and electric
power required to drive a carrier motor 402a and

1 feed motor 402b, respectively; 510, a carrier sensor
to detect the current position of the carrier 102 and
determine whether the carrier 102 is currently at its
home position or not, for example; and 511, a paper
5 sensor to detect the presence of a recording medium
6 in order not to perform recording on any places
other than the recording medium 6 when the recording
medium 6 is yet to be inserted or a recording is
terminated up to the end of a page.

10 Moreover, a reference numeral 605 designates
an external storage such as FDD, HDD, or RAM card,
and 512, an external interface to communicate with
other information processing apparatuses, or to
control peripheral apparatuses by making connection
15 with inner buses.

In this respect, although not included in the
block diagram shown in Fig. 11, an electric power
source is provided to supply current to the above-
mentioned electric circuits. For such an electric
20 power source, there is available a rechargeable
battery, disposable dry cells, or AC power converter
when the information processing apparatus body is
fixed for use, for example.

With the above-mentioned structure of
25 electric circuits, recordings are performed on the
recording medium 6 by the recording unit. Now,
using a flowchart shown in Fig. 12, the recording

1 operation control sequence will be described briefly.

With an instruction to start recording by the use of the recording instruction key on an indication operation unit of a printer body or by an external
5 instruction to start recording through the external interface, a series of procedures are started as follows:

At first, in step S1, whether the indication operation unit is in the on line status or not is
10 determined. This is a precaution not to start any recording operation without a required preparation on the printer side when an external instruction to start recording operation is transmitted mainly by communications. Here, if the indication operation
15 unit is determined to be in the on line status, the procedure will proceed to step S2.

In the step S2, whether the recording medium
6 is set on the printing unit or not is determined in accordance with signals from the paper sensor 511
20 and others. This is a precaution not to start printing because if any printing is started without a recording medium, ink is scattered in the printer to stain the apparatus itself particularly when an ink jet printer or the like is used as a recording
25 apparatus, or the ink which is a recording medium is wastefully consumed.

Furthermore, in the step S2, it may be

1 possible to determine whether the pinch roller 202
and feed roller 201 are released or not in addition
to the detection of the presence of the recording
medium. This is required to prevent any irregular
5 feeding of the recording medium because when the
pinch roller 202 is released, the normal feed is
impossible even if the recording medium 210 is set.
Whether the pinch roller 202 is release or not can
be detected by means of a mechanical switch provided
10 for the release lever or the like. Here, if it is
found that the recording medium is not normally set,
the procedure will proceed to the next step 3 .

In the step S3, a message is emitted to call
the attention of an operator to set the recording
15 medium. Such a message can be emitted by
illuminating light in the indication operation unit
or make a buzzer sound.

Also, in the step S3, if the recording medium
6 is found to have been set, the procedure will
20 proceed to step S4.

In the step, the recording is started. With
the instruction from the CPU 502, the head driver 508
drives the head cartridge 101. Also, in synchronism
therewith, the motor drivers 509a and 509b drive the
25 carrier motor 402a and feed motor 402b, respectively,
to perform the recording while allowing the carrier
102 to be shifted in the main scanning direction,

1 the recording medium to be shifted in the sub-
scanning direction, and the recording head 1 to be
cleaned among others.

5 Lastly, in step S5, if an instruction to
terminate the recording operation is given by the
corresponding signal from the CPU 502, for example,
or if it is determined that any more recording is
possible when the number of recording lines in a
page in a given sub-scanning direction has been
10 reached or the terminating end of the recording area
in a recording medium 6 is detected by the paper
sensor 511, it is judged that the recording operation
is terminated and that the recording operation
procedures are completed.

15 In step S6, then, the carrier 102 is returned
to its home position as a procedure to terminate the
recording operation. This is carried out to cap the
ink discharging surface of the recording head 1 for
its protection in preparation for the power turn off
20 after the termination of the recording operation.

Then, if, for example, the feed motor 402b is driven
for a given amount or the feed motor 402b is driven
until when the paper sensor 510 detects and verifies
that the recording medium 6 has been discharged.

25 In this way, the recording medium is discharged.
After that, the CPU 502 instructs the indication
operation unit to display the termination of the

1 recording operation or informs the peripheral
apparatuses accordingly through the external
interface; hence terminating the recording operation
completely.

5 As described above, the recording head and
ink tank are separable as in the present embodiment,
and then, by arranging the structure of the ink jet
recording apparatus such as to conduct the separating
or integrating operation either in the on carrier
10 condition or off carrier condition, the following
effects can be obtained:

Since the ink tank is mounted on the carrier,
any ink supply tube and the like are no longer
needed. Thus, it is possible to fabricate the
15 apparatus smaller.

Also, when ink is totally consumed, it will
suffice only if the ink tank is replaced, not the
cartridge which is integrated with the head.
Therefore, it is possible to reduce the running cost
20 significantly.

Also, if either one of the recording head
and ink tank needs to be replaced, it is possible to
replace only the one which must be replaced. Thus,
the operational economy is improved.

25 Also, when the recording head and ink tank
are separated on the carrier by the use of a lever
or the like, it is possible to control the speed with

1 which the separation is carried out; thus preventing
ink to be scattered from the ink supply inlet 10 and
ink supply outlet 11.

5 Also, when the recording head and ink tank
are separated on the carrier, there is no need for
holding the recording head by hand directly.
Accordingly, there is no possibility that a hand
touches the vicinity of nozzles of the recording head
1. It is thus possible to prevent any unwanted
10 contamination that may produce adverse effects on
printing.

15 Also, when the recording head and ink tank
are separated on the carrier, the portion where force
exerted by the ink tank 2 can be specified.
Therefore, the structure can be arranged so that
it is made strong enough only against such specific
portion. Consequently, any other portions than this
can be fabricated thin; thus enabling the tank to be
made light in its weight while increasing its volume.
20 Also, if ink colors should be replaced, the recording
heads and ink tanks can be replaced as they are still
in the coupled state. There is no possibility that
ink colors are mixed. The replacement can also be
carried out simply.

25 Fig. 13 is a plan view schematically showing
another embodiment according to the present invention.

Fig. 13 is a plan view corresponding to the

1 view of the foregoing embodiment shown in Fig. 1
observed from the above, in which a reference numeral
112 designates a head clamp lever to fix the
recording head 1 to the carrier 102; 113, a head
5 contact to connect the head electrically; and 114, an
ink tank pressure lever which is interrelated with an
ink tank lever 107 to execute the integration and
separation of the ink tank 2. The head unit and
carrier unit of the ink jet recording apparatus
10 comprise each of these elements.

In the foregoing embodiment, the recording
head 1 is pressed to the stopper 110 in the direction
indicated by an arrow a in Fig. 6 to couple the
recording head 1 and carrier 102 mechanically with
15 the pressure exerted by the head fixing spring 108.
The method for fixing the recording head is not
confined thereto. It may be possible to adopt a
method given below.

In other words, the head clamp lever 112 is
20 structured with a rigid material to be able to rotate
and move in parallel, not with a resilient material
to press the object. Here, the description will be
made of a method for fixing the recording head to the
carrier 102. At first, the head clamp 112 is
25 retracted to the position which is indicated by a
broken line. Then, the recording head 1 itself or
the recording head 1 and ink tank 2 which are in the

1 integrated state are inserted in the direction
indicated by an arrow a in Fig. 13 and shifted from
such a state shown until the leading end of the
recording head 1 is butted to the head contact 113.

5 From this state, the head clamp lever 112 is shifted
in the direction indicated by an arrow c in Fig. 13
while being rotated to arrive at the position which
is indicated by a solid line and is fixed as it is.

In the head contact 113, a resilient pad 111
10 is pinched as described in conjunction with the
foregoing embodiment. Therefore, the recording head
1 is pressed back in the direction indicated by an
arrow b in Fig. 13, but due to the presence of the
head clamp lever 112, it cannot be shifted but fixed
15 there. At this juncture, by the force exerted to
press it back, the contact pressure of the head
contact 113 is secured. Also, the separation of the
recording head 1 and carrier 102 can be performed
in the operation contrary to the above, and withdrawn
20 by shifting them in the direction indicated by an
arrow b in Fig. 13.

In this respect, for the separation of the
ink tank 2, the ink tank lever 107 (not shown) is
operated to cause the ink tank pressure lever 114 to
25 be shifted in the direction indicated by an arrow b
in Fig. 13. With the above-mentioned structure, the
following effects can be obtained:

1 When the separating operation for the ink
tank 2 is executed in the on carrier condition, the
force exerted on the recording head 1 is received
by the head clamp lever 112. Therefore, the
5 recording head 1 is not shifted; obtaining an
enhanced reliability.

Also, when only the ink tank 2 is separated
in the on carrier condition, or the recording head
1 and ink tank 2 are separated from the carrier 102
10 still in the coupled state, the shifting direction
is as indicated by an arrow b in Fig. 13.
Accordingly, the operativity is improved.

Fig. 14 is a plan view schematically showing
a method according to another embodiment.

15 In Fig. 14, a reference numeral 115
designates a head pressure lever holding a head
contact 113, which can rotate or move in parallel
and 116, a head stopper fixed on the inner side of
the carrier.

20 According to the present embodiment, the
following procedures will be taken to fix the carrier
102 and recording head 1. The head fixing lever 115
which is rotatively fixed to the carrier 102 is
rotated to the position indicated by a broken line
25 in Fig. 14. Then, the recording head 1 itself or
the coupled recording head 1 and ink tank 2 is
inserted in the direction perpendicular to the plane

1 of Fig. 14, so that the protrusion of the recording
head 1 is placed between the head stopper 116 and
head pressure lever 115. Then,⁹ the head fixing lever
115 is rotated to the position indicated by a solid
5 line; hence fixing the head fixing lever 115 by a
means which is not shown in Fig. 14. At this
juncture, since a resilient pad 111 is used for
the head contact 113 as in the case of the foregoing
embodiment described in Fig. 13, the contact pressure
10 is secured by the compressed resilience of the
resilient material.

Also, the separation of the recording head
1 and carrier 102 can be performed by the operation
contrary to the above, and withdrawn by shifting them
15 in the direction perpendicular to the plane of Fig.
14.

In this respect, in order to separate the
ink tank 2, the ink tank lever 107 (not shown) is
operated to shift the ink tank pressure lever 114 in
20 the direction indicated by an arrow b in Fig. 14.
With the above-mentioned structure, the following
effect can be obtained:

When the ink tank 2 separation is performed
in the on carrier condition, the force exerted on the
25 recording head 1 is received by the head stopper 116
so as not to cause the recording head 1 to be
shifted; hence obtaining an improved reliability.

1 Figs. 15B, 15C, and Fig. 16 illustrate the
ink passage coupling of the recording head and ink
tank according to still another embodiment of the
present invention. Fig. 15B shows the case where the
5 ink supply outlet 11b is made of a resilient material
such rubber, and it is possible to make the inner
diameter of the ink supply outlet 11b smaller than
the outer diameter of the ink supply inlet 10a; thus
improving the contactness between the ink supply
10 inlet 10a and ink supply outlet 11b when the
recording head 1 and ink tank 2 are coupled.
Accordingly, the sealing capability of the ink
passage is also improved. Further, since a force
required to deform the ink supply outlet 11b can be
15 small; it is possible to make the force required to
mount and demount the recording head 1 and ink tank
2 equally small.

Fig. 15C illustrates the case where the ink
supply inlet 10c is made annular having an acute end
20 while the ink supply outlet 11c is formed by a
resilient material such as rubber without any hole.
When separated from the recording head 1, the ink
supply outlet 11c of the ink tank 2 is closed so as
not to allow any ink leakage from the ink supply
25 outlet 11c. Therefore, the ink tank 2 itself can be
handled in an excellent condition. Also, when the
ink tank 2 and recording head 1 should be coupled,

1 the acute end of the ink supply inlet 10c made a hole
in the ink supply outlet 11c to form an ink passage.
Thus, a stabilized coupling of ink passages is
possible, at the same time making the force required
5 to connect or separate the ink tank 2 to or from the
recording head small.

Fig. 16 illustrate the case where guides 10e
and 11e are provided in the direction perpendicular
to the direction of the ink passage. By shifting
10 the ink tank 2 in the direction perpendicular to
the plane of Fig. 16 with respect to the recording
head 1, the coupling and separation are performed.
Also, in the coupling portion, a sealing member 10f
made of a resilient material such rubber is provided
15 to prevent ink leakage. When the directions in which
the recording head 1 are mounted or demounted are the
same as the directions in which the ink tank 2 is
mounted or demounted, the structure will be the same
as the foregoing embodiment, but such directions are
20 arranged as indicated by arrows a and b in Fig. 16,
the mounting or demounting directions are different
for the recording head 1 and ink tank 2. As a
result, the relationship associated with the forces
as shown in Fig. 6 will be eliminated; thus making
25 it possible to mount or demount the ink tank 2 and
recording head 1 with a minimum force required.

