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(54) CLEANING METHOD AND CLEANING UNIT OF INK EJECTION SECTION, AND IMAGE FORMING APPARATUS

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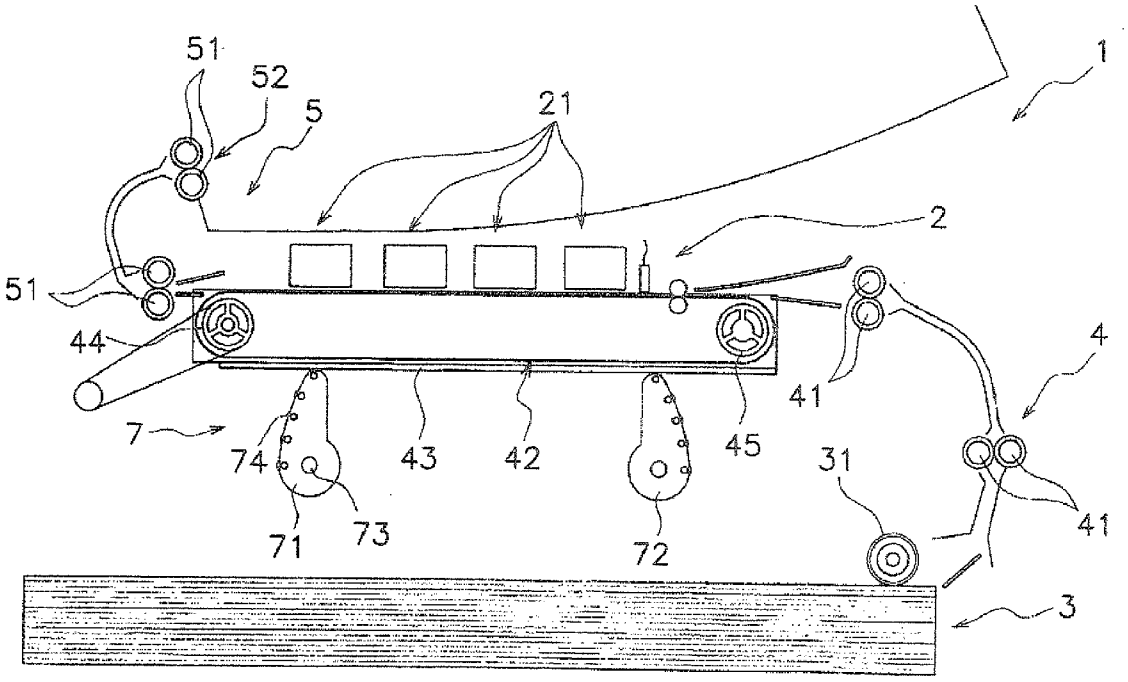
(57) **ABSTRACT**

A method of cleaning an ink ejection section in an image forming apparatus that forms an image by ejecting an ink from the ink ejection section. The method includes the steps of: an ink wiping step for wiping off the ink on the surface of the ink ejection section; a first cleaning step for cleaning the surface of the ink ejection section with a water-soluble organic solvent; a second cleaning step for cleaning with water the surface of the ink ejection section cleaned with the water-soluble organic solvent; and a liquid wiping step for wiping off the liquid on the surface of the ink ejection section cleaned through the second cleaning step.



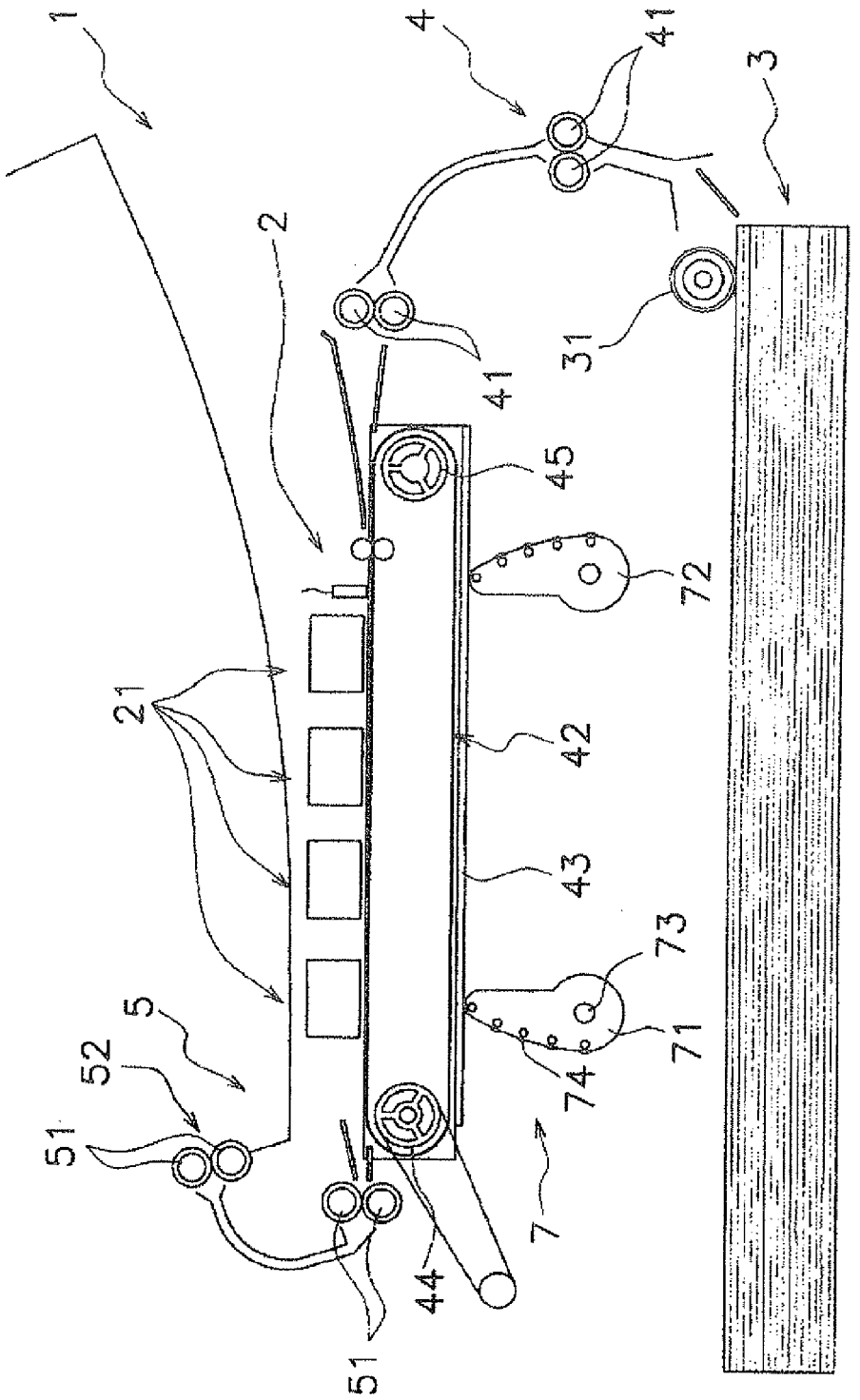
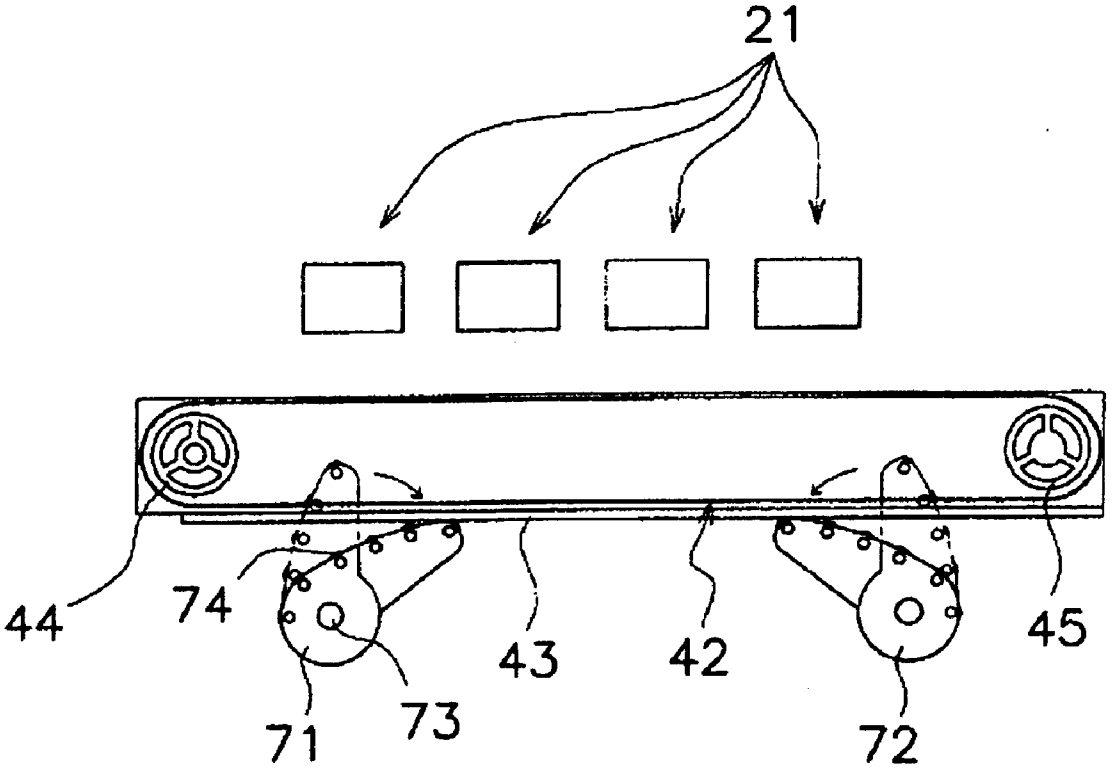


Fig. 1

Fig. 2



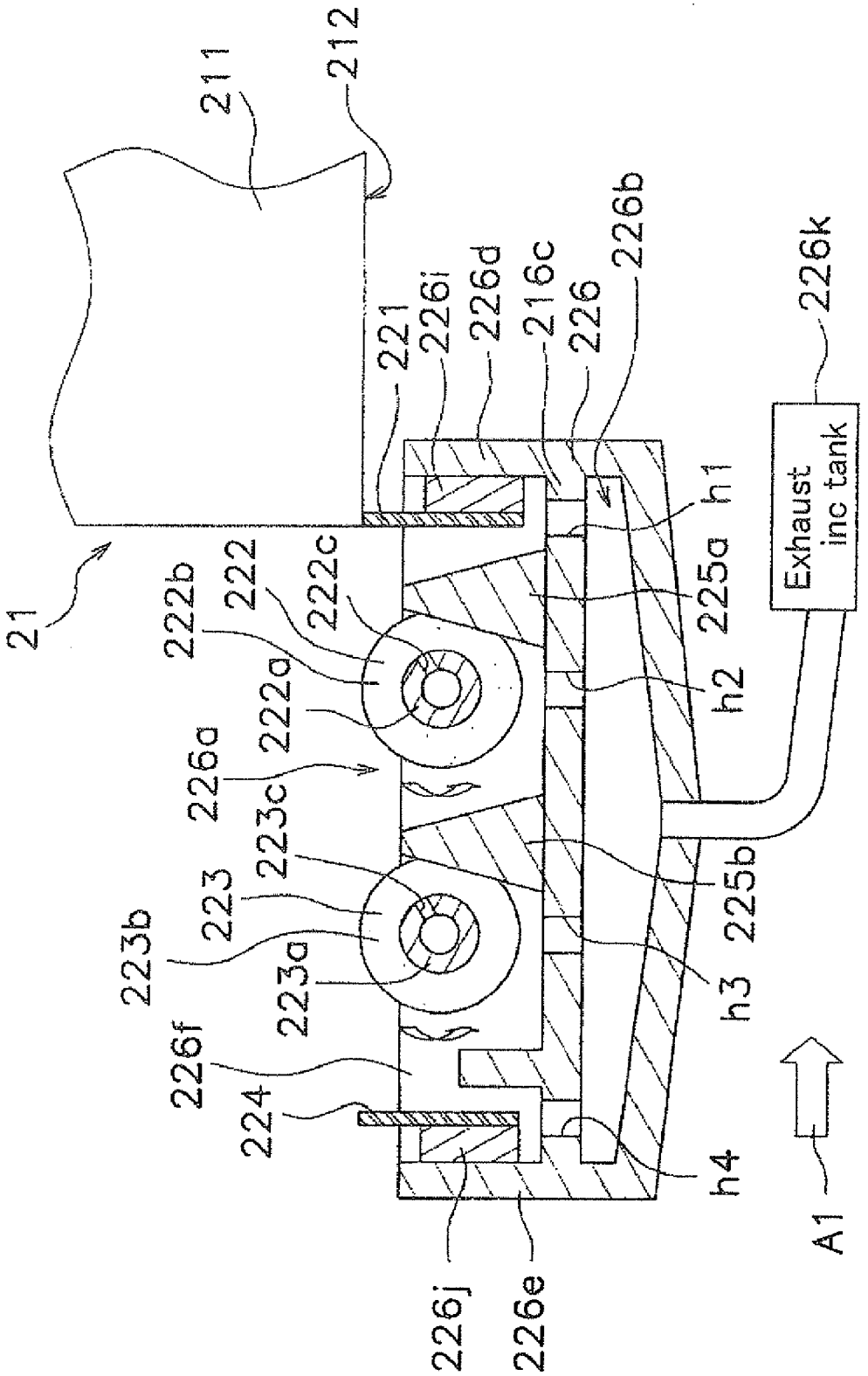

211
212
21
221
226i
226d
216c
226
226b
226k
Exhaust
inc tank
h1
225a
h2
225b
h3
h4
A1
222b
222
222c
222a
226a
223c
223
223b
223a
226f
224
226j
226e