Figs. 17A and 17B illustrate another

1 embodiment according to the present invention wherein
the mounting and demounting of the ink tank 2 are
controlled. Fig. 17A shows the state where no
recording head 1 nor the ink tank 2 is present, in
5 which a reference numeral 151 designates a head
detection lever rotating in response to the mounting
or demounting of the recording head 1; 151a, a pinion
transmitting the rotation of the head detection lever
151 to the rack 152a of a stopper 152; a tank control
10 lever to control the installation of the ink tank 2.
When neither the recording head 1 nor the ink tank
2 is present, both the head detection lever 151 and
tank control lever 153 are arranged to block the
installation passages of the ink tank 2 and recording
15 head 1 by the biasing force exerted by springs or the
like (not shown). Also, the stopper 152 is shifted
by the head detection lever 151 to the position where
it can regulate the rotation of the tank control
lever 153 in the installation direction of the ink
20 tank 2. In other words, when the recording head 1 is
yet to be mounted, the installation of the ink tank 2
is blocked by the tank control lever 153. Fig. 17B
illustrates the state where the recording head 1 is
mounted. The head detection lever 151 is rotated due
25 to the installation of the recording head 1 as shown
in Fig. 17B. The rotation of the head detection
lever 151 is transmitted to the stopper 152 through

1 the pinion 151a to release the rotational regulation
of the tank control lever 153 as shown in Fig. 17B.
In other words, when the recording head 1 is mounted,
the installation of the ink tank 2 becomes possible.
5 As a result, the ink tank 2 can be attached to or
detached from the recording head 1. Also, in a case
where the arrangement is simple so that only the
recording head 1 is mounted on or demounted from the
carrier 102, the installation of the ink tank 2 is
10 prohibited when the recording head 1 is yet to be
mounted; hence preventing any erroneous operations.

Figs. 18A and 18B illustrate still another
embodiment according to the present invention wherein
the mounting and demounting of the recording head 1
15 are controlled. Fig. 18A shows the state where both
the recording head 1 and ink tank 2 are installed.
The structure is the same as Fig. 4, but there is a
tank detection lever 160 provided beneath the lower
part of the ink tank mounting unit of the carrier
20 102. The contacting portion 160a of the tank
detection lever 160 is regulated by the ink tank 2
to set its position while the hook 160b of the ink
detection lever 160 is released from the cut off
portion 106a of the head lever 106. Thus, the head
25 lever 106 is rotative. When the head lever 106 is
rotated in the direction indicated by an arrow at
a, the recording head 1 and ink tank 2 are shifted

1 in the direction indicated by an arrow at b as they
are still in the coupled condition as in the case
shown in Fig. 4. Hence, it becomes possible to
remove them. Fig. 18B shows the state where the
5 recording head 1 is mounted while the ink tank 2 is
yet to be mounted. The tank detection lever 160 is
biased by biasing means (not shown) such as a spring
in the direction indicated by an arrow at d. When
the ink tank 2 is not present, the lever is rotated
10 as it is in the state shown in Fig. 18B. Then, the
hook 160b engages with the cut off portion 106a to
regulate the rotation of the head lever 106. In
other words, it becomes impossible to remove the
recording head 1 if no ink tank 2 is present. As
15 a result, it becomes impossible to handle the
recording head 1 itself. Thus, there is no
possibility that a hand touches the vicinity of the
ink ejection nozzles of the recording head 1 or the
vicinity of the ink supply inlet 10. Any
20 contamination which may produce adverse effects on
recording can be prevented assuredly. Also, any
adverse effect that may affect the recordings
attributable to the fact that the recording head 1
is handled as a single body can be eliminated
25 assuredly because there is no possibility that air is
taken from the ink ejection nozzles and the ink
supply inlet 10 to be mixed in the ink passages.

1 In the foregoing embodiment described in Fig.
1, the presence of the recording head 1 on the
carrier 102 can be detected by discriminating whether
the recording head 1 is electrically connected or
5 not. However, it does not have any means to detect
the remaining quantity of ink in the ink tank 2 or
to transmit to an information processing apparatus
the information regarding the presence of the ink
tank 2 on the carrier 102.--The present invention
10 is not confined to this, and it may be possible to
provide the above-mentioned detecting means.

Fig. 19 is a block diagram showing the
electric circuits of an information processing
apparatus according to still another embodiment of
15 the present invention.

In Fig. 19, a reference numeral 513
designates an ink tank sensor to detect whether the
ink tank 2 is present on the carrier 102 or not, and
514, an ink remain sensor to detect the presence of
20 printable ink in the ink tank 2. The description
of any elements having the same reference numerals as
those in Fig. 11 will be omitted.

More specifically, the ink tank sensor 513
may be such that mechanical contacts are arranged on
25 the carrier 102, or a structure is arranged so as to
provide an optical sensor for the purpose. The ink
remain sensor 514 may be arranged in such a manner

1 that by making the ink tank 2 with a transparent
material so as to allow the remaining quantity to be
detected optically from outside, or a sensor is
provided in the ink tank 2 to sense the liquid
5 therein and contacts are arranged on the surface of
the ink tank connecting to such a sensor; thus
arranging the contacts on the carrier 102.

With the above-mentioned sensors, it is
possible to transmit to the CPU 502 information
10 through the interface 506 to issue warning or execute
appropriate processes when a recording operation is
intended without the presence of ink tank 2 or
recording head 1, or the related printing becomes
disabled due to the shortage of the remaining ink
15 during the recording operation.

For example, there is a possibility that the
recording operation becomes disabled immediately
after the ink tank 2 is connected to the recording
head 1 because of air bubbles mixed in the recording
20 head 1. In order to prevent this, it may be possible
to arrange the system to interpret such a change in
the status that while the recording head 1 is on the
carrier 102, the ink tank 2 which is absent is now
present as a case where an ink tank 2 is newly
25 connected to the recording head in the on carrier
condition, and to allow the carrier 102 to return
to its home position for the suction operation by

1 the recovery unit 301.

With the above-mentioned structure, the following effects can be obtained.

While in printing, if ink is totally
5 consumed, the operation is automatically suspended and a warning is given accordingly. Thus, no recording medium will be wasted.

Also, after the replacement of ink tanks, there is no need for executing the recovery operation
10 manually. Therefore, operativity will be improved.

Each of the embodiments set forth below can be preferably used for the foregoing ink jet recording apparatus. Hereinafter, as another
15 embodiment, the description will be made of an embodiment wherein a recording head and an ink tank are separable and replaceable, and the recording head is coupled by pressing it to the carriage which carries the recording head in a given direction.

Fig. 23 is a cross-sectional view showing
20 the state where a recording head, ink tank, and carriage are coupled in an ink jet recording apparatus according to another embodiment of the present invention.

In the present embodiment, a recording head
25 1010a is of a type which is used for an ink jet method using electrothermal transducers to generate thermal energy to give film boiling to ink in

1 accordance with electric signals.

In Fig. 23, the principle structure of the recording head 1010a is such that all the elements are laminated by adhesion or pressing on a head base plate 1011a with the positioning protrusions 1011a-1 and 1011a-2 arranged on the head base plate 1011a as positioning reference.

Here, in the vertical direction in the inner face in Fig. 23 is positioned by the reference face 1104a-1 of a front board 1101a and a protrusion 1011a-1, while the horizontal direction in the inner face of Fig. 23 is positioned by a head positioning unit 1104a and a protrusion 1011a-2. Further, the direction perpendicular to the cross-section of Fig. 23 is positioned by the protruded portion (not shown) of the protrusion 1011a-2 which is protruded partially to cover the head positioning unit 1104a, and the head positioning unit 1104a.

On a heater board 1013a-2, there are formed by film deposition on an Si substrate, electrothermal transducers (ejection heaters) arranged in plural arrays and electric lines of aluminum and others to supply electric power. The heater board is connected to a head flexible board (hereinafter referred to as head PCB) 1013a having lines with pads 1013a-1 arranged at its leading ends to receive electric signals from the apparatus body. The connection is

1 made by wire bonding with each of the corresponding
lines arranged face to face. Then, the ink ejection
unit is formed with a common liquid chamber inducing
ink from a replaceable ink tank 1001a through
5 partition walls to partition each of the plural ink
passages in accordance with the ejection heaters and
liquid passages in order to supply it to ink
passages, and a grooved ceiling board 1012a, which
is integrally formed with orifices constituting a
10 plurality of discharging ports by polysulfone or the
like, is pressed by a spring (not shown) to the
heater board 1013a-2, at the same time being fixed
by pressing with adhesives and sealed; thus
fabricating the ink discharging unit. The liquid
15 passages 1015a coupled to the grooved ceiling 1012a
and sealed can be connected to the replaceable ink
tank 1001a in the present embodiment. To this end,
the liquid passages are penetrated through to the
opposite side of the head base plate 1011a through
20 the hole provided for the head PCB 1013a and head
base plate 1011a, at the same time being fixed
adhesively to the head base plate 1011a.

Also, at the end of the coupling side between
the liquid passage 1015a and ink tank 1001a, a filter
25 1008a is provided to prevent dust particles and
unwanted air bubbles from flowing into the
discharging ports. Also, a head cover 1018a is

1 provided to protect the discharging ports of the
recording head 1010a and the pad 1013a-1 for
electrical connection as well as to make it easier
to hold the recording head 1010a from its handling
5 end.

The replaceable ink tank 1001a has, in its
tank case 1001a-1 having ribs 1001a-2 on its inner
face, the ink absorbents 1002a retaining ink stuffed
with almost no space, the ink supply outlet (hole)
10 1004a to which the leading end of the liquid passage
1015a with the filter 1008a provided at its leading
end is inserted to make ink connection, and the air
conduit 1003a (hole) to prevent a negative pressure
from being generated excessively by introducing air
15 into the replaceable ink tank 1001a in an amount
corresponding to ink flowing out from the replaceable
ink tank 1001a. On the inner wall of the tank case
1001a-1, the ribs 1001a-2 are provided in order to
prevent direct air conduction to the ink supply
20 outlet 1004a through the inner wall of the tank case
1001a-1 for the maximum utilization of ink in the
total area of the ink absorbents 1002a by the force
exerted by the capillary phenomenon and at the same
time, the air conduit 1003a is arranged away from
25 the ink supply outlet 1004a as far as possible. The
ribs 1001a-2 function to reinforce the tank case
1001a-2 simultaneously so as to contribute to

1 improving the operativity when tanks are replaced.
The initial amount of ink retained in the ink
absorbents 1002a is less than the total absorbable
amount of the ink absorbents 1002a in order to give
5 a negative water head pressure to the meniscus of the
discharging ports of the recording head 1010a when
it is coupled for the functional purpose to enable
a stabilized ejection as well as for the operational
purpose to prevent any ink-leakage even when a slight
10 shock is given at the time of replacing ink tanks.
It may be possible to control ink leakage from the
air conduit 1003a by arranging the provision of a
liquid repellent treatment for the ink absorbent
1002a in the air conduit 1003a or using a separate
15 liquid repellent absorbent. The ink supply to the
replaceable ink tank 1001a comes to a limit when
the retained ink in the ink absorbent 1002a becomes
extremely small to make the ink suction of the ink
absorbent 1002a greater than the ink supply capability
20 to the recording head 1010a by the force exerted by the
capillary phenomenon of the nozzles following the
ink ejection or when the air induced from the air
conduit 1003a becomes great around the filter 1008a
and the air is supplied to the ink absorbent 1002a
25 in a large amount through the air filter 1008a.

The mechanical and electrical connection of
the recording head 1010a and replaceable ink tank
1001a to the carrier HC are conducted in the

1 following manner.

For the carriage HC, there are provided a front board 1101a positioned on the platen side (the front side of the head); a flexible sheet 1102a-1 provided with the head driving electrode 1102a corresponding to the pad 1013a-1 on the head PCB of the recording head 1010a; an electrical contact supporting board 1100a which a resilient member (rubber pad) 1102a-2 pressing the flexible sheet from its rear side; a head positioning unit 1104a to fix the recording head 1010a mechanically; and a pressing hook 1103a to support the recording head 1010a with one-way biasing. Here, two front boards 1101a are arranged each for the foregoing positioning protrusions 1011a-1 and 1011a-2 providing the positioning reference surface 1104a-1 for the head base plate 1011a of the recording head 1010a. The pressure hook 1103a of the carriage HC is structured to exert a biasing force in the direction indicated by a broken arrow in Fig. 23, that is, inclined approximately at ten degrees in the traveling direction of the carriage HC. Therefore, due to such a biasing force, the recording head 1010a is pressed in both directions toward the front board 1101a and the electric connection supporting board 1100a. At the same time, it is biased in the traveling direction of the carriage HC in the head positioning

1 unit 1104a with the electric connection supporting
board 1100a as its pivot. Although this pressure
coupling operation of the pressure hook 1103a can
be executed anyway, it is preferable to do it by a
5 lever or the like from the upper surface side of the
carriage HC. In any way, when this pressure hook
1103a is coupled, the recording head 1010a and
replaceable ink tank 1001a are electrically connected
after being slightly rotated on the carrier HC to
10 allow the positioning protrusions 1011a-1 and 1011a-2
to be in contact with the positioning reference
surface 1104a-1 of the front board 1101a. Thus,
the positioning of the pad 1013a-1 on the head PCB
1013a and head driving electrode 1102 is also
15 reliably executed.