Fig. 3

Fig. 4

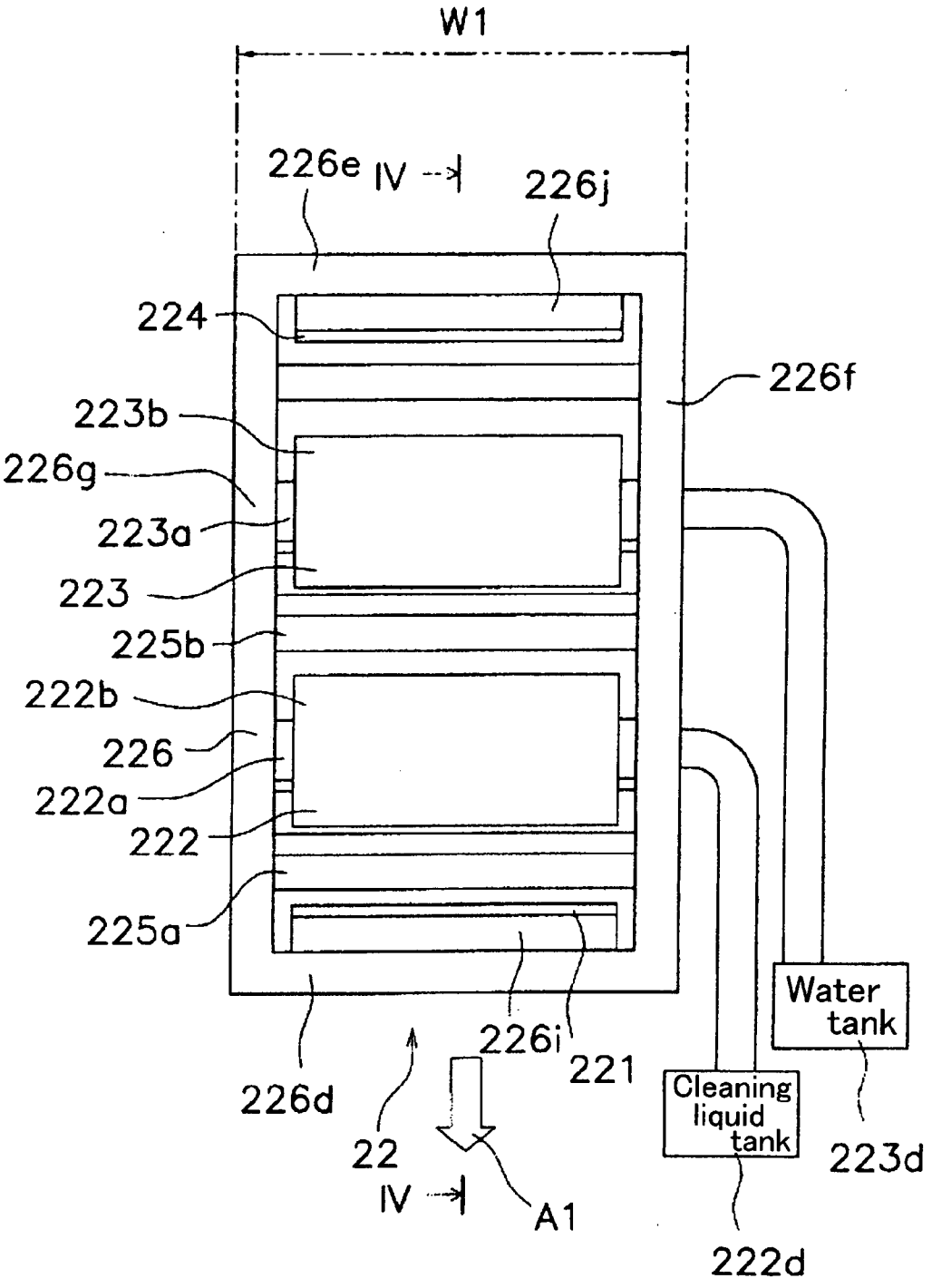
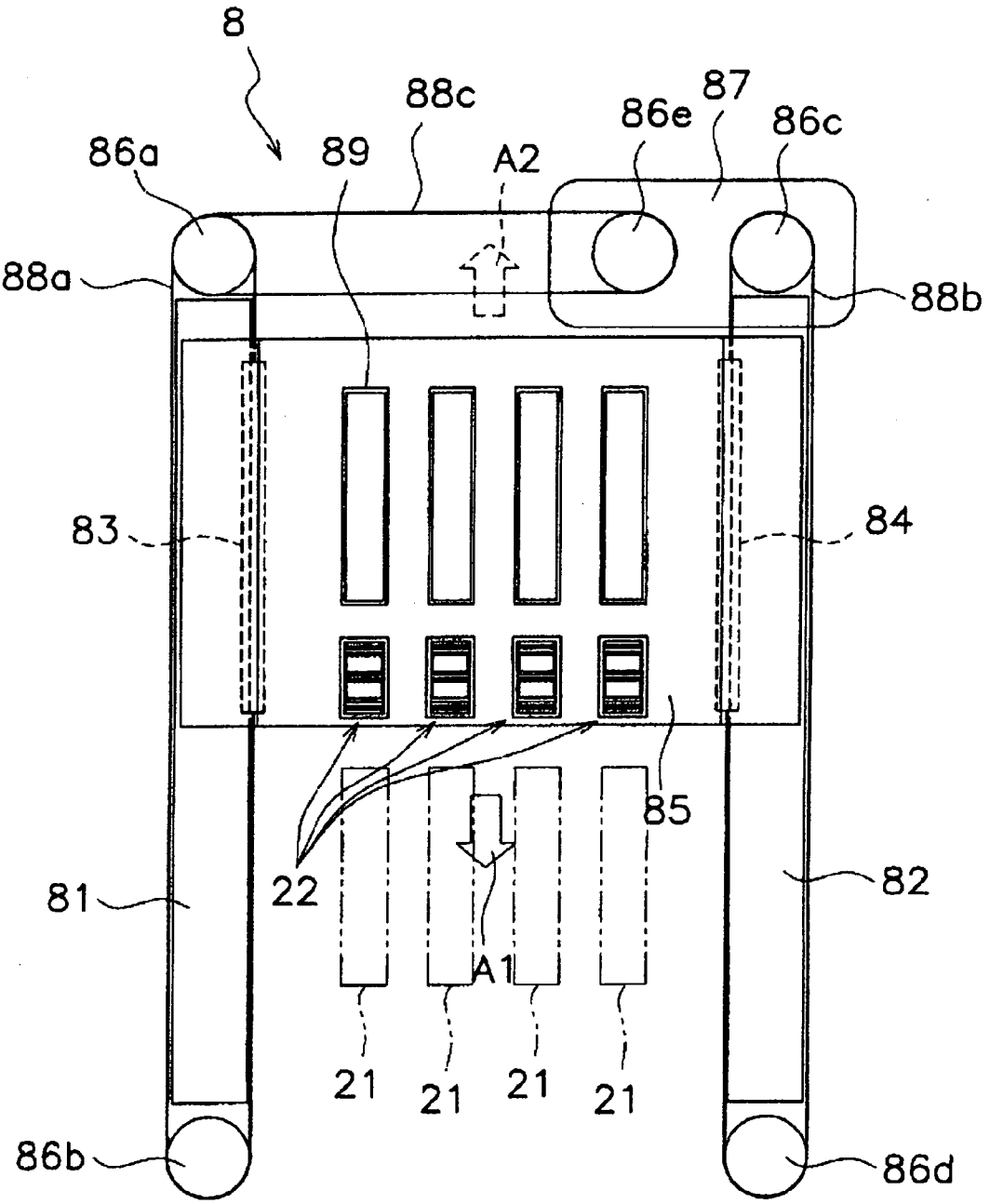
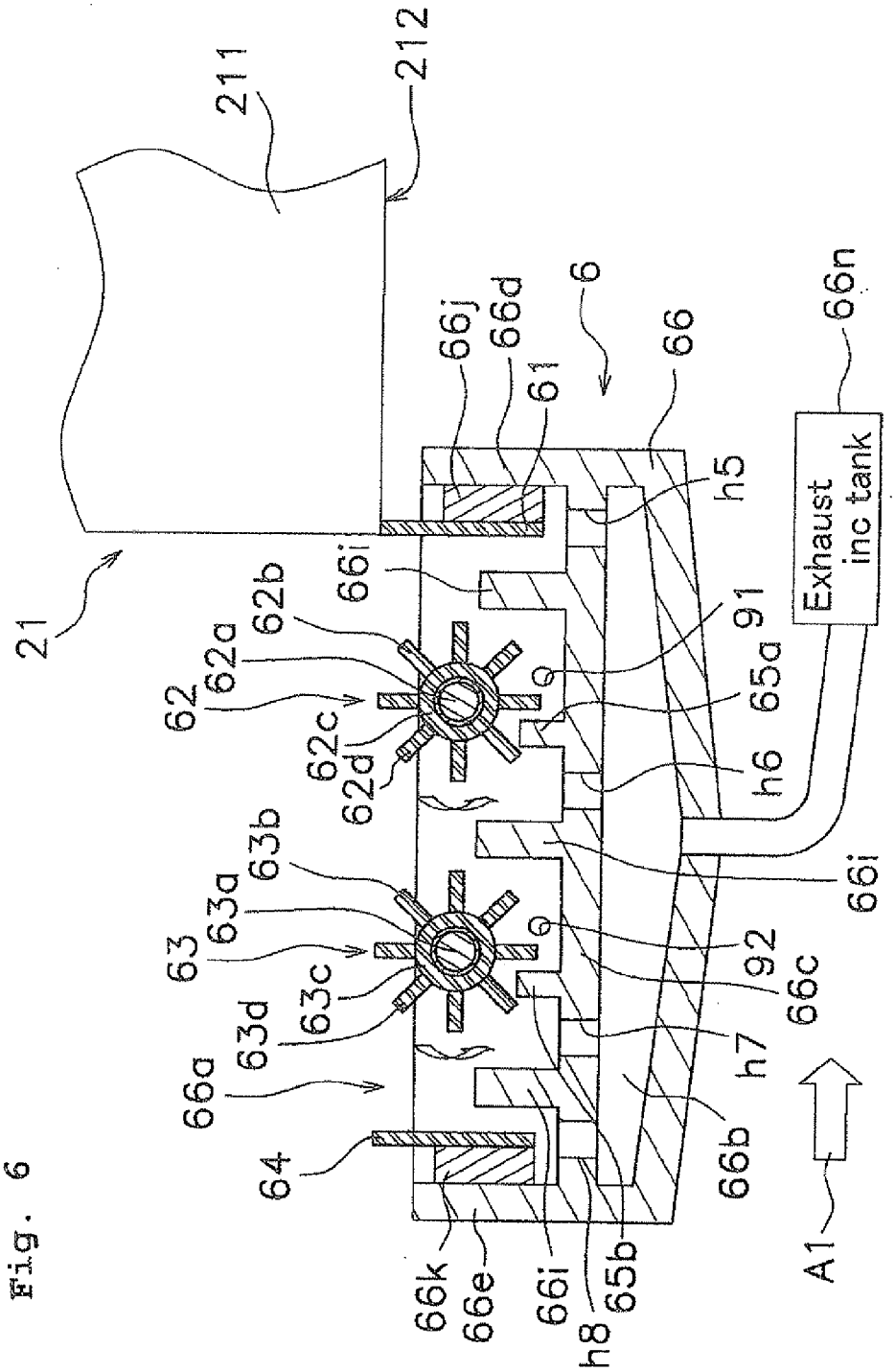