Before the recording head 1010a and
replaceable ink tank 1001a are coupled, the carriage
HC and recording head 1010a, and the recording head
1010a and replaceable ink tank 1001a are separated
20 as shown in Fig. 24. Only the respective coupling
portions are in contact. The recording head 1010a
and replaceable ink tank 1001a begin to be coupled
with the engagement between the coupling hook 1017a
provided on the head base plate 1010a and coupling
25 guide 1005a provided on the replaceable ink tank
1001a as shown in Fig. 24. To arrange this coupling
portion between the ink supply outlet 1004a and head

1 positioning unit 1104a makes it possible to connect
ink supply passages reliably when the replaceable
ink tank is coupled to the recording head 1010a.

In other words, as clear from Fig. 24, when
5 the replaceable ink tank 1001a is rotated in
clockwise direction in Fig. 24, the ink supply outlet
1004a becomes the actuating point with the
coupling portion between the coupling hook 1017a
and coupling guide 1005a as its pivot if a thought
10 is given as to the coupling of the recording head
1010a and replaceable ink tank 1001a. Therefore,
the liquid passage end are coupled with the ink
absorbent 1002a and filter 1008a as coupling faces.
Further, at the same time, a resilient ring seal
15 1009a pinched between the head base plate 1011a and
the outer wall of the replaceable ink tank is pressed
and deformed to be tightly in contact with them.
Thus, the conduction between the interior of the
replaceable ink tank 1001a and the atmosphere is
20 completely blocked in the ink supply outlet 1004a.
If this sealing is insufficient, the air induction
to the interior of the replaceable ink tank 1001a
following the ink supply to the recording head 1010a
occurs directly without any intervention of the ink
25 absorbent 1002a. As a result, it becomes difficult
to effectively utilizes ink retained in the ink
absorbent 1002a. The pressure hook 1103a is

1 established to provide its pressure in the direction
inclined at ten degrees in order to position the
recording head 1010a in the direction toward the
plane of Fig. 24 with respect to the carriage HC
5 as described earlier. Therefore, also, in
consideration of the coupling to the recording
head 1010a, a force is exerted in the direction
orthogonal to the coupling direction.

Now, given the force in the pressure
10 direction as F and the contacting force between the
pad 1013a-1 on the head PCB 1013a of the recording
head 1010a and the head driving electrode 1102a on
the flexible sheet 1102a-1 through the rubber pad
1102a-2 on the electrical connection supporting board
15 1100a as F_1 , the following relationship is
obtainable:

$$F_1 = F \cos 10^\circ$$

On the other hand, given the contacting pressure
between the positioning protrusion 1011a-1 of the
20 head base plate 1011a of the recording head 1010a
and the positioning reference surface 1104a-1 of the
front board 1101a of the carriage as F_2 , the
following relationship is obtainable:

$$F_2 = F \sin 10^\circ$$

25 This force F_1 which effectuates the electrical
connection is a component in the direction toward
the plane of the head driving electrode when the

1 pressure hook 1103a is inclined at ten degrees to
the plane perpendicular to the head driving electrode
plane with respect to the pressure guide 1011a-3
which is a part of the head base plate 1011a of the
5 recording head 1010a. However, it effectuates the
recording head 1010a directly without intervention
of any other members such as the replaceable ink
tank 1001a. Therefore, it is possible to obtain
an optimally effective force F_1 assuredly; hence
10 enabling the provision of a recording apparatus
having an extremely high reliability in its
electrical connection in terms of environmental
and distributional aspects.

15

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25

1 On the other hand, it is implemented by the
application of the contact force F_2 to obtain the
position where the carriage HC is opposed to the
surface of a recording medium. The recording quality
5 depends greatly on the positional relationship between
the carriage HC and recording head 1010a. If such a
position is not appropriate, the recording is slanted
or the ruled lines represent a saw tooth configuration.
In a worst case, the electrical connection is displaced
10 to cause defective contacts, which generates missing
dots.

 In the present embodiment, the positioning
contact pressure F_2 directly effectuates the pressure
guide 1011a-3 which is a part of the head base plate
15 1011a of the recording head 1010a without the inter-
vention of any other members. Its effective force is
not attenuated and thus an optimal contact force F_2
can be obtained. In this way, a significant improve-
ment is made for the accuracy of the distance between
20 the recording medium and recording head, which is one
of the major factors to affect the recording quality
of an ink jet recording apparatus.

 Moreover, since the F_1 force effectuates the
pressure guide with the electrical connection as its
25 pivot, a moment is generated on the recording head
1010a with the electrical connect as its pivot.

Therefore, a contact force is given by the foregoing

1 moment to the positioning protrusion 1011a-2 which is
a part of the head base plate 1011a of the recording
head 1010a, and the head positioning unit 1104a on the
front board 1101a of the carriage HC without the inter-
5 vention of any other members. As a result, the
positioning accuracy of the recording head 1010a in the
printing direction is significantly improved.

As described above, by directly passing the
recording head 1010a, the electric power is assuredly
10 supplied from the recording apparatus to the recording
head 1010a, at the same time enabling the positioning
accuracy to be significantly improved for the carriage
HC and recording head 1010a. Hence, it is possible to
obtain an ink jet recording apparatus having a high
15 reliability and desirable recording quality.

Subsequently, the description will be made of
another embodiment with reference to Figs. 26 to 29.

Although the fundamental structures of the
recording head 1010b and replaceable ink tank 1001b are
20 the same as the embodiment described in Fig. 23, this
embodiment is different in the direction of pressing
force for coupling the recording head 1010b to the
carriage HC as well as the direction in which the
replaceable ink tank 1001b is installed.

25 In other words, as shown in Fig. 26, there is
no front board positioned in the platen side (front
side of the head). A side board 1900 of the carriage

1 HC is provided in the direction perpendicular to the
platen instead. On this, the electrical connection is
arranged as in the embodiment described in Fig. 23.
In the two locations in the substantial center of both
5 ends of the head base plate 1011b of the recording
head 1010b, pressure guides 1901 are provided. To the
pressure guides 1901, the side board 1900 of the
carriage HC is pressed by the pressure hook 1908 shown
in Fig. 29. Thus, it becomes possible to supply power
10 from the recording apparatus to the recording head
1010b. In this case, too, the pressing force is
directly given to the recording head 1010b vertically
without the intervention of any other members. Thus,
an optimal pressure force can be obtained assuredly.
15 Hence, it is possible to obtain a recording apparatus
having an extremely high reliability in its electrical
connection in terms of environmental and distributional
aspects.

Also, the protrusion 1902 which is a part of the
20 base plate 1011b of the recording head 1010b and the
carriage positioning unit 1903 are butted so as to
enable the pressing force to the carriage HC to be
given directly from the recording head 1010b.
Consequently, the positioning accuracy of the recording
25 head 1010b in the recording direction is significantly
improved.

In this respect, it may be possible to couple

1 the replaceable ink tank 1001b to the recording head
1010b after the recording head 1010b has been coupled
to the carriage HC or to couple the recording head
1010b to the replaceable ink tank 1001b before the
5 recording head 1010b is installed on the carriage HC.

Fig. 27 shows the state where the recording
head 1010b and replaceable ink tank 1001b are separated.
Also, Fig. 28 shows the state where the recording head
1010b and replaceable ink tank 1001b are coupled.

10 Fig. 29 is a partially cross-sectional view
observed in the direction indicated by a blank arrow
A shown in Fig. 26, in which a reference numeral 1906
designates the portion where the recording head 1010b
and replaceable ink tank 1001b are coupled. On the
15 side board 1900 of the carriage, a dowel 1907 is
provided, the pressure hook 1908 is rotated with this
dowel 1907 as its pivot. At the leading end 1908a
of the pressure hook 1908, the nail is provided to
hold the pressure guide 1901 which is integrated with
20 the base head base plate of the recording head 1904.
Also, the dowel 1907 and pressure hook dowel 1909 are
tensioned by a tensioning coil spring 1911. In this
way, the recording head 1010b is electrically connected
to the carriage HC through its side board 1900
25 reliably. These recording head amounting pressure
hooks 1908 are also provided beneath the recording
head 1010b. Thus, the recording head 1010b is stably

1 pressed to the carriage side board 1900 from above
and below as well.

In this respect, a reference numeral 1910
designates nozzles ejecting ink; 1908b, a lever to be
5 used when the recording head 1010b is removed from the
carriage HC. By pinching the two places thereof, the
leading end 1908a of the pressure hook 1908 is
released from the pressure guide 1901 of the recording
head 1010b; thus enabling the recording head 1010b to
10 be demounted from the carriage.

Subsequently, as another embodiment, the
description will be made of an embodiment wherein an
ink tank and recording head can be separated while the
foregoing ink tank and recording head are mounted by
15 separate means, respectively.

An ink tank 2001a is inserted into a carriage
HC in the direction perpendicular to the plane of
Fig. 30 in the state where it is coupled to a recording
head 2010a. At this juncture, the replaceable ink
20 tank 2001a is installed in a given location in the
carriage HC by being guided by a replaceable ink tank
front guide 2907a and replaceable ink tank rear guide
2908a on the carriage HC. Then, the replaceable ink
tank 2901a is regulated by the snapping function of a
25 pair of tank pressing front nails 2909a and 2911a and
that of tank pressing rear nails 2910a and 2912a.

Fig. 31 is a partially sectional view illustrating this

1 Viewed from the ink discharging surface side. The
liquid passage 2913a extending from the recording head
2010a penetrates the bottom of the replaceable ink tank
2001a to the ink absorbent 2002a in the replaceable ink
5 tank 2001a.

Here, in order not to allow dust particles and
other impurities to be mixed in the recording head
2010a, a filter 2914a is provided and also, a ring
seal 2915a is provided around the liquid passage 2913a
10 to prevent ink leakage from the portion where the
recording head 2010a and replaceable ink tank 2001a are
coupled.

A member which connect the ink tank and
recording head, that is, an ink absorbent 2002a with
15 which a liquid passage 2913a is in contact under
pressure, is of a sponge type. Also, the ring seal
2915a is made of a resilient material having a low
hardness. Therefore, no compulsory force is exerted
by the ink tank 2001a against the recording head
20 2010a. In this respect, a reference numeral 2916a
designates nozzles. Fig. 32 is a cross-sectional view
taken along line A-A in Fig. 30 to illustrate the
replaceable ink tank itself. When it is mounted on the
recording head 2010a, a supply unit seal 2004a-1 and
25 conduit unit seal 2003a-1 are removed in the direction
indicated by arrows, respectively.

Now, the description will be made of still

1 another embodiment with reference to Fig. 33 to Fig.
35.

In the present embodiment, the fundamental
structures of a recording head 2010b and replaceable
5 ink tank 2001b are the same as the foregoing embodiment
described in Fig. 30. What differs is the direction in
which pressure is given when the recording head 2010b
is coupled to the carriage HC and also the direction
in which the replaceable ink tank 2001b is installed.

10 In other words, as shown in Fig. 33, there is
no front board positioned on the platen side (front
side of the head). A side board 2900b of the carriage
HC is provided in the direction perpendicular to the
platen instead. On this, the same electrical con-
15 nection unit as the foregoing embodiment described in
Fig. 30 are arranged. In two locations in the sub-
stantial center of both ends of the head base plate
2011b of the recording head 2010b, pressure guides
2901b are arranged. These pressure guides 2901b are
20 pressed to the side board 2900b of the carriage HC by
the pressure hooks 2908b shown in Fig. 35. Thus, it
becomes possible to supply power from the recording
apparatus to the recording head 2010b. Here, the
pressure is exerted directly on the recording head
25 2010b vertically without the intervention of any other
members. As a result, an optimal pressure is obtained
reliably. It is thus possible to obtain a recording

1 apparatus having an extremely high reliability in its
electrical connection in terms of environmental and
distributinal aspects.

Also, the protrusion 2902b which is a part of
5 the head base plate 2011b of the recording head 2010b
and the carriage positioning unit 2903b are butted to
enable a direct effect of the pressure from the
recording head 2010b to the carriage HC. The positional
accuracy of the recording head 2010b in the recording
10 direction can be significantly improved.

In this respect, the replaceable ink tank 2001b
is coupled to the recording head 2010b after the
recording head 2010b is mounted on the carriage HC.

Fig. 34 illustrates the state where the
15 recording head and replaceable ink tank are separated.

Fig. 35 is a partially cross-sectional view
illustrating the recording head and tank viewed in the
direction indicated by a blank arrow B in Fig. 33, in
which dowels 2907b are arranged on the side board
20 2900b of the carriage HC, and the pressure hooks 2908b
are rotated with the dowels 2907b as pivot, respec-
tively. At the leading ends 2908b-1 of the pressure
hooks 2908b, nails are arranged to hold the pressure
guides 2901b which are integrally formed with the
25 head base plate 2011b of the recording head 2010b.
Also, the dowels 2907b arranged on the side board
2900b and the pressure hook dowels 2909b are tentioned

1 by tensioning spring coils 2911b, respectively. Hence,
the recording head 2010b is electrically connected
assuredly to the carriage HC on^g the side board 2900b.
These recording head mounting pressure hooks 2908b
5 are also provided beneath the recording head 2010b to
press the recording head 2010b to the side board
2900b of the carriage from above and below stably.