W1
226e
IV
IV
226j
224
226f
223b
226g
223a
223
225b
222b
226
222a
222
225a
226d
22
IV
226i
221
A1
Cleaning liquid tank
Water tank
223d
222d

Fig. 5


8
88c
87
86e
86c
86a
89
A2
88a
88b
83
84
85
22
81
82
A1
21
21
21
21
86b
86d


211
212
6
66j
66d
61
66
66n
Exhaust
inc tank
h5
21
66i
62b
62a
62
62c
62d
91
65a
h6
63b
63a
63
63c
63d
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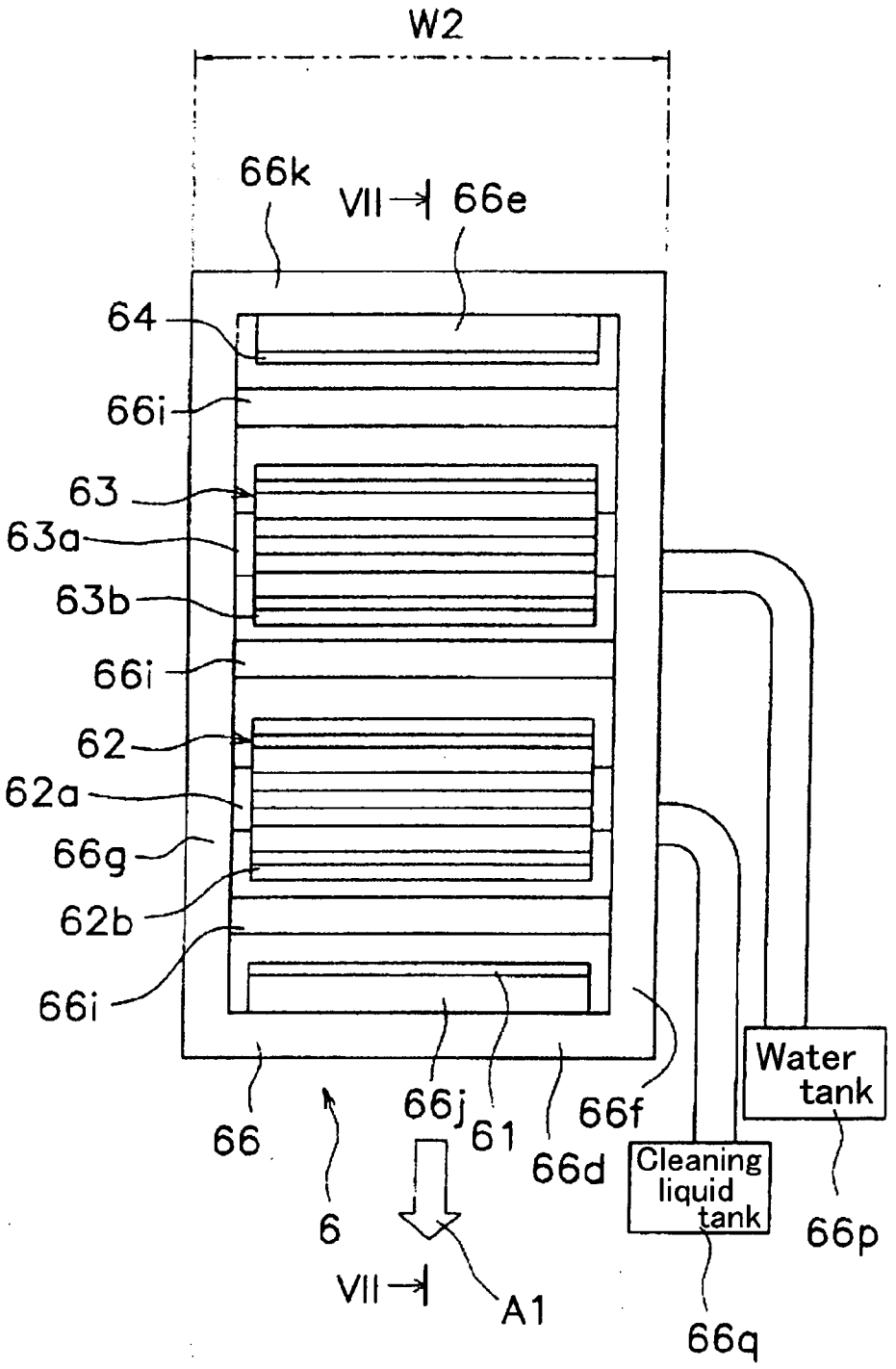
66c
h7
66a
64
66b
A1
66k
66e
66i
h8
65b

Fig. 6

Fig. 7


W2
66k
VII
66e
64
66i
63
63a
63b
66i
62
62a
66g
62b
66i
66
66j
61
66d
66f
Water tank
Cleaning liquid tank
66p
66q
6
VII
A1

CLEANING METHOD AND CLEANING UNIT OF INK EJECTION SECTION, AND IMAGE FORMING APPARATUS

[0001] Priority is claimed to Japanese Patent Application No. 2008-042635 filed on Feb. 25, 2008, the disclosure of which is incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a cleaning method and a cleaning unit of an ink ejection section in an image forming apparatus such as an inkjet color printer, and to an image forming apparatus.

[0004] 2. Description of Related Art

[0005] In image forming apparatuses, there are apparatuses of the type which forms an image on a paper by ejecting an ink onto a paper as a recording medium, such as inkjet color printers. These image forming apparatuses are provided with an image formation section capable of forming an image, a paper storage section to store a paper whose surface is used for image formation, a paper transport section to transport a paper to the image formation section, and a paper discharge section capable of discharging a paper with an image formed on the surface thereof. In these image forming apparatuses, the paper stored in the paper storage section is transported to the image formation section by the paper transport section, and the image based on image information is formed on the paper. The paper after being subjected to the image formation by the image formation section is then discharged into the paper discharge section.

[0006] Specifically, the image formation section has an ink ejection section capable of ejecting an ink onto a paper, and a cleaning unit to clean the ink ejection section as shown in, for example, Japanese Unexamined Patent Application Publication No. 2002-361879. During an image forming operation, the ink is ejected onto a paper from the ink ejection section, and the ink ejection section is cleaned by the cleaning unit. This cleaning unit is provided with a cleaning blade formed by an elastic material, and a wet porous elastic body.

[0007] In the cleaning unit as described above, after the ink of the ink ejection section is absorbed by the porous elastic body, the surface of the ink ejection section is wiped off by the cleaning blade, that is, the moisture and the like at the ink ejection section are wiped off. However, if the ink cannot be completely absorbed by the porous elastic body, cleaning efficiency becomes poor, and the water repellency of the ink ejection section is deteriorated by the adhered and dried ink at the ink ejection section. Thus, the deteriorated water repellency of the ink ejection section leads to deterioration of image quality.

[0008] Also in a state in which the resin composition contained in the ink is adhered to the ink ejection section, image quality might also be deteriorated by the difficulty in controlling the ink ejection. Particularly in an elongated line head, because the amount of ink adhesion is larger than that of a serial head, there is a large possibility that image quality may be deteriorated due to insufficient ink removal. That is, the ink adheres to the ink ejection section and then dries there, so that the resin composition is solidified around an ink ejection hole provided at the ink ejection section. When the ink is ejected in this state, for example, the solidified resin composition and the ejected ink contact with each other, and the normal ink ejection may be hindered to cause image quality deterioration.

SUMMARY OF THE INVENTION

[0009] An advantage of the present invention is to provide a cleaning method and a cleaning unit of an ink ejection section, and an image forming apparatus which are capable of efficiently removing the ink adhered to the ink ejection section and improving poor ink ejection.

[0010] The present invention is a method of cleaning an ink ejection section in an image forming apparatus that forms an image by ejecting an ink from the ink ejection section. The method includes an ink wiping step for wiping off the ink on the surface of the ink ejection section, a first cleaning step for cleaning the surface of the ink ejection section with a water-soluble organic solvent, a second cleaning step for cleaning with water the surface of the ink ejection section cleaned with the water-soluble organic solvent, and a liquid wiping step for wiping off the liquid on the surface of the ink ejection section cleaned through the second cleaning step.

[0011] Preferably, the water-soluble organic solvent has a solubility parameter (SP value) of 7 to 14. The term "solubility parameter" (unit: $(cal/cm^3)^{1/2}$) is a numerical value indicating the polarity of a material. A smaller SP value difference between a solute and a solvent produces a larger solubility.

[0012] According to the present invention, the ink solidified at the ink ejection section can be efficiently removed to enable improvement of poor ink ejection by wiping off the ink on the surface of the ink ejection section before the cleaning step, and further cleaning the surface of the ink ejection section with the water-soluble organic solvent. Additionally, the water repellency of the surface of the ink ejection section can be recovered to reduce image quality deterioration by cleaning and removing with water the water-soluble organic solvent remaining on the surface of the ink ejection section.

[0013] A cleaning unit of the present invention suitable for practicing the above cleaning method is shiftably mounted in an image forming apparatus provided with an ink ejection section having an ink ejection surface capable of ejecting an ink. The cleaning unit includes a first blade member for wiping off an ink contactable with the ink ejection surface, a first porous member impregnated with a water-soluble organic solvent, a second porous member impregnated with water, and a second blade member for wiping off liquid contactable with the ink ejection surface. The first blade member, the first porous member, the second porous member and the second blade member are arranged in the order named along the shift direction of the cleaning unit.

[0014] An image forming apparatus of the invention includes at least an image formation section provided with an ink ejection section having an ink ejection surface capable of ejecting an ink, and further includes the above cleaning unit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIG. **1** is a schematic front view of an image forming apparatus according to the invention;

[0016] FIG. **2** is an explanatory drawing showing the up and down movement of a transport belt by a lift unit;

[0017] FIG. **3** is a sectional view of a cleaning unit according to a first preferred embodiment of the invention;

[0018] FIG. **4** is a plan view of the cleaning unit in FIG. **3**;

[0019] FIG. **5** is a diagram showing the configuration of the shift mechanism of the cleaning unit;

[0020] FIG. **6** is a sectional view of a cleaning unit according to a second preferred embodiment of the invention; and

[0021] FIG. **7** is a plan view of the cleaning unit in FIG. **6**.

DESCRIPTION OF PREFERRED EMBODIMENTS

First Preferred Embodiment

<Image Forming Apparatus>

[0022] An inkjet printer **1** as an image forming apparatus according to the invention is shown in FIG. **1**. FIG. **1** is a schematic front view schematically showing the configuration of the inkjet printer **1**. The inkjet printer **1** is an apparatus which is connected to an external computer or the like (not shown), and capable of forming an image based on image information transmitted from the computer, and which is provided with an image formation section **2**, a paper storage section **3**, a paper transport section **4**, a lift unit **7** and a paper discharge section **5**.

[0023] The image formation section **2** forms an image based on image information, and has inkjet heads **21**. That is, the four inkjet heads **21** are arranged side by side above a later-described transport belt **42** of the paper transport section **4**, and they eject inks onto a paper based on the image information. These inkjet heads **21** store different color inks and have ink ejection sections **211** (refer to FIG. **3**) capable of ejecting the inks stored therein, respectively. These inkjet heads **21** are substantially rectangular parallelepiped-shaped members extending in one direction (a direction orthogonal to the paper surface in FIG. **1**). Each of these ink ejection sections **211** has an ink ejection surface **212** (refer to FIG. **3**) arranged oppositely to the paper, and is provided with a plurality of ink ejection holes arranged side by side. The ink ejection surface **212** has a rectangular shape extending long in the back-and-forth direction. The term "back-and-forth direction" means a direction perpendicular to the paper surface in FIG. **1**, and the near side and the rear side in the direction perpendicular to the paper surface in FIG. **1** are referred to as "the front" and "the rear," respectively.

[0024] The paper storage section **3** is capable of storing papers for image formation and arranged at a lower part of the inkjet printer **1**. The paper storage section **3** has a paper supply roller **31** for supplying papers to the paper transport section **4**, above the tip end on the paper supply side.

[0025] The paper transport section **4** transports the paper in the paper storage section **3** to the image formation section **2**, and also transports the paper with an image formed on the surface thereof to the discharge section **5**. The paper transport section **4** is provided with a plurality of rollers **41** for transporting a paper, and the transport belt **42**. The transport belt **42** is an endless belt underlying the inkjet heads **21**, and has on both ends thereof rollers **44** and **45** for circulating the transport belt **42**.

[0026] The lift unit **7** underlies the transport belt **42** of the paper transport section **4** and vertically lifts the transport belt **42**. The lift unit **7** has a pair of eccentric cams **71** and **72**. Specifically, the first eccentric cam **71** positioned leftward in FIG. **1** is provided rotatably around a shaft **73**, and rotationally driven by a motor (not shown). The first eccentric cam **71** is provided with a plurality of bearings **74**, and supports a belt support member **43** through these bearings **74**. In FIG. **1**, the reference numeral is applied only one of these bearings **74**, with others omitted. The second eccentric cam **72** positioned rightward in FIG. **1** has the same structure as the first eccentric cam **71**, and has a symmetrical shape with respect to the first eccentric cam **71** in the left-to-right direction in FIG. **6**.

[0027] FIG. **1** shows the state in which the transport belt **42** is ascended. From this state, the transport belt **42** is descended by the inward rotation of the pair of the eccentric cams **71** and **72** (refer to FIG. **2**). When the image formation section **2** forms an image on a paper, the lift unit **7** provides a suitable space for printing (approximately 1 mm in the present preferred embodiment) between the inkjet heads **21** and the paper by bringing the transport belt **42** into the ascent state shown in FIG. **1**. When removing a jam occurred on the transport belt **42**, and when later-described cleaning units **22** clean the inkjet heads **21**, the lift unit **7** provides a wide space between the inkjet heads **21** and the paper by bringing the transport belt **42** into the descent state shown in FIG. **2**.

[0028] The discharge section **5** discharges the paper with the image formed thereon by the image formation section **2**, and is arranged at the upper part of the inkjet printer **1**. The discharge section **5** is provided with a plurality of rollers **51**. The paper with the image formed thereon by the image formation section **2** is transported by the transport belt **42** of the paper transport section **4** and these rollers **51** of the discharge section **5**, and then discharged outside of the apparatus from a discharge port **52**.

<Cleaning Unit Configuration>

[0029] FIGS. **3** and **4** are the overall schematic diagrams of the cleaning unit **22**. FIG. **3** is a sectional view of the cleaning unit **22**, and FIG. **4** is a plan view thereof. The cleaning units **22** for cleaning the ink ejection surfaces **212** are shiftable in the longitudinal direction of the inkjet heads **21** (refer to an arrow A**1** in FIGS. **3** and **5**). During image formation, the cleaning units **22** are retreated outside of the longitudinal ends of the inkjet heads **21**, so as not to hinder the ink ejection. These cleaning units **22** are provided correspondingly to the individual inkjet heads **21**, and are connected to an exhaust ink tank **226***k*. Each of these cleaning units **22** has a casing **226** provided with a first blade member **221**, a cleaning liquid roller **222**, a water roller **223**, a second blade member **224** and restriction plates **225***a* and **225***b*, each of which is shifted in the direction of the arrow A**1** along the ink ejection surface **212** by a shift mechanism **8** shown in FIG. **5**.

[0030] The first blade member **221** wipes off the ink on the ink ejection surface **212**, which is a plate-shaped member extending in one direction (a direction orthogonal to the paper surface in FIG. **3**, namely, the transverse direction of the ink ejection surface **212**). The length of the first blade member **221** in the direction orthogonal to the paper surface in FIG. **3** is substantially the same as the transverse length of the ink ejection surface **212**. The first blade member **221** is arranged on the tip end in the shift direction of the casing **226**, and the upper tip end thereof is arranged at a slightly higher position than the ink ejection surface **212**. The first blade member **221** is formed by an elastic deformable material, such as EPDM or fluoro rubber, and arranged along the transverse direction of the ink ejection surface **212**.