In this respect, a reference numeral 2910b
designate discharging ports (may be referred to nozzles
10 in some cases) which eject ink, and 2908b-2, a notch
used when the recording head 2010b is to be removed
from the carriage. By pinching two parts of the notch,
the leading ends 2908b-1 of the pressure hooks 2908b
are released from the pressure guides 2901b of the
15 recording head 2010b. Thus, the recording head 2010b
is detached from the carriage HC.

Figs. 33 and 35 are views illustrating the
replaceable ink tank 2001b installed in the horizontal
direction as in Fig. 34 when the entire status is such
20 as described above. The replaceable ink tank 2001b
is installed in the horizontal direction against the
pressure exerted by a pair of tank side end nails
2912b and 2913b. Accordingly, when it is butted
against a pair of carriage stoppers 2914b and 2915b,
25 the tank side end nails 2912b and 2913b are restored
to complete the installation of the replaceable ink
tank 2001b thereby to fit it there. Also, the

1 carriage front nail 2916b and carriage rear nail 2917b
are those which prevent the replaceable ink tank 2001b
from being detached upward.

Here, at the same time that the replaceable
5 ink tank 2001b is mounted on the carriage, a resilient
ring seal 2009b provided in the portion 2906b where
the recording head 2010b and replaceable ink tank
2001b are coupled is deformed to connect them. As a
result, no ink leakage will take place. Also, since
10 the coupling portion is flexibly structured using
resilient material, no compulsory force is exerted on
the recording head 2010b when the replaceable ink tank
2001b is mounted on the carriage. There is no possi-
bility that the positioning accuracy of the recording
15 head 2010b to the carriage is not lowered.

Fig. 36 is a schematically perspective view
illustrating the recording head and ink tank of an ink
jet recording apparatus according to another embodiment.
In Fig. 36, a reference numeral 3001 designates a
20 recording head ejecting ink in accordance with electric
signals; 3002, an ink tank (ink cartridge) containing
ink to be supplied to the recording head 3001; 3010, an
ink supply inlet (liquid passage connecting unit)
which serves as a passage for supplying ink from the
25 ink tank 3002 to the recording head 3001; 3011, an
ink supply outlet (liquid passage connecting unit) to
supply ink from the ink tank 3002 to the recording

1 head 3001; 3012, coupling nails which guide and hold
the recording head 3001 and ink tank 3002 when both
of them are integrated; 3013a and 3013b, coupling nail
guide grooves to engage with the coupling nails 3012;
5 3016, a plurality of tank inner walls to partition the
interior of the ink tank 3002 into small chambers; and
3017, conductive holes opened on the tank inner walls
3016. With these elements, the head cartridge 3101
is structured.

10 Fig. 37 is a schematically perspective view
illustrating the state where the head cartridge 3101
shown in Fig. 36 is mounted on the carrier unit. In
Fig. 37, a reference numeral 3102 designates a carrier
(mounting unit) provided for a recording apparatus
15 body which holds the recording head 3001 and ink tank
3002; 3106, a head lever to hold or release the
recording head 3001; 3107, an ink tank lever to mount
or demount the ink tank 3002; and 3108, a head fixing
spring to fix the recording head 3001 to the carrier
20 3102. With these elements, the head unit and carrier
unit of the recording apparatus are structured.

The above-mentioned recording head 3001
comprises a plurality of electrothermal transducers
which generate thermal energy to be utilized for
25 ejecting ink, and a substrate on which a driving
circuit is formed to drive these transducers; dis-
charging ports and liquid passages arranged on the

1 substrate corresponding to each of the above-mentioned
plural electrothermal transducers; and further, a
laminated ceiling board constituting a common liquid
chamber conductively connected to each of the liquid
5 passages. Then, the recording head 3001 thus
structured is mounted on the apparatus in such a manner
that the discharging surface where the discharging
ports are arranged is placed to face a recording
medium. In the head cartridge 3101 shown in Fig. 36,
10 the structure is arranged so that ink is ejected in
the direction indicated by an arrow a.

The ink tank 3002 is arranged to refill ink
consumed by recording while holding ink and supplies ink
to the recording head 3001 appropriately. When this ink
15 tank 3002 is present as a single body, the ink supply
outlet 3011 is sealed with sealing means (not shown)
so as not to allow any ink leakage. This sealing means
is automatically or manually released when the ink tank
is integrated with the recording head 3001 to make ink
20 supply possible. Also, it may be possible to arrange
a mechanism to induce air from the outside as the ink
volume is being decreased by the ink consumption.
Furthermore, the structure may be made to arrange a
mechanism inside so as to maintain the pressure of ink
25 to be supplied to the recording head 3001 slightly
negative; thus making it possible to improve the
printing quality as well as to prevent any ink leakage.

1 Also, the recording head 3001 and ink tank 3002
are used for the apparatus in a recording operation as
a head cartridge 3101 wherein both of them are
integrated. Now, the description will be made of a
5 method for integrating both of them.

Fundamentally, the recording head 3001 and ink
tank 3002 are integrated by coupling the ink supply
inlet 3010 and ink supply outlet 3011. Therefore,
this portion is carefully arranged to prevent ink
10 leakage from or air intake into the ink passages.
In the present invention, as shown in Fig. 38, a method
is adopted to utilize the resiliency of a mold member
for the purpose. In other words, the ink supply
inlet hole 3010a and the ink supply outlet hole 3011a
15 are formed cylindrically and then the inner diameter of
the ink supply outlet 3011a is slight smaller than the
outer diameter of the ink supply inlet hole 3010a.
Thus, when the ink supply inlet hole 3010a is pressed
into the ink supply outlet hole 3011a, these two holes
20 are tightly integrated while being slightly deformed
in the radial direction. Also, the coupling portion
is not necessarily of a mold member, but it will
suffice only if the material has a sealing capability.
The other coupling methods will be described later.

25 In the integration of the recording head 3001
and ink tank 3002, while it is good enough to couple
the ink supply inlet 3010 and ink supply outlet 3011

1 as described above, the coupling is intensified in the
present embodiment by providing the coupling nails
3012 and coupling nail guiding grooves 3013a in order
to prevent them from being disengaged simply due to
5 any unexpected force that may be exerted when the head
cartridge 3101 is handled or to facilitate the
integration. In other words, the coupling nails 3012
formed integrally with the ink supply inlet 3010 by
molding and capable of being resiliently deformed are
10 provided with protrusions at the leading ends, and
are fitted into the coupling nails guiding grooves
3013a while being resiliently deformed by the portions
corresponding to the height of the protrusions. The
coupling is completed when the protrusions of the
15 coupling nails 3012 reach the deepest portions
arranged in the rear sides of the coupling nail
guiding grooves 3013a.

Further, the coupling nails 3012 serve as
guides so as to allow the ink supply inlet 3010 and
20 ink supply outlet 3011 to be easily joined when the
recording head 3001 and ink tank 3002 are coupled. In
other words, the coupling nails 3012 are made longer
than the ink supply inlet 3010 so that the coupling
nails 3012 are to be in contact with the ink tank 3002
25 before the ink supply inlet 3010 reaches the ink supply
outlet 3011. Here, the leading ends of the coupling
nails 3012 are cut off diagonally. This diagonally

1 cut off portion serves as its guide in the direction
indicated by an arrow b in Fig. 36 to facilitate the
engagement with the nail guiding grooves 3013d. Also,
the protrusions provided at the leading ends of the
5 coupling nails 3012 are also cut off diagonally to
promote an easier engagement by serving as its guide
in the direction indicated by an arrow c in Fig. 36.

In this respect, while the coupling nails 3012
are provided on the recording head 3001 side, its
10 position is not confined thereto. It may be possible
to position them on the ink tank 3002 side or on both
sides of the recording head 3001 and ink tank 3002.

Here, in the above-mentioned embodiment, the
interior of the ink tank 3002 is separated into
15 several small chambers by the inner walls 3016. The
structure is arranged so that the small chambers
themselves are connected through conductive holes 3017
provided in the vicinity of the bottom end of the inner
walls 3016 of the ink tank 3002. In this case, some
20 of the conductive holes 3017 must be filled with ink.
Accordingly, it is necessary for the ink tank 3002 to
have the end where the conductive holes 3017 are
arranged at its bottom with respect to gravity (in the
direction in which it is located in Fig. 36).

25 Therefore, if it is required to rotate the ink
ejection direction a from the downward direction as
shown in Fig. 36 to the direction indicated by an

1 arrow d in Fig. 36, or to use the recording head for
an apparatus wherein the advancing direction of its
recording medium (not shown) is vertical and not
horizontal, for example, or to place a recording
5 apparatus itself vertically or horizontally for its
use, the ink tank 3002 which is rotated together with
the ink cartridge 3101 cannot satisfy the foregoing
conditions, thus disabling its ink supply. In the
present embodiment, therefore, a second coupling
10 direction which is rotated approximately 90 degrees is
arranged in addition to a first direction wherein the
coupling nails 3012 and coupling nail guiding grooves
3013a are engaged. For this second coupling direction,
the coupling nails 3012 are used in the same manner,
15 but the coupling nail guiding groove 3013 engages with
the other coupling nail guiding groove 3013b. The
coupling method in this case is the same as the one used
for the coupling in the first direction.

Also, since the positional relationship between
20 the coupling nails 3012 and coupling nail guiding
grooves 3013 is symmetrical in rotation with respect
to the ink supply inlet 3010, the coupling is possible
in a total of four directions, that is, two more
directions at 90 degrees each further from the above-
25 mentioned second coupling direction.

Fig. 39 illustrates another embodiment to show
the portion where the ink passages of the recording

1 head 3001 and ink tank 3002 are coupled. Fig. 39A
represents a case where the ink supply outlet 3011b is
made of a resilient material such as rubber. Here, it
is possible to make the inner diameter of the ink
5 supply outlet 3011b smaller than the outer diameter of
the ink supply inlet 3010b. Thus, the contactness
between the ink supply inlet 3010b and ink supply
outlet 3011b is improved when the recording head 3001
and ink tank 3002 are coupled. As a result, the
10 sealing capability of the ink passages is enhanced.
Also, a force required to deform the ink supply outlet
3011b can be small. The force required to effectuate
the attachment and detachment of the recording head
3001 and ink tank 3002 can also be small.

15 Also, Fig. 39B illustrates a case where the
ink supply inlet 3010c is formed to be annular having
an acute end, while the ink supply outlet 3011c is
made of a resilient material such as rubber having no
holes. When separated from the recording head 3001,
20 the ink supply unit 3011c of the ink tank 3002 is in a
blocked state. Therefore, there is no ink leakage from
the ink supply unit 3011c. The ink tank 3002 can be
handled excellently as a single body. Also, when the
ink tank 3002 is coupled to the recording head 3001,
25 the acute end of the ink supply inlet 3010c makes a
hole in the ink supply outlet 3011c to provide an ink
passage. The liquid passages can be coupled stably.

1 A force required to attach or detach the ink tank 3002
can also be small.

In the other embodiment described in Fig. 36,
the mounting direction of the ink tank 3002 is of such
5 a type that it is different only by the difference in
angle in the axial direction, but irrespective of this,
it may be possible to provide ink passages in a differ-
ent position. Fig. 40 is a view schematically showing
still another embodiment structured such as this to
10 illustrate the direction in which the recording head
3001 and ink tank 3002 are coupled. In Fig. 40, a
reference numeral 3018 designates a first ink supply
inlet provided for the recording head 3001, and 3019,
a second ink supply inlet arranged in a direction
15 different from the first ink supply inlet 3018. A head
cartridge 3101 comprises each of these elements. Here,
the ink ejecting direction of the recording head 3001
is the one indicated by an arrow Bk in Fig. 40. As
ink supply inlets to supply ink to the recording head
20 3001, the first ink supply inlet 3018 and second ink
supply inlet 3019 are opened at angles of approximately
90 degrees to each other. These inlets are sealed if
no ink supply outlets 3011 of the ink tank 3002 are
installed. By a mechanism (not shown), these are
25 released only when the ink supply outlet 3011 is mounted
to form an ink passage. Therefore, when the ink tank
3002 is attached to either one of them, the other one is

1 closed, and no air is mixed in the ink passage. Also,
when the ink tanks are attached to both of them, ink
can flow smoothly.

In this respect, unlike the embodiment described
5 in Fig. 36, it is possible to use an ink tank which can
supply ink without being affected by gravity as the ink
tank 3002. Hence, in the present embodiment, it is
also possible to attach the ink tank 3002 to the second
ink supply inlet 3019 in the direction indicated by an
10 arrow a. Also, the ink tank 3002 can be attached to
the first ink inlet 3018 in the direction indicated
by an arrow b in Fig. 40.

Also, if the scanning direction of the carrier
3102 is assumed to be in the direction indicated by
15 an arrow a in Fig. 40 when the head cartridge 3101 is
mounted on the carrier 3102, the ink tank 3002 which
is attached to the second ink supply inlet 3019 is not
protruded above the recording apparatus. Thus, the
total height can be lowered. When the ink tank 3002 is
20 attached to the first ink inlet 3018, it is possible to
narrow the width of the carrier 3102. Thus, the total
width of the recording apparatus can be narrowed.
Further, in a case where another ink supply inlet is pro-
vided to allow the ink tank 3002 to be attached in the
25 direction indicated by an arrow c in Fig. 40, the total
width of the recording apparatus can also be narrowed.

As described above, with the structure which

1 allows the coupling direction of the recording head
3001 and ink tank 3002 to be provided in two or more
directions, it is possible to obtain an effect that
with only one recording head 3001, the mode of head
5 cartridge 3101 can be varied to meet many kinds of
recording apparatuses; thus enabling its versatility
to be enhanced to provide a desirable efficiency.

Fig. 41 is a perspective view illustrating the
structure of a further embodiment according to the
10 present invention. To be specific, the present
embodiment is to constitute a color recording head by
the utilization of the recording head 3001 in the
embodiment described in conjunction with Fig. 40.

In Fig. 41, the recording head 3001 and ink
15 tank 3002 comprise the recording heads 1BK, 1Y, 1M,
and 1C which eject color ink materials of black (Bk),
yellow (Y), magenta (M), and cyanogen (C), respectively,
and ink tanks 2BK, 2Y, 2M, and 2C. The directions
indicated by arrows in Fig. 41 represent those in
20 which ink materials are ejected.

For the configuration of the above-mentioned
recording head 3001, the same type of head used in the
embodiment described in Fig. 40 can be used. For the
structure of the liquid passage between the head and
25 ink tank 3002, the first ink supply inlet 3018 is also
usable. Here, in a case of heads for color recording,
it is required to maintain the precision with which to

1 position the recording heads themselves accurately.
Therefore, a positioning protrusion 3020 is provided
on the side of the recording head 1 opposite to a
second ink supply inlet. This is coupled to the
5 second ink supply inlet of the adjacent recording head.
In this way, the positioning may be arranged.

Also, ink supply inlets can be arranged in the
direction indicated by an arrow c in Fig. 41 and the
ink tank 3002 may be connected in such a direction
10 as matter of course.

As described above, the installation direction
of the recording head 3001 and ink tank 3002 are made
arrangeable in two directions or more and then a
plurality of these recording heads 3001 and ink tanks
15 3002 are made usable. Hence, the following effects
can be obtained:

It is possible to simply obtain a color
recording cartridge by adding head cartridges for
plural colors to the head cartridge 3101 which is
20 usually used for a single color.

Also, by arranging the size of an ink tank
3002 for the use of a single color and that of the
recording head 3001 which is added for recording in
multicolor substantially the same, it is possible
25 to perform a single color recording and a multicolor
recording with a carrier which can be shared for the
purpose. Hence, it becomes possible to provide a

1 compact color recording apparatus at a low cost.
Further, by utilizing the ink supply inlet for
positioning, it is possible to accurately execute the
positioning between heads for a high quality color
5 recording.

Fig. 42 illustrates another embodiment. In a
recording head 4002a, a detaching and holding lever
4002f is provided for an ink cartridge 4002. This
lever 4002f can be held down with its mounting shaft
10 4002g as pivot. When an ink jet cartridge 4002 is
installed in the carrier, the lever is raised in the
direction opposite to the ink ejection direction as
indicated by solid lines in Fig. 42 so as to install
it in the direction indicated by an arrow A with the
15 aforesaid mounting shaft 4002g being fitted along the
carrier guide grooves 4001c. Then, as shown in Fig.
43, when the mounting shaft 4002g reaches the bottom
of the guide grooves 4001c and becomes no longer
shiftable, the lever 4002f is rotated in the direction
20 B by 90 degrees to hold the carrier 4001. In practice,
it is preferable to provide a click function or the
like to improve the sense of operation. At this
juncture, the elongated cylindrical portions 4002h
provided for the lever 4002f are regulated by the
25 walls 4001e of the positioning grooves 4001d and are
shifted by ϵ to the left in Fig. 43. By this shift,
the contact between the recording head 4002a and

1 carrier 4001 is made to electrically connect them.

Now, still another embodiment will be described.

As shown in Fig. 44, the present embodiment is such that the ink jet cartridge detaching and holding

5 lever 4002f provided for the recording head 4002a in the foregoing embodiment described in conjunction with Fig. 42 is arranged on the ink tank 4002c. Any structures other than this are the same as the embodiment in Fig. 42.

10 Subsequently, still another embodiment will be described. As shown in Fig. 45, the present embodiment is applicable to the structure wherein the recording head 4002a and ink tank 4002b are separable. In the present embodiment, the elongated cylindrical
15 portions 4002k of the ink tank lever 4002j are made larger. Accordingly, the shiftable amount ϵ is also made larger by that much. As shown in Fig. 46, this is needed to insert the connecting rod 4002d of the recording head 4002a into the connecting hole 4002e of
20 the ink tank 4002b.

Now, still another embodiment will be described.

As shown in Fig. 47, the present embodiment is a variation of the embodiment described in conjunction with Fig. 45. Its structure is arranged to hold the
25 ink tank 4002b by the recording head 4002a. The guide grooves for the ink tank 4002b are provided on the recording head 4002a (4021) while the guide grooves for

1 the recording head 4002a are provided on the carrier
(4001f). In the present embodiment, the ink tank
4002b can be replaced independently by the ink tank
lever 4002j, but the recording head 4002a cannot be
5 replaced independently. It must be replaced in the
mode of the ink jet cartridge while holding the ink
tank 4002b.

With a structure such as this, the replacement
can be made with only one operation whereas in the
10 prior art the operation should be carried out twice
when the recording head 4002a is replaced, that is,
at first, the ink tank 4002b must be removed before
the removal of the recording head 4002a.

Now, Figs. 48 and 49 illustrate another
15 embodiment. Fig. 48 is a schematically perspective
view showing a state before an ink tank is attached to
a recording head. Fig. 49 is a schematically per-
spective view showing a state after the ink tank is
attached to the recording head.

20 In Figs. 48 and 49, a reference numeral 5006
designates an ink tank containing ink to supply ink
to a recording head 5004 from the nozzle 5005 of the
recording head 5004 through a hole 5007 provided for
the ink tank 5006. Also, the recording head 5004 is
25 coupled detachably to a hole 5003 of a carriage
5001 by a means which is not shown. Here, the

1 scanning directions of the carriage 5001 are such as
indicated by an arrow S in Fig. 48. The direction in
which ink is ejected from the recording head 5004 to
a recording medium is such as indicated by an arrow T
5 in Fig. 48.

An operator of a recording apparatus removes
an empty ink tank 5006 when it is known that ink in
the ink tank 5006 is being exhausted and installs an
ink tank 5006 containing ink on the recording head
10 5004.

In such a case, the ink tank 5006 is shifted
from the position in Fig. 48 in the direction
indicated by an arrow P in Fig. 48 to allow the
nozzles 5005 of the recording head 5004 to be coupled
15 to the hole 5007 of the ink tank 5006. At this
juncture, the ink tank 5006 engages with a stopper
5002 of the carriage 5001 before it is butted against
the recording head 5004 (Fig. 49).

With the provision of the stopper 5002 on the
20 carriage 5001 in this way, the ink tank 5006 is
allowed to engage with the stopper 5002 of the
carriage 5001 before butting the recording head 5004
even if an excessive force is given to the ink tank
5006 when the ink tank 5006 is installed. Therefore,
25 there is no possibility that the recording head 5004
is damaged.

Figs. 50 and 51 illustrate another embodiment.

1 Fig. 50 a schematically perspective view showing a
state before an ink tank is installed on a recording
head. Fig. 51 is a schematically perspective view
showing a state after the ink tank is installed on the
5 recording head.

In Figs. 50 and 51, a reference numeral 5026
designates an ink tank containing ink to supply it
from the ink supply nozzle 5005 of a recording head
5004 to the recording head 5004 through a hole 5028
10 provided for the ink tank 5026. Also, the recording
head 5004 is detachably coupled to the hole 5021 of a
carriage 5020 by a means which is not shown. Here,
the scanning directions of the carriage 5020 are such
as indicated by an arrow S while the ink ejection
15 direction from the recording head 5004 to a recording
medium is such as indicated by an arrow T. A reference
numeral 5027 designates ink tank installation grooves
provided on the ink tank 5026, which engage with the
bosses 5025 arranged on a carriage lever 5024 installed
20 to the upper holes 5023 of arms 5022 provided on both
sides of the carriage 5020.

An operator raises the carriage lever 5024 to
install the ink tank 5026 so that the grooves 5027
of the ink tank 5026 engage with the bosses 5025 when
25 installing it on the recording head 5004 (Fig. 50).
Then, the carriage lever 5024 is held down in the
direction indicated by an arrow A. Thus, the ink tank

- 1 5026 is caused to be shifted in the direction
(indicated by an arrow B) approaching the recording
head 5004. The ink supply nozzle 5005 of the recording
head 5004 and the hole 5028 of the ink tank 5026 are
5 coupled (Fig. 51). In this case, even if an operator
gives an excessive force to the carriage lever 5024, a
stopper 5029 arranged on the carriage lever 5024 is
caused to butt the carriage 5020 and the ink tank
5026 can no longer approach the recording head 5004.
- 10 Here, Fig. 52 illustrates the recording head 5004 in
the embodiment described in Fig. 50 and the positional
relationship between the grooves 5027 of the ink tank
5026 and the bosses 5025 of the carriage lever 5024.
Now, even if an operator erroneously presses the ink
15 tank 5026 in the direction approaching the recording
head 5004, the ink tank 5026 will not push the
recording head 5004 because as shown in Fig. 52 a
space y between the recording head 5004 and ink tank
5026 is greater than a space x between the bosses
20 5025 and grooves 5027 to maintain a relationship
($y > x$).

With the structure as described above, even
when an excessive force is added to the ink tank
5026, there is no possibility that the recording head
25 5004 is damaged.

Also, in the present embodiment, the bosses
5025 are arranged on the carriage lever 5024, but it

1 is not necessarily to configure them to be boss type
only if some protrusions can be provided instead.

Figs. 53 to 56 illustrate still another
embodiment. Fig. 53 shows schematically an ink tank
5 itself. Fig. 54 is a side view of the ink tank
viewed in the direction indicated by an arrow C in
Fig. 53. Fig. 55 is a schematically perspective view
illustrating the state where the recording head is
installed on a carriage before the ink tank is mounted
10 on the carriage. Fig. 56 is a schematically perspective
view illustrating the state where the ink tank is
attached to the recording head installed on the
carriage.

In Figs. 53, 54, and 55, a reference numeral
15 5046 designates an ink tank containing ink in it.
Ink is supplied to the recording head 5004 from the
ink supply nozzle 5005 of the recording head 5004
through the hole 5048 of the ink tank 5046. Also, the
recording head 5004 is detachable coupled to the hole
20 5041 of the carriage 5040 by a means which is not shown.
A reference numeral 5042 designates a guide provided to
guide the carriage 5040 for the ink tank installation,
and also 5047, a stopper rib provided for the ink tank
5046.

25 An operator inserts the ink tank 5046 into the
guide 5042 of the carriage 5040 from the hole 5048 in
the direction indicated by an arrow D in Fig. 55 so as

1 to allow the direction (E) of the ink tank 5046 where
no rib 5047 is provided to be matched with the F
portion of the carriage 5040 when the ink tank 5046
is attached to the recording head 5004. The ink tank
5 is inserted until the rib 5047 of the ink tank 5046
butts the edge 5043 of the guide 5042. Thus, the
ink supply nozzle 5005 of the recording head 5004 and
the hole 5048 of the ink tank 5046 are coupled to
complete the installation of the ink tank 5046 (Fig.
10 56).

By providing the stopper rib 5047 for the ink
tank 5046 as described above, there is no possibility
that the recording head 5004 is damaged even when the
recording head 5004 is pushed due to an excessive
15 force given to the ink tank 5046.

Figs. 57 to 59 illustrate still a further
embodiment. Fig. 57 is a schematically perspective
view showing an ink tank itself. Fig. 58 is a
schematically perspective view showing the state where
20 a recording head is mounted on a carriage before the
ink tank is installed on the carriage. Fig. 59 is a
schematic perspective view showing the state where the
ink tank is attached to the recording head installed
on the carriage.

25 In Figs. 57 and 58, a reference numeral 5056
designates an ink tank containing ink in it. Ink
is supplied to the recording head 5004 from the ink

1 supply nozzle 5005 of the recording head 5004 through
the hole 5058 of the ink tank 5056. Also, the
recording head 5004 is detachably coupled to the hole
5051 of the carriage 5050 by means which is not shown.

5 A reference numeral 5052 designates a guide provided
for the carriage for the installation of the ink tank,
and also, 5057, a stopper provided for the ink tank
5056, which engages with the groove 5053 of the guide
5052.

10 An operator inserts the ink tank 5026 into the
guide 5052 of the carriage 5050 from the hole 5058 in
the direction indicated by an arrow D in Fig. 58 so
as to allow the protrusion 5057 of the ink tank 5056
and the groove 5053 of the carriage 5050 to be matched
15 when the ink tank 5056 is attached to the recording
head 5004. The ink tank is inserted until the
protrusion 5057 butts the deepest portion of the groove
5053. Thus, the ink supply nozzle 5005 of the
recording head 5004 and the hole 5058 of the ink tank
20 5056 are coupled to complete the installation of the
ink tank 5056 (Fig. 59).