[0031] The cleaning liquid roller **222** cleans the ink ejection surface **212** with a water-soluble organic solvent described later, which is arranged adjacent to the first blade member **221**, namely, arranged next to the first blade member **221** in the shift direction of the cashing **226**. The length of the cleaning liquid roller **222** in the direction orthogonal to the paper

surface in FIG. **3** (namely in the axial direction of the roller **222**) is substantially the same as the transverse length of the ink ejection surface **212**. The cleaning liquid roller **222** also has a cleaning liquid roller rotary shaft **222***a* and a first porous member **222***b*. The cleaning liquid roller rotary shaft **222***a* is a cylindrical hollow shaft member and extends in a direction orthogonal to the paper surface in FIG. **1**. The cleaning liquid roller rotary shaft **222***a* is capable of containing therein the water-soluble organic solvent, and connected to a cleaning liquid tank **222***d* containing the water-soluble organic solvent. The cleaning liquid roller rotary shaft **222***a* also has an axially extending cleaning liquid admitting slit **222***c* (except for both ends of the rotary shaft), enabling the cleaning liquid therein to be supplied to the first porous member **222***b*. Instead of the cleaning liquid admitting slit **222***c*, a plurality of fine holes may be provided at the cleaning liquid roller rotary shaft **222***a*. The cleaning liquid roller rotary shaft **222***a* is fixed to the casing **226**. The first porous member **222***b* is a porous member, such as a sponge, arranged around the cleaning liquid roller rotary shaft **222***a*. The first porous member **222***b* is arranged so that the uppermost position in the height position thereof is substantially the same as the height position of the tip end of the first blade member **221**. The first porous member **222***b* is rotatable with respect to the cleaning liquid roller rotary shaft **222***a*, and rotates counterclockwise in FIG. **1** upon the shift of the cleaning unit **22** so as to bring the first porous member **222***b* into contact with the ink ejection surface **212**. Alternatively, the cleaning liquid admitting slit **222***c* may be replaced with a plurality of through-holes.

[0032] The water roller **223** cleans with water the ink ejection surface **212** after being cleaned with the water-soluble organic solvent, which is arranged next to the cleaning liquid roller **222** along the shift direction of the casing **226**. The length of the water roller **223** in the direction orthogonal to the paper surface in FIG. **3** is substantially the same as the transverse length of the ink ejection surface **212**. The water roller **223** has a water roller rotary shaft **223***a* and a second porous member **223***b*. The water roller rotary shaft **223***a* is a cylindrical hollow shaft member and capable of containing therein water. The water roller rotary shaft **223***a* has a water admitting slit **223***c*, enabling the water therein to be supplied to the second porous member **223***b*. The water roller rotary shaft **223***a* is the member extending in the direction orthogonal to the paper surface, which is fixed to the casing **226** and connected to the water tank **223***d* shown in FIG. **4**. The second porous member **223***b* is a porous member, such as a sponge, arranged around the water roller rotary shaft **223***a*, and is rotatable with respect to the water roller rotary shaft **223***a*. The second porous member **223***b* is arranged so that the uppermost position in the height position thereof is substantially the same as the height position of the upper tip end of the first blade member **221**. The second porous member **223***b* rotates counterclockwise in FIG. **3** upon the shift of the cleaning unit **22** so as to bring the second porous member **223***b* into contact with the ink ejection surface **212**.

[0033] Alternatively, the water admitting slit **223***c* may be replaced with a plurality of through-holes arranged at equal intervals.

[0034] The second blade member **224** wipes off liquid such as an ink, water and a cleaning liquid on the ink ejection surface **212**, which is a plate-shaped member extending in one direction (a direction orthogonal to the paper surface in FIG. **3**). The length of the second blade member **224** in the direction orthogonal to the paper surface is substantially the same as the transverse length of the ink ejection surface **212**. The second blade member **224** is arranged at the rear end in the shift direction of the casing **226**, and the upper tip end thereof is arranged at a slightly higher position than the ink ejection surface **212**. The second blade member **224** is formed by an elastic deformable material, such as EPDM or fluoro rubber.

[0035] The restriction plate **225***a* is in contact with a part of the first porous member **222***b* of the cleaning liquid roller **222**, and the restriction plate **225***b* is in contact with a part of the second porous member **22***eb* of the water roller **223**. The first porous member **222***b* and the second porous member **223***b* are compressed upon contact with the restriction plates **225***a* and **225***b*, respectively. This enables the squeeze of the liquid absorbed by the first porous member **222***b* and the second porous member **223***b*. Thus, upon rotation of the first porous member **222***b* and the second porous member **223***b*, the parts of the first porous member **222***b* and the second porous member **223***b* which are in contact with the ink ejection surface **212** are shifted and brought into contact with the restriction plates **225***a* and **225***b*, so that the water and the cleaning liquid each containing the ink can be squeezed out of the first porous member **222***b* and the second porous member **223***b*, respectively. As shown in FIG. **1**, the restriction plates **225***a* and **225***b* are columnar members having a trapezoidal cross section, and the upper area is smaller than the lower area.

[0036] The casing **226** supports the first blade member **221**, the cleaning liquid roller **222**, the water roller **223**, the second blade member **224** and the restriction plates **225***a* and **225***b*, and has an arrangement section **226***a* to arrange the first blade member **221**, the cleaning liquid roller **222** and the like, and an exhaust liquid storage section **226***b* to collect the exhaust liquid. The arrangement section **226***a* has a bottom surface **226***c*, a first blade member sidewall surface **226***d*, a second blade member sidewall surface **226***e*, a first sidewall **226***f* and a second sidewall **226***g*. The bottom surface **226***c* is a plate-shaped member underlying the first blade member **221**, the second blade member **224**, the cleaning liquid roller **222** and the water roller **223**, and has holes h**1** to h**4** to permit passage of liquid arranged at positions corresponding to the first blade member **221**, the cleaning liquid roller **222**, the water roller **223** and the second blade member **224**, respectively.

[0037] The first blade member sidewall surface **226***d* is arranged at the front in the shift direction of the first blade member **221**, namely on the right in FIG. **3**, and provided with a first fixing member **226***i* for fixing the first blade member **221**. The upper height position of the first fixing member **226***i* is lower than the upper height position of the first blade member sidewall surface **226***d*, making it difficult for the ink wiped off by the first blade member **221** to overflow the casing **226**. The second blade member sidewall surface **226***e* is arranged at the rear in the shift direction of the second blade member **224**, namely on the left in FIG. **3**, and provided with a second fixing member **226***j* for fixing the second blade member **224**. The upper height position of the second fixing member **226***j* is lower than the upper height position of the second blade member sidewall surface **226***e*, making it difficult for the ink wiped off by the second blade member **224** to overflow the casing **226**.

[0038] The first sidewall **226***f* is arranged so as to connect one end of the first blade member sidewall surface **226***d* and one end of the second blade member sidewall surface **226***e*, and provided with a hole to permit connection of a pipe for supplying the cleaning liquid from the cleaning liquid tank

222*d* to the cleaning liquid roller **222**, and a hole to permit connection of a pipe for supplying the water from the water tank **223***d* to the water roller **223**. The second sidewall **226***g* is opposed to the first sidewall **226***f*, and cooperates with the first sidewall **226***f* to support the water roller rotary shaft **223***a* and the cleaning liquid roller rotary shaft **222***a*. The exhaust liquid storage section **226***b* underlies the arrangement section **226***a* and temporarily stores the water, the ink, the cleaning liquid and the like after passing through the holes h**1** to h**4** arranged at the bottom surface **216***c*. The exhaust liquid storage section **226***b* is connected to the exhaust ink tank **226***k*. The water tank **223***d*, the cleaning liquid tank **222***d* and the exhaust ink tank **226***k* are detachably mounted on the surface of a later-described shift support member **85** opposite the cleaning unit **22**.