By providing the stopper protrusion 5057 of
the ink tank 5056 as well as the groove 5053 on the
guide 5052 of the carriage 5050 as described above,
25 there is no possibility that the recording head 5004
is damaged even if the recording head 5004 is pushed
by an excessive force added to the ink tank 5056.

1 Figs. 60A and 60B illustrate another embodiment.
In an ink jet head 6101, an ink supply barrel 6104
serves as ink supply means. This shows a cylindrical
outer appearance, which can be fitted into an ink
5 supply outlet 6103, a recess provided for the ink tank
6102, with a desirable tightness. However, the
interrelated positional relationship in coupling the
ink jet head 6101 and ink tank 6102 is not determined
only by ink supply means 6104 and the ink supply outlet
10 6103. The positioning is perfectly made three
dimensionally further by fitting positioning pins
6105 and 6106 provided for the ink jet head 6101 into
the positioning holes 6107 and 6108 provided for the
ink tank 6102 as well as by allowing the members
15 6109 and 6110 which block detachment provided for the
ink jet head 6101 to engage with the recesses 6111
and 6112 provided for the ink tank 6102. As shown in
Figs. 60A and 60B, it is clear that the positioning
means for coupling the ink jet head and ink tank is
20 not dependent of ink supply means.

 In the ink jet head 6101, the positions where
the positioning pins 6105 and 6106 are arranged are
not particularly conditioned. However, it is
preferable to set them as far away as possible from
25 the ink supply means in order to hinder its effects
and to enhance the positioning accuracy. It is good
enough to select convenient positions on the surface

1 opposite to where ink jet head 6101 and ink tank 6102
are coupled. The selection of the position where the
detachment blocking members are arranged requires a
consideration for an easier releasing of the coupling
5 in addition to the same views as described above.

The positioning pins and detachment blocking members
shown in Figs. 60A and 60B are merely one embodiment,
respectively, and are not intended to be confined
thereto.

10 The configurations of the ink supply barrel
6104 and ink supply outlet 6103 are not necessarily
the constituents of the present invention, and can be
selected arbitrarily. It is preferable, however,
to form a cylindrical protrusion and an opposing
15 recess from the viewpoint of preventing ink leakage.

Fig. 60B is a cross-sectional view taken along
line X - X (shown in the ink tank 6102) after the ink
cartridge 6101 and ink tank 6102 are coupled and
illustrates the coupling states of positioning means
20 6106 and 6108 arranged on both members, respectively,
and of the detachment blocking members 6109 and 6111.
In this respect, a reference numeral 6115 designates
an ink chamber.

Fig. 61 illustrates still another embodiment.

25 As far as an appropriate ink supply passage
can be formed in a carriage 6301, it may be possible
to use the carriage 6301 for positioning the ink jet

1 head 6302 and ink tank 6303 by arranging a coupling
between the ink jet head 6302 and carriage 6301 and
a coupling between the ink tank 6303 and carriage 6301
in place of using the head cartridge of a type where
5 an ink jet head and ink tank are coupled as in the
embodiment described in Figs. 60A and 60B.

In this case, too, the ink supply barrels 6308
and 6309 which are interrelatedly conductive to each
other are not used for positioning. For the carriage
10 6301, members 6304, 6405, 6306, and 6307 are provided
dedicatedly for positioning only. Meanwhile, a
structure is arranged to provide opposing recesses on
the ink jet head 6302 and ink tank 6303. Hence, it
becomes possible to position the ink jet head and ink
15 tank accurately, although the ink supply barrels are
formed cylindrical with a desirable tightness.

The ink jet head 6302 and ink tank 6303 are
formed by resilient materials, respectively, and the
detachment blocking members' 6310, 6311, 6312, and
20 6313 are detachably coupled to the recesses 6314, 6315,
6316, and 6317 of the carriage 6301.

Figs. 62 to 65 illustrate still another
embodiment. Fig. 62 is a schematically perspective
view showing an ink tank itself. Fig. 63 is a
25 schematically perspective view showing the state
where a recording head is installed on a carriage
before the ink tank is mounted on the carriage.

- 1 Fig. 64 is a schematically perspective view showing
the recording head, ink tank, and carriage before the
ink tank is attached to the recording head. Fig. 65
is a schematically perspective view showing the
5 state where the ink tank is attached to the recording
head installed on the carriage.

In Figs. 62 and 63, a reference numeral 7026
designates an ink tank containing ink in it. Ink is
supplied to the recording head 7004 from the ink supply
10 nozzle 7005 of the recording head 7004 through the
hole 7028 of the ink tank 7026. Also, the recording
head 7004 is detachably coupled to the hole 7021 of
the carriage 7020 by a means which is not shown.
Here, the scanning direction of the carriage 7020 is
15 such as indicated by an arrow S in Fig. 62 while the
ink ejection direction of the recording head 7004 to
a recording medium is such as indicated by an arrow
T in Fig. 62. A reference numeral 7027 designates
grooves provided for the ink tank 7026 to prevent any
20 erroneous tank installation, which engage with the
bosses 7025 arranged on the carriage lever 7024
rotatively mounted in the upper holes 7023 of the
arms 7022 which are provided on both sides of the
carriage 7020.

- 25 An operator installs the ink tank 7026 so that
the grooves 7027 of the ink tank 7026 engage with the
bosses 7025 while the carriage lever 7024 is held up

1 when the ink tank 7026 is attached to the recording
head 7004 (Fig. 64).

5 In this case, if the ink tank 7026 happens to
be upside down or inside out, that is, directions
other than the normal direction, when it is installed
on the carriage 7020, the bosses and grooves 7027 are
not matched and even the installation on the carriage
7020 is impossible.

10 Subsequently, the carriage lever 7024 is
held down in the direction indicated by an arrow A.
In this way, the ink tank 7026 is allowed to shift
in the direction approaching the recording head
7004 (indicated by an arrow B). The ink supply nozzle
7005 of the recording head 7004 is coupled to the
15 hole 7028 of the ink tank 7026 to complete the
installation of the ink tank 7026. At this juncture,
a stopper 7029 provided for the carriage lever 7024
is allowed to butt the carriage 7024 (Fig. 65).

20 As described above, the grooves 7027 are
provided as shown in Fig. 62 in the position apart
from the center of the ink tank 7026 while the
bosses 7025 which engage with the grooves 7027 are
provided on the carriage 7020. Hence, it becomes
possible to prevent any erroneous installation of
25 the ink tank 7026 on the carriage 7020.

Also, in the present embodiment, the bosses
7025 are provided for the carriage lever 7024, but the

1 bosses 7025 are not necessarily limited to that shape,
if only these are in a protruded shape.

Figs. 66 to 69 illustrate still another
embodiment. Fig. 66 is a schematically perspective
5 view showing an ink tank itself. Fig. 67 is a
schematically perspective view showing the state
where a recording head is installed on a carriage
before the ink tank is mounted on the carriage. Fig.
68 is a schematically perspective view showing the
10 recording head, ink tank, and carriage before the ink
tank is attached to the recording head. Fig. 69 is a
schematically perspective view showing the state where
the ink tank is attached to the recording head
installed on the carriage.

15 In Figs. 66 and 67, a reference numeral 7036
designates an ink tank containing ink in it. Ink is
supplied to the recording head 7004 from the ink
supply nozzle 7005 of the recording head 7004 through
the hole 7038 of the ink tank 7036. Also, the
20 recording head 7004 is detachably coupled to the
hole 7021 of the carriage 7020 by a means which is
not shown. A reference numeral 7037 designates
grooves provided for the ink tank 7036 which engage
with the bosses 7025 arranged on the carriage lever
25 7024 rotatively mounted in the upper holes 7023 of
the arms 7022 which are provided on both sides of the
carriage 7020.

1 An operator installs the ink tank 7036 so that
the wall 7039 of the ink tank 7036 can be placed on
the recording head 7004 side, and also the grooves
7037 engage with bosses 7025 while the carriage lever
5 7024 is held up when the ink tank 7036 is attached to
the recording head 7004 (Fig. 68). In this case, if
the ink tank 7036 happens to be upside down or inside
out, that is, directions other than the normal
direction, when it is installed on the carriage 7020,
10 the wall 7039 is blocked by the recording head 7004
or the bosses 7025 are not matched with the position
of the grooves 7037, and even the installation on the
carriage 7020 is impossible.

Subsequently, the carriage lever 7024 is held
15 down in the direction indicated by arrow A. Thus, the
ink tank 7036 is shifted in the direction approaching
the recording head 7004 (direction indicated by an
arrow B), and the ink supply nozzle 7005 of the
recording head 7004 is coupled to the hole 7038 of
20 the ink tank 7036 to complete the installation of
the ink tank 7036 (Fig. 69).

As described above, the wall 7039 is provided
at the end portion of the ink tank 7036 and further,
the grooves 7037 are provide away from the center of
25 the ink tank 7036 while the bosses 7025 which engage
with the grooves 7037 are provided on the carriage
7020. Hence, it becomes possible to prevent any

1 erroneous installation of the ink tank 7036 on the
carriage 7020.

Also, in the present embodiment, the bosses
7025 are provided for the carriage lower 7024, but the
5 bosses 7025 are not necessarily limited to that shape,
if only these are in a protruded shape.

Figs. 70 to 73 illustrate still another
embodiment. Fig. 70 is a schematically perspective
view showing an ink tank itself. Fig. 71 is a side
10 view schematically showing the ink tank viewed in the
direction indicated by an arrow C in Fig. 70. Fig.
72 is a schematically perspective view showing the
state where a recording head is installed on a carrier
before the ink tank is mounted on the carriage. Fig.
15 73 is a schematically perspective view showing the
state where the ink tank is attached to the recording
head installed on the carriage.

In Figs. 70, 71, and 72, a reference numeral
7046 designates an ink tank containing ink in it.
20 Ink is supplied to the recording head 7004 from the
ink supply nozzle 7005 of the recording head 7004
through the hole 7048 of the ink tank 7046. Also,
the recording head 7004 is detachably coupled to the
hole 7041 of the carriage 7040 by a means which is
25 not shown. A reference numeral 7042 designates an ink
tank installation guide provided for the carriage
7042, and also 7047, a rib to prevent the erroneous

1 installation of the ink tank 7047.

An operator inserts the ink tank 7046 into the guide 7042 of the carriage 7040 in the direction indicated by an arrow D in Fig. 72 from the hole 7048 so as
5 to match the direction (E) in which no rib 7047 is present for the ink tank 7046 with the portion F of the carriage 7040 when the ink tank 7046 is attached to the recording head 7004. The ink tank is inserted until
10 the rib 7047 of the ink tank 7046 is allowed to butt the edge 7043 of the guide 7042 of the carriage 7040. Thus, the ink supply nozzle 7005 of the recording head 7004 is coupled to the hole 7048 of the ink tank 7046 to complete the ink tank installation (Fig. 73).

In this case, if the ink tank 7046 happens to
15 be upside down or inside out, that is, in the directions other than the one regulated, when it is mounted on the carriage 7040, the rib 7047 stands in the way so that the carriage 7040 cannot be inserted into the guide 7042; thus disabling the installation.

20 As described above, the rib 7047 is arranged at the end of the ink tank 7046 for the provision of the guide 7042 on the carriage 7040 thereby to prevent the ink tank 7046 from being incorrectly mounted on the carriage 7040.

25 Figs. 74 to 76 illustrate still another embodiment. Fig. 74 is a schematically perspective view showing an ink tank itself. Fig. 75 is a

1 schematically perspective view showing the state where
a recording head is installed on a carriage before the
ink tank is mounted on the carriage. Fig. 76 is a
schematically perspective view showing the state where
5 the ink tank is attached to the recording head
installed on the carriage.

In Figs. 74 and 75, a reference numeral 7056
designates an ink tank containing ink in it. Ink
is supplied to the recording head 7004 from the ink
10 supply nozzle 7005 of the recording head 7004 through
the hole 7058 of the ink tank 7056. Also, the
recording head 7004 is detachably coupled to the
hole 7051 of the carriage 7050 by means which is not
shown. A reference numeral 7052 designates an ink
15 tank installation guide provided for the carriage
7050; 7057, a protrusion to prevent the ink tank
from being erroneously mounted; and 7053, a groove
provided for the carriage to prevent the ink tank
from being erroneously mounted.

20 When an operator mounts the ink tank 7056 on
the recording head 7004, the ink tank 7056 is
inserted into the guide 7052 of the carriage from the
hole 7058 in the direction indicated by an arrow D
in Fig. 75 so the protrusion 7057 of the ink tank
25 7056 and the groove 7053 of the carriage 7050 are
matched. The ink tank is inserted until the
protrusion 7057 butts the end of the groove 7053.

1 Thus, the ink supply nozzle 7005 of the recording
head 7004 and the hole 7058 of the ink tank 7056 are
coupled to compete the installation of the ink tank
7056 (Fig. 76).