[0039] The shift mechanism **8** shown in FIG. **5** shifts the cleaning unit **22** in the longitudinal direction of the inkjet heads **21**. FIG. **5** is a schematic plan view schematically showing the configuration of the shift mechanism **8**. The shift mechanism **8** is provided with a pair of rail members **81** and **82**, a pair of sliders **83** and **84**, the shift support member **85**, a plurality of pulleys **86***a* to **86***e*, a drive motor **87** and a frame body (not shown) to support these members. The pair of the rail members **81** and **82** have a slender shape extending back and forth, and are spaced laterally and arranged parallel to each other. The pair of the sliders **83** and **84** are slidably provided along the rail members **81** and **82**, respectively.

[0040] The shift support member **85** is formed by bending a plate material, and extends between the pair of the rail members **81** and **82**. The shift support member **85** is fixed to the pair of the sliders **83** and **84**, and shifts back and forth (in the direction indicated by the arrow A**1** or A**2**) by the sliders **83** and **84** that shift along the rail members **81** and **82**. A plurality of the cleaning units **22** are fixed to the front portion of the upper surface of the shift support member **85**. A plurality of cap members **89** corresponding to the ink ejection surfaces **212** of the inkjet heads **21** are provided at the rear of the cleaning unit **22**. In FIG. **5**, the reference numeral is applied only one of these cap members **89**, with others omitted. In the standby state, these cap members **89** cover the ink ejection surfaces **212**, thereby preventing the ink from being dried and deteriorated.

[0041] Specifically, the plurality of pulleys **86***a* to **86***e* are the first pulley **86***a* to the fifth pulley **86***e*, each of which is provided rotatably. The first pulley **86***a* and the second pulley **86***b* are arranged on the front and the rear of the rail member **81** with the rail member **81** interposed therebetween, respectively. A belt **88***a*, one end of which is fixed to the front end of the slider **83** and the other end is fixed to the rear end of the slider **83**, is entrained around the first pulley **86***a* and the second pulley **86***b*. The third pulley **86***c* and the fourth pulley **86***d* are arranged on the front and the rear of the rail member **82** with the rail member **82** interposed therebetween, respectively. A belt **88***b*, one end of which is fixed to the front end of the slider **84** and the other end is fixed to the rear end of the slider **84**, is entrained around the third pulley **86***c* and the fourth pulley **86***d*. The third pulley **86***c* is rotationally driven by the drive motor **87**. The fifth pulley **86***e* rotates in the opposite direction to the third pulley **86***c* upon the rotation transmission from the drive motor **87** through a gear (not shown) rotationally driven by the drive motor **87**. An endless belt **88***c* is entrained around the fifth pulley **86***e* and the first pulley **86***a*.

[0042] In the shift mechanism **8**, when the third pulley **86***c* is rotationally driven counterclockwise in FIG. **5** by the drive motor **87**, the belt **88***b* is driven and the slider **84** is shifted forward. At the same time, the fifth pulley **86***e* is driven clockwise, so that the endless belt **88***c* and the belt **88***a* are driven and the slider **83** is shifted forward. Thus, the cleaning unit **22** shifts forward together with the shift support member **85** (refer to the arrow A**1**). When the drive motor **87** is driven in a direction opposite to the above-mentioned direction, the shift support member **85** and the cleaning unit **22** shift rearward (refer to the arrow A**2**).

<Ink>

[0043] Any one of conventionally used inkjet printer inks is applicable to the inkjet printer **1**. These inks are composed mainly of a coloring agent (mostly a pigment), a resin and a solvent, and also contain various types of additives such as dehydrating agent and antioxidant when necessary. Although no limit is imposed on the resin, there are, for example, polymers and copolymers such as polystyrene, acryl resin, polyester, polyethylene and polyamide, low molecular weight polyethylene and polypropylene. The solubility parameter (hereinafter referred to as an "SP value") of these resins is normally in the range of 7 to 14, without being limited thereto. In general, 1 to 20% by weight of a resin is contained with respect to the total amount of an ink.

[0044] Usually, water alone or an aqueous medium obtained by adding an aqueous organic solvent into water is used as a solvent. Alternatively, surfactant, antiseptic and fungicide may be contained in the ink.

<Water-Soluble Organic Solvent>

[0045] The water-soluble organic solvent used as a cleaning liquid is preferably compatible with a resin. Examples thereof include alcohols such as ethanol, isopropyl alcohol, n-hexanol, 1,3-butandiol, hexylene glycol, ethylene glycol, triethylene glycol monobutyl ether, 2-pyrrolidone and glycerin, and ethers.

[0046] It is particularly preferable to use a water-soluble organic solvent having an SP value that approximates the SP value of the resin contained in an ink, in order to dissolve the solidified resin. Specifically, because the resin having an SP value of 7 to 14 is generally used in an ink, the SP value of the water-soluble organic solvent is preferably not more than 14, more preferably not more than 12. Further, the water-soluble organic solvent having a smaller SP value difference from the resin exhibits better dissolution. Therefore, the SP value difference between the resin and the water-soluble organic solvent is preferably not exceeding 0.5. Examples of suitable water-soluble organic solvents include ethanol (12.4), isopropyl alcohol (11.0), n-hexanol (10.2), 1,3-butandiol (13.9), hexylene glycol (11.8), triethylene glycol monobutyl ether (8.5) and 2-pyrrolidone (13.8), where the values in parentheses are the SP values of these organic solvents, respectively.

[0047] The use of the cleaning agent, namely, the above water-soluble organic solvents enables the removal of the resin composition of the ink adhering to the ink ejection sections **211** of the inkjet heads **21**, thereby improving poor ink ejection.

<Cleaning Method>

[0048] When each of the ink ejection sections **211** of the inkjet heads **21** is cleaned, the cleaning unit **22** shifts in the

longitudinal direction of the ink ejection surface **212** by the shift mechanism **8**, from the state where the first blade member **221** is in contact with one end of the longitudinal direction of the ink ejection surface **212**. Before starting a cleaning operation, the cleaning unit **22** is retracted rearwardly of the inkjet head **21** (refer to FIG. **5**), and shifts forward upon starting the cleaning operation. Thus, the casing **226** is shifted to the other end in the longitudinal direction of the ink ejection surface **212**. This shift brings the first blade member **221**, the cleaning liquid roller **222**, the water roller **223**, the second blade member **224** into contact with the ink ejection section **211** in the order named.

[0049] At this time, the first blade member **221** wipes off the ink at the ink ejection section **211** (the ink wiping step). The ink wiped off by the first blade member **221** is admitted into the exhaust liquid storage section **226***b* through the hole h**1**, and then recovered into the exhaust ink tank **226** through the pipe.

[0050] Subsequently, the cleaning roller **222** slidingly contacts the portion from which the ink has been wiped off by the first blade member **221**, and this portion is then cleaned with the water-soluble organic solvent (the first cleaning step). The cleaning liquid is supplied from the cleaning liquid tank **226***k* through the pipe, the hollow portion of the cleaning liquid roller rotary shaft **222***a* and the cleaning liquid admitting slit **222***c* to the cleaning roller **222**. The portion of the second porous member **222***b* of the cleaning roller **222** which is brought into contact with the ink ejection surface **212** causes a rotational shift to contact the restriction plate **225***a*, so that the cleaning liquid containing the ink recovered from the ink ejection surface **212** can be squeezed from the first porous member **222***b*. The squeezed cleaning liquid is admitted into the exhaust liquid storage section **226***b* through the hole h**2**, and then recovered into the exhaust ink tank **226***k* through the pipe.

[0051] Next, the water roller **223** slidingly contacts the portion cleaned with the water-soluble organic solvent (the cleaning liquid), and this portion is then cleaned with water (the second cleaning step). The water is supplied from the water tank **223***d* through the pipe, the hollow portion of the water roller rotary shaft **222***a* and the water admitting slit **223***c* to the water roller **223**. The portion of the second porous member **223***b* of the water roller **223** which is brought into contact with the ink ejection surface **212** causes a rotational shift to contact the restriction plate **225***b*, so that the water containing the ink recovered from the ink ejection surface **212** can be squeezed from the second porous member **223***b*. The squeezed cleaning liquid is admitted into the exhaust liquid storage section **226***b* through the hole h**3**, and then recovered into the exhaust ink tank **226***k* through the pipe.

[0052] Thereafter, the second blade member **224** wipes off the ink, the cleaning liquid and the water on the ink ejection surface **212** of the ink ejection section **211** (the liquid wiping step). The liquid thus wiped off by the second blade member **224** is admitted into the exhaust liquid storage section **226***b* through the hole h**4**, and then recovered into the exhaust ink tank **226***k* through the pipe.

Second Preferred Embodiment

[0053] A second preferred embodiment of the invention will be described below and, in some cases, the description of the identical parts to those of the first preferred embodiment will be omitted.

[0054] FIGS. **6** and **7** are overall schematic diagrams of a cleaning unit according to the second preferred embodiment (hereinafter referred to as "second cleaning units **6**"). FIG. **6** is a sectional view of each of the second cleaning units **6**, and FIG. **7** is a plan view thereof.

[0055] Each of the second cleaning units **6** cleans an ink ejection surface **212**, and the width W**2** of the second cleaning unit **6**, namely the length in a direction perpendicular to the paper surface in FIG. **6** (refer to FIG. **7**) is larger than the width in the transverse direction of the ink ejection surface **212**. These second cleaning units **6** are provided correspondingly to individual inkjet heads **21**, and are connected to an exhaust ink tank **66***n*. The second cleaning units **6** are shifted in the direction of an arrow A**1** in FIG. **5** along the ink ejection surfaces **212** by the same shift mechanism as the first preferred embodiment. Each of the second cleaning units **6** is provided with a third blade member **61**, a first elastic gear **62**, a second elastic gear **63**, a fourth blade member **64**, restriction plates **65***a* and **65***b*, and a second casing **66**.

[0056] The third blade member **61** is a plate-shaped member for wiping off the ink on the ink ejection surface **212**, and extends in one direction (a direction orthogonal to the paper surface). The length of the third blade member **61** in the direction orthogonal to the paper surface is substantially the same as the transverse length of the ink ejection surface **212**. The third blade member **61** is arranged at one end of the second casing **66**, and the upper tip end thereof is arranged at a slightly higher position than the ink ejection surface **212**. The third blade member **61** is formed by an elastic deformable material, such as EPDM or fluoro rubber.

[0057] The first elastic gear **62** cleans the ink ejection surface **212** with a water-soluble organic solvent, and is arranged next to the third blade member **61** along the shift direction A**1** of the second casing **66**. The length of the first elastic gear **62** in a direction orthogonal to the paper surface is substantially the same as the transverse length of the ink ejection surface **212**. The first elastic gear **62** also has a first rotary shaft **62***a* and a first elastic body member **62***b*. The first rotary shaft **62***a* extends in a direction orthogonal to the paper surface in FIG. **6**, and is fixed to the second casing **66**. The first elastic body member **62***b* has a tubular part **62***c* arranged around the first rotary shaft **62***a*, and blade parts **62***d* arranged radially from the tubular part **62***c*. At least the surface portions of the blade parts **62***d* are composed of a porous material, such as a sponge, and thus capable of absorbing a cleaning liquid. The first elastic body member **62***b* is arranged so that the uppermost position in the height position thereof is substantially the same as the height position of the upper tip end of the third blade member **61**. The first elastic body member **62***b* is rotatable with respect to the first rotary shaft **62***a*, and rotates counterclockwise upon the shift of the second cleaning unit **6** so as to bring the blade parts **62***d* into contact with the ink ejection surface **212**.

[0058] The second elastic gear **63** cleans the ink ejection surface **212** with water, and is arranged next to the first elastic gear **62** along the shift direction A**1** of the second casing **66**. The length of the second elastic gear **63** in a direction orthogonal to the paper surface is substantially the same as the transverse length of the ink ejection surface **212**. The second elastic gear **63** has a second rotary shaft **63***a* and a second elastic body member **63***b*. The second rotary shaft **63***a* extends in a direction orthogonal to the paper surface and is fixed to the second casing **66**. The second elastic body member **63***b* has a tubular part **63***c* arranged around the second

rotary shaft **63***a*, and blade parts **63***d* arranged radially from the tubular part **63***c*. These blade parts **63** are provided with a porous material such as a sponge, and thus capable of absorbing water. The second elastic body member **63***b* is arranged so that the uppermost position in the height position thereof is substantially the same as the height position of the upper tip end of the fourth blade member **64**. The second elastic body member **63***b* is rotatable with respect to the second rotary shaft **63***a*, and rotates counterclockwise upon the shift of the second cleaning unit **6** so as to bring the blade parts **63***d* into contact with the ink ejection surface **212**.

[0059] The fourth blade member **64** wipes off the liquid, such as an ink, water and a cleaning liquid, on the ink ejection surface **212**, which is a plate-shaped member extending in one direction (a direction orthogonal to the paper surface in FIG. **6**). The fourth blade member **64** is arranged at the side end opposite the side end at which the third blade member **61** of the second casing **66** is arranged, and the upper tip end thereof is arranged at a slightly higher position than the ink ejection surface **212**. The fourth blade member **64** is formed by an elastic deformable material, such as EPDM or fluoro rubber.

[0060] The restriction plates **65***a* and **65***b* are plate-shaped members projecting upward from a bottom surface **66***c* of the second casing **66**, and arranged so as to contact the blade parts **62***d* and **63***d* of the first and second elastic gears **62** and **63**, respectively. At the time of rotation of the first elastic gear **62** and the second elastic gear **63**, the restriction plates **65***a* and **65***b* contact the blade parts **62***d* and **63***d*, and also press the blade parts **62***d* and **63***d*, thereby enabling the squeeze of the ink, the water and the cleaning liquid absorbed by the blade parts **62***d* and **63***d*.

[0061] The second casing **66** supports the third blade member **61**, the first elastic gear **62**, the second elastic gear **63**, the fourth blade member **64** and the restriction plates **65***a* and **65***b*, and has an arrangement section **66***a* to arrange the third blade member **61**, the first elastic gear **62** and the like, and an exhaust liquid storage section **66***b* to collect the exhaust liquid. The arrangement section **66***a* has the bottom surface **66***c*, a third blade member sidewall surface **66***d*, a fourth blade member sidewall surface **66***e*, a first sidewall **66***f* and a second sidewall **66***g*.

[0062] The bottom surface **66***c* is a plate-shaped member underlying the third and fourth bade members **61** and **64**, and the first and second elastic gears **62** and **63**, and has holes h**5** to h**8** to permit passage of liquid arranged at positions corresponding to the third blade member **61**, the first elastic gear **62**, the second elastic gear **63** and the fourth blade member **64**, respectively. The bottom surface **66***c* is further provided with partition projections **66***i* to partition the space for the third blade member **61**, the space for the first elastic gear **62**, the space for the second elastic gear **63**, and the space for the fourth blade member **64**.

[0063] The third blade member sidewall surface **66***d* is arranged at the front in the shift direction of the third blade member **61**, namely on the right in FIG. **6**, and provided with a third fixing member **66***j* for fixing the third blade member **61**. The upper height position of the third fixing member **66***j* is lower than the upper height position of the third blade member sidewall surface **66***d*, making it difficult for the ink wiped off by the third blade member **61** to overflow the second casing **66**. The fourth blade member sidewall surface **66***e* is arranged at the rear in the shift direction of the fourth blade member **64**, namely on the left in FIG. **6**, and provided with a fourth fixing member **66***k* for fixing the fourth blade member **64**. The upper height position of the fourth fixing member **66***k* is lower than the upper height position of the fourth blade member sidewall surface **66***e*, making it difficult for the ink wiped off by the fourth blade member **64** to overflow the second casing **66**.

[0064] The first sidewall **66***f* is arranged so as to connect one end of the third blade member sidewall surface **66***d* and one end of the fourth blade member sidewall surface **66***e*, and provided with a hole **91** to permit connection of a pipe for supplying the water-soluble organic solvent from a cleaning liquid tank **66***q* to the first elastic gear **62**, and a hole **92** to permit connection of a pipe for supplying water from a water tank **66***p* to the second elastic gear **63**. The second sidewall **66***g* is opposed to the first sidewall **66***f*, and cooperates with the first sidewall **66***f* to support the first and second elastic gears **62** and **63**. The exhaust liquid storage section **66***b* underlies the arrangement section **66***a*, and temporarily stores the water, the ink, the cleaning liquid and the like after passing through the holes h**5** to h**8** provided at the bottom surface **66***c*. The exhaust storage section **66***b* is connected to the exhaust ink tank **66***n*.

<Cleaning Method>

[0065] When each of the ink ejection sections **211** of the inkjet heads **21** is cleaned, the second casing **66** is shifted in the direction indicated