5 In this case, if the ink tank 7056 happens
to be upside down or inside out or any other
directions than normally regulated, the ink tank
cannot be inserted into the guide 7052 of the carriage
7050 because it is blocked by the protrusion 7057;
10 disabling its installation.

As described above, it is thus possible to
prevent the ink tank 7056 from being installed
incorrectly into the carriage 7050 by providing the
protrusion for the ink tank 7056 as well as the
15 groove 7053 for the guide 7052 of the carriage 7050.

Fig. 77 illustrates, as another embodiment,
the state where a head cartridge 8002 is separated
from a recording head 8002a and ink tank 8002b.

In the present embodiment, the recording
20 head 8002a and ink tank 8002b are coupled in such a
manner that an ink supply tube 8002a4 formed in the
recording head 8002a to supply ink to the recording
head 8002a from the ink tank 8002b is coupled to
a seal ring 8002b4 provided for the ink tank 8002b
25 to prevent ink leakage by being fitted into the
foregoing ink supply tube 8002a4, and then locking
nails 8002b3 formed on the ink tank 8002b are

1 coupled to the receptacles 8002a3 provided for the
recording head 8002a to receive the foregoing locking
nails 8002b3. Reference numerals 8002a1 and 8002b1
designate the matching marks provided for the ink
5 tank 8002b to indicate a correct position of the
inserting amount when being coupled; 8002a2 and
8002b2, marks provided for the recording head 8002a
and ink tank 8002b, respectively, to indicate the
direction in which these are coupled and are arranged
10 in stripes of different colors from the recording
head 8002a and ink tank 8002b, lines engraved, or the
like to facilitate discriminating the coupling
direction of the recording head 8002a and ink tank
8002b when separated; 8002a5, a contact to make
15 electrical connection between the carrier 8001 and
recording head 8002a when the head cartridge 8002 is
mounted on the carrier 8001; and 8002b5, a receptacle
for a lock lever (to be described later) to fix the
head cartridge 8002 to the carrier when the head
20 carriage 8002 is mounted on the carrier 8001.

Fig. 78 illustrates the state where the
recording head 8002a and ink tank 8002b are on the
way to be coupled.

When the ink tank 8002b is being inserted
25 into the recording head 8002a, a load is more
increased in pressing it where the locking nails
8002b3 butt the locking nail receptacles 8002a3.

1 However, in this state, the matching marks 8002a1 and
8002b1 are still displaced. Thus, an operator can
recognize that the coupling is still incomplete.

5 When the ink tank 8002b is further pressed,
the arms of the locking nails 8002b3 are bent to
climb over the receptacles 8002a3 to allow them to
be joined correctly. Then, the matching marks
8002a1 and 8002b1 are matched. Fig. 79 illustrates
this state.

10 Fig. 80 illustrates the state where the head
cartridge 8002 is mounted on the carrier. Here, the
recording head 8002a and ink tank 8002b are not
particularly coupled securely. There is still a
space between them in such a coupling state of the
15 head cartridge 8002 shown in Fig. 80. In the present
embodiment, a correct installation is possible even
in such a state as this.

20 In Fig. 80, there are provided for the
carrier 8001 an electrical contact 8001a to make
electrical connection with the recording head 8002a;
a resilient member 8001b made of rubber or the like
to give pressure needed for the electrical contact;
an operation lever 8001c to mount or demount the head
cartridge 8002; a cartridge locking lever 8001d to
25 fix the head cartridge to the carrier 8001; a lever
spring 8001e to bias the operation lever 8001c; a
push lever 8001f to support the head cartridge 8002

1 from the beneath; and an interlocking lever 800lg to
move the foregoing push lever 800lf. The four compo-
nents, the operation lever 800lc, cartridge locking
lever 800ld, push lever 800lf, and interlocking lever
5 800lg, are axially supported at a same point. The
three components, the operation lever 800lc, cartridge
locking lever 800ld, and interlocking lever 800lg,
are interlockingly fixed and operated in synchronism
while the movement of the operation lever 800lc is
10 transferred to the push lever 800lf through the
interlocking lever 800lg.

When there is no cartridge 8002 on the
carrier 8001, the above-mentioned levers are biased
by the lever spring 800le in clockwise in Fig. 80.
15 The state shown in Fig. 80 is such that the head
cartridge is mounted under this condition. From this
state, the operation lever 800lc is rotated in the
direction indicated by an arrow c. Then, the
leading end of the push lever 800lf is lowered to
20 cause the head cartridge 8002 to be lowered likewise.
As the operation lever 800lc is further rotated, the
interlocking lever 800lg is parted from the push lever
800lf and is no longer rotated; thus the state
becoming as represented in Fig. 81. When the operation
25 lever 800lc is further rotated, the cartridge locking
lever 800ld begins to push the ink tank 8002b. Here,
even if there is a space due to incomplete coupling

1 of the recording head 8002a and ink tank 8002b, the
ink tank is pressed by the cartridge locking lever
8001d in the mounting direction. Hence, ultimately,
the recording head 8002a and ink tank 8002b are
5 completely coupled as far as the head cartridge 8002
is mounted on the carrier 8001.

Fig. 81 illustrates the state where the head
cartridge 8002 is fixed to the carrier. From this
state, when the operation lever 8001c is rotated in
10 counterclockwise, the leading end of the cartridge
locking lever 8001d reaches the lower side of the
rotational center of the lever (Fig. 82). Thus, by
the force exerted by the resilient member 8001b, the
cartridge locking lever 8001d is further pressed in
15 counterclockwise against the force exerted by the
lever spring 8001e. Thus, the cartridge locking
lever 8001d becomes locked.

Now, as still another embodiment, the
description will be made of a case where the coupling
20 indication marks are provided for a type which stores
an ink tank in a recording head housing. Fig. 83 is a
schematically perspective view illustrating a
recording head and ink tank according to the present
embodiment. Fig. 84 is a plan view. In Fig. 83, a
25 reference numeral 8200 designates a recording head and
8220, an ink tank. For the foregoing recording head
8200 there are provided a nozzle unit 8201 to eject

1 ink droplets; a supply tube 8202 to receive the ink
supply from an ink tank 8220; a window 8203 to examine
matching marks; matching marks 8204; finger stays 8205
for the removal of ink tank 8220; and locking nails
5 8206 to fix the ink tank 8220. For the foregoing ink
tank 8220 there are provided matching lines 8221;
finger stays 8222 for installation use; an ink supply
outlet to supply ink to the foregoing recording head
8200; and receptacles 8224 to receive the foregoing
10 locking nails 8206.

The coupling of the ink tank 8220 is conducted
by inserting the ink tank in the direction indicated
by an arrow.

As shown in the left-hand side in Fig. 84,
15 when the ink tank 8220 is inserted into the correct
position, the matching mark 8204 of the recording
head 8200 and the matching line 8221 of the ink tank
8220 are matched. Hence, it is easy to discriminate
whether the installation is correctly conducted or
20 not. If the installation is incorrect, the matching
mark 8204 and matching line 8221 are displaced as
shown in the right-hand side in Fig. 83. Since the
examination window 8203 is diagonally provided with
respect to the installation direction, even a slight
25 displacement in the installation direction is
emphatically indicated so as to make discrimination
easier.

1 As still another embodiment, Fig. 85
illustrates a case where a click is provided for the
coupling of a head cartridge and carrier in a mode
that an ink tank is stored in the recording head
5 housing. Fig. 85 is a schematically perspective view
showing a recording head and ink tank according to the
present embodiment. For each element which has the
same function as above, the same reference mark is
provided in the corresponding location, and the
10 description thereof will be omitted.

 In Fig. 85, the ink tank 8002b is installed in
the direction indicated by an arrow A with respect to
the recording head 8002a, and these are coupled by
clicking of the nails 8002a6 arranged in two locations
15 on the recurrent head side and the receptacles 8002a6
on the ink tank side. The recording head 8002a is
installed in the direction indicated by an arrow B
which is the same as the direction indicated by the
arrow A with respect to the carrier 8001 and is
20 coupled thereto by clicking of a spring 8001h and a
receiving portion 8002a7. The ink tank 8002b can be
replaced alone even in a state where the recording
head 8002a is coupled to the carrier 8001, but since
the ink tank 8002b and recording head 8002a are
25 mounted or demounted in the same direction, the
strength of the click for coupling for the ink tank
8002b should be set weaker than that of the click for

1 coupling the recording head 8002a. In this way, when
only the ink tank 8002b is replaced, it is possible
to prevent the recording head 8002a from being
removed together with the ink tank by mistake.

5 Also, as shown in Fig. 86, the installation
direction of the recording head 8002a and that of the
ink tank 8002b are made different. As a result, it
becomes possible to reliably conduct the installations
of the ink tank and recording head separately.

10 In Fig. 86, although the way to couple the
ink tank 8002b and recording head 8002a are the same
as the case described in conjunction with Fig. 85,
the directions in which the recording head 8002a and
carrier 8001 are coupled are different. In order
15 to couple the recording head 8002a to the carrier
8001, the recording head 8002a must be slight
displaced at first before being mounted on the
carrier 8001. If the amount of such a displacement
is not enough, a pin 8002a9 is caused to butt a slop
20 8001n provided for the carrier to displace the
recording head 8002a in the horizontal direction, at
the same time preventing the intervention of the
nails 8001m and receptacles 8002a8. When the
recording head 8002a is mounted on the carrier as
25 indicated by an arrow D, it is shifted in the
horizontal direction to complete the installation by
clicking of the nails 8001m on the carrier side and the

1 receptacles 8002a8 on the recording head side.

As shown in Fig. 87, the recording head 9002a and ink tank 9002b are coupled by inserting a connecting rod 9002d into a connecting hole 9002e.

5 The connection and separation operations are executed on the carrier 9001a by lever and the like provided for the carrier. Here, the description and representation of such operations by a drawing will be omitted.

10 Usually, the ink jet cartridge 9002 with the recording head 9002a and ink tank 9002b being coupled is mounted on a carrier to operate printing. A reference numeral 9043 designates an absorbent according to the present invention and is made of a
15 high molecular polymer or the like. It is adhesively arranged on the carrier by a double coated adhesive tape or the like so that the absorbent is placed beneath the coupling portion of the connecting rod 9002d and connection hole 9002e, that is, it is
20 provided in the vicinity of the coupling portion of the recording head and ink tank. Therefore, when the recording head 9002a and ink tank 9002b are separated, the absorbent 9043 receives ink dropping from the outer periphery of the connecting rod 9002d
25 and the end of the connecting hole 9002e and holds such ink droplets to prevent them from flowing outside. Here, the vicinity of the coupling portion

1 means in the present invention that the area including
the coupling portion and its vicinity where ink leakage
or ink scattering takes place when the recording head
and ink tank are separated.

5 Now, still another embodiment will be described.

As shown in Fig. 88, a groove 9001b is provided
beneath the coupling portion of the connecting rod
9002d and connection hole 9002e for the carrier 9001.
The present embodiment is effective when the absorbent
10 9043 shown in the embodiment described in conjunction
with Fig. 87 cannot be placed at a desired location.
With the present embodiment, it is possible to
allow the absorbent 9043 to be adhesively arranged at
an arbitrary position. At first, ink dropping from
15 the coupling portion is received by the groove 9001b,
and by capillary phenomenon, it flows along the
groove 9001b. Ultimately, it reaches the absorbent
9043 adhering to the trailing end of the groove and
then held there.

20 Subsequently, still another embodiment will
be described.

As shown in Fig. 89, the absorbent 9043 is
arranged adhere to the recording head 9002a. Also,
in Fig. 90, the absorbent 9043 is fitted around the
25 outer periphery of the connecting rod 9002d and pressed
onto the ink tank 9002c side by a compression spring
9044. Thus, when separated, it is removed from the

1 connecting rod 9002d while absorbing ink existing on
the outer periphery of the connecting rod 9002d.
Further, a groove is provided for at least one of
the recording head 9002a and ink tank 9002c; thus
5 arranging a structure which can bring about the same
effect as the embodiment described in conjunction with
Fig. 88.

Subsequently, another embodiment will be
described.

10 As shown in Fig. 91, the present embodiment is
such that the absorbent in the embodiment described in
conjunction with Fig. 87 is arranged on the ink tank
side.

Now, still another embodiment will be described.

15 As shown in Fig. 92, the present embodiment is
such that a water repellent treatment is given to the
connecting rod 9002d while a hydrophilic treatment is
given to the connecting hole 9002e. In the case, ink
does not adhere to the connecting rod 9002d to which
20 the water repellent treatment is given. It always
adheres to the ink hole 9002e where the hydrophilic
treatment is conducted. As a result, there will be
no ink leakage from inside the ink tank 9002c to the
outside.

25 Fig. 93 illustrates another embodiment and is a
block diagram showing a circuit to detect the ink tank
and ink amount using a detection terminal 9360 and

1 detection pin 9380. This circuit is provided in the
ink jet recording apparatus body, described earlier.

In Fig. 93, whether the ink tank is present and
also a sufficient amount of ink exists or not is
5 determined by the discriminating circuit 9300 on the
basis of the detection results of the current
detection circuit 9200 in accordance with the contact/
non-contact between the detection terminal 9360 and
detection pin 9380 as well as the existing amount of
10 ink as described above. The signals carrying the
detection results are transmitted to a control
circuit 9400. The control circuit 9400 is installed in
the ink tank 9900. If it is found that ink exists,
the usual recording operation such as driving of the
15 recording head will be conducted through the carriage
driving (driving circuit for this is not shown) and
recording head driving circuit 9500. On the other
hand, if the discriminating circuit 9300 detects no
ink. Then, the control circuit 9400 causes the
20 recording operation to be disabled.

Also, the control circuit 9400 causes an
indication device 9600 to indicate the results output
from the discriminating circuit 9300.

In this respect, according to the present
25 embodiment, the detection is conducted by two
detection pins 9380 to detect the presence of ink, but
it may be possible to detect the remaining amount of

1 ink by detecting the material value of ink using the
two detection pins 9380.

Also, in the present embodiment, the current
detection circuit 9200 and discriminating circuit
5 9300 are provided on the recording apparatus side,
but it may be possible to arrange them on the head
cartridge side.

In another embodiment the details of which are
shown in Fig. 94, the detection terminal 9360 to
10 detect the presence of the ink tank 9900 is arranged
on the carriage HC side. Hence, it becomes possible
to detect the presence of ink tank and ink as well in
accordance with the installation of the head cartridge
on the carriage HC.

15 As described above, each of the embodiments
is effective by itself, but it may be possible to
combine a plurality of these embodiments in order to
provide an ink jet recording apparatus having a
higher reliability.

20 In this respect, particularly among ink jet
recording methods, the present invention produces an
excellent effects on a recording head and recording
apparatus which creates change of state in ink with
means provided to generate thermal energy to be
25 utilized for ejecting ink (electrothermal transducers,
laser beam, or the like, for example).

Regarding the typical structure and operational

1 principle of such a method, it is preferable to adopt
those which can be implemented using the fundamental
principle disclosed in the specifications of U.S.
Patent Nos. 4,723,129 and 4,740,796. This method is
5 applicable to so-called on-demand type recording system
and a continuous type recording system. Particularly,
however, it is suitable for the on-demand type because
the principle is such that at least one driving signal,
which provides a rapid temperature rise beyond a
10 departure from nucleation boiling point in response
to recording information, is applied to an electro-
thermal transducer disposed on a liquid (ink)
retaining sheet or liquid passage whereby to cause
the electrothermal transducer to generate thermal
15 energy to produce film boiling on the thermoactive
portion of the recording head; thus effectively leading
to the resultant formation of a bubble in the recording
liquid (ink) one to one for each of the driving signals.
By the development and contraction of the bubble, the
20 liquid (ink) is ejected through a discharging port
to produce at least one droplet. The driving signal
is preferably in the form of pulses because the
development and contraction of the bubble can be
effectuated instantaneously, and, therefore, the
25 liquid (ink) is ejected with quick response.

The driving signal in the form of pulses is
preferably such as disclosed in the specifications of

1 U.S. Patent Nos. 4,463,359 and 4,345,262.

In addition, the temperature increasing rate of the heating surface is preferably such as disclosed in the specification of U.S. Patent No. 4,313,124 for
5 an excellent recording in a better condition.

The structure of the recording head may be as shown in each of the above-mentioned the specifications wherein the structure is arranged to combine the discharging ports, liquid passages, and the
10 electrothermal transducers as disclosed in the above-mentioned patents (linear type liquid passage or right angle liquid passage). Besides, the structure such as disclosed in the specifications of U.S. Patent Nos. 4,558,333 and 4,459,600 wherein the thermal
15 activation portions are arranged in a curved area is also included in the present invention.

In addition, the present invention is applicable to the structure disclosed in Japanese Laid-Open Application No. 59-123670 wherein a common slit is
20 used as the discharging ports for plural electrothermal transducers, and to the structure disclosed in Japanese Patent Laid-Open Application No. 59-138461 wherein an opening for absorbing pressure wave of the thermal energy is formed corresponding to the discharging
25 ports. In other words, according to the present invention, it becomes possible to operate the recording assuredly irrespective of the modes of the

1 recording head.

Furthermore, as a full line type recording head having a length corresponding to the maximum recording width, it may be possible to arrange a structure either by combining plural recording heads disclosed in the above-mentioned specifications or by a single recording head integrally constructed to cover such a length.

In addition, the present invention is applicable to a serial type recording head wherein the recording head is fixed on the main assembly, to a replaceable chip type recording head which is connected electrically with the main apparatus and can be supplied with ink when it is mounted in the main assemble, or to a cartridge type recording head having an intergral ink container.

Also, it is preferable to additionally provide recording head recovery means and preliminarily auxiliary means which are arranged as constituents of a recording apparatus according to the present invention. These elements will contribute to making the effectiveness of the present invention more stabilized. To name them specifically, such elements are capping means for the recording head, cleaning means, compression or suction means, preliminary heating means such as electrothermal transducers or heating elements other than such transducing type or

1 the combination of those types of elements, and the
preliminary ejection mode besides the regular
ejection for recording.

As regards the kind and number of the recording
5 heads mountable on the carriage, it may be a single
color ink, or may be plural heads corresponding to a
plurality of ink materials having different recording
color or density. The present invention is effectively
applicable to an apparatus having at least one of a
10 monochromatic mode mainly with black, a multi-color
mode with different color ink materials and/or a
full-color mode using the mixture of the colors, which
may be an integrally formed recording unit or a
combination of plural recording heads.

15 Now, in the embodiments, according to the
present invention set forth above, while the ink has
been described as liquid, it may be an ink material
which is solidified below the room temperature but
liquefied at the room temperature. Since the ink is
20 controlled within the temperature not lower than 30°C
and not higher than 70°C to stabilize its viscosity
for the provision of the stable ejection in general,
the ink may be such that it can be liquefied when
the applicable recording signals are given.

25 In addition, while preventing the temperature
rise due to the thermal energy by the positive use of
such energy as an energy consumed for changing states

1 of the ink from solid to liquid, or using the ink
which will be solidified when left intact for the
purpose of preventing ink evaporation, it may be
possible to apply to the present invention the use of
5 an ink having a nature of being liquefied only by the
application of thermal energy such as an ink capable
of being ejected as ink liquid by enabling itself to
be liquefied anyway when the thermal energy is given
in accordance with recording signals, an ink which
10 will have already begun solidifying itself by the time
it reaches a recording medium.

For an ink such as this, it may be possible
to retain the ink as a liquid or solid material in
through holes or recesses formed in a porous sheet
15 as disclosed in Japanese Patent Laid-Open Application No.
54-56847 or Japanese Patent Laid-Open Application No.
60-71260 in order to execute a mode whereby to enable
the ink to face the electrothermal transducers in such
a state.

20 For the present invention, the most effective
method for each of the above-mentioned ink materials is
the one which can implement the film boiling method
described above.

Furthermore, as modes of the foregoing ink jet
25 recording apparatus, a copying apparatus combined with
reader and the like or a facsimile apparatus having
transmission reception functions or the like may be

1 employed in addition to those used as an image output
terminal of an information processing apparatus such
as a computer.

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1 WHAT IS CLAIMED IS:

1. An ink jet recording apparatus comprising:
 - an ink tank containing ink;
 - a recording head for performing recording by
 - 5 selectively ejecting ink;
 - a mounting portion for mounting said ink tank
 - and said recording head;
 - a liquid passage coupling portion provided on
 - either or both of said ink tank and said recording for
 - 10 separating or connecting the ink passages in said ink
 - tank and said recording head;
 - a holding portion provided on either or both
 - of said ink tank and said recording head for guiding
 - said ink tank to said recording head to hold them
 - 15 separably;
 - an electrically connecting portion provided on
 - either or both of said recording head and said mounting
 - portion for electrically connecting said recording head
 - to or separating it from said mounting portion; and
 - 20 a mechanically connecting portion provided on
 - either or both of said recording head and said mounting
 - portion for mechanically connecting said recording head
 - to or separating it from said mounting portion.
2. An ink jet recording apparatus according to
- 25 Claim 1, wherein said ink tank can be attached or
- detached on said mounting portion.

1 3. An ink jet recording apparatus according to
Claim 1, wherein said ink tank can be attached or
detached on said mounting portion only when said
recording head is mounted.

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 4. An ink jet recording apparatus according to
Claim 1, wherein said recording head can be detached
only when said ink tank is mounted.

10 5. An ink jet recording apparatus according to
Claim 1, wherein said recording head can be attached or
detached only when said ink tank is mounted.

 6. An ink jet recording apparatus according to
15 Claim 1, wherein said recording head is coupled by
pressing said recording head to a carriage capable of
shifting said recording head in a given direction.

 7. An ink jet recording apparatus according to
20 Claim 1, wherein said recording head and carriage can
be electrically connected by pressing the recording
head.

 8. An ink jet recording apparatus according to
25 Claim 1, wherein said ink tank and recording head are
mounted on the carriage respectively by separate
means.

1 9. An ink jet recording apparatus according to
 Claim 1, wherein said liquid passage coupling portion
 has at least two different coupling directions.

5 10. An ink jet recording apparatus according to
 Claim 1, wherein said liquid passage coupling portion
 has at least two different directions, and the
 coupling direction is varied by the rotation of the
 periphery of said liquid-passage coupling portion.

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 11. An ink jet recording apparatus according to
 Claim 1, wherein said liquid passage coupling portion
 is provided in at least two locations or more on said
 recording head, and said ink tank is selectively
15 separated from or coupled to any one of such a
 location or plural locations.

 12. An ink jet recording apparatus according to
 Claim 1, wherein a member for attaching or detaching
20 said recording head to or from the carrier and for
 holding the head on the carrier is arranged on said
 recording head.

 13. An ink jet recording apparatus according to
25 Claim 1, wherein a member for attaching or detaching
 said ink tank to or from the carrier and for holding
 the ink tank on the carrier is arranged on said ink
 tank.

1 14. An ink jet recording apparatus according to
Claim 1, wherein an ink tank is held by a recording
head, and a member for attaching or detaching said ink
tank is arranged on said ink tank to attach or detach
5 said recording head and said ink tank to or from the
carrier, and further, a member for holding them on said
carrier is arranged on said recording head.

10 15. An ink jet recording apparatus according to
Claim 1, wherein means for regulating the direction
in which said ink tank approaches the recordnig head is
provided on said carriage.

15 16. An ink jet recording apparatus according to
Claim 1, wherein means for regulating the direction
in which said ink tank approaches the recording head
is provided on said ink tank.

20 17. An ink jet recording apparatus according
to Claim 1, wherein means for regulating the direction
in which said ink tank approaches the recording head
is provided on said carriage and ink tank.

25 18. An ink jet recording apparatus according
to Claim 1, wherein a coupling and positioning portion
is provided to indicate whether said recording head
and said ink tank are completely coupled or not.

1 19. An ink jet recording apparatus according to
Claim 1, wherein in the vicinity of said liquid passage
coupling portion, any one of or a combination of an
absorbent, groove, and hydrophilic or water repellent
5 portion is provided on said mounting portion for
preventing ink scattering.

 20. An ink jet recording apparatus according to
Claim 1, wherein in the vicinity of said liquid passage
10 coupling portion, any one of or a combination of an
absorbent, groove, and hydrophilic or water repellent
portion is provided on said recording head for
preventing ink scattering.

15 21. An ink jet recording apparatus according to
Claim 1, wherein in the vicinity of said liquid
passage coupling portion, any one of or a combination
of a absorbent, groove, and hydrophilic or water
repellent portion is provided on said ink tank for
20 preventing ink scattering.

 22. An ink jet recording apparatus according to
Claim 1, wherein said apparatus comprises:
 detecting means for detecting the installation
25 of said ink tank in said ink jet recording apparatus;
and

 controlling means for controlling the

1 recording operation of said ink jet recording apparatus
in accordance with the detected results of said
detecting means.

5 23. An ink jet recording apparatus according to
Claim 22, wherein said detecting means also serves to
detect the remaining amount of ink in said ink tank.

24. An ink jet recording apparatus according to
10 Claim 23, wherein indicating means is provided for
indicating the results detected by said detecting means.

25. An ink jet recording apparatus according to
Claim 23, wherein said controlling
15 means is structured to disable the recording operation
when said ink tank is not installed in said ink jet
recording apparatus.

26. An ink jet recording apparatus according to
20 any one of Claims 1 to 25, wherein said recording head
generates bubbles by utilizing thermal energy and eject
ink on the basis of the development of said bubbles.

27. A method for installing an ink jet recording
25 head for performing recording on a recording medium,
wherein the electrical connection of said recording
head is pressed against an electrically connecting

1 portion for mounting a head cartridge to which a
recording head and ink tank separable from each other
are coupled to enable ink supply, and said recording
head is installed on said carriage.

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28. A method for installing an ink jet recording
head according to Claim 27, wherein said ink jet
recording head ejects ink to perform recording by
utilizing film boiling generated by thermal energy
10 generated by electrothermal transducers by energizing
said electrothermal transducers in accordance with
signals.

29. A cartridge for ink jet recording apparatus
15 including a detachable recording head connectable
directly to an ink cartridge.

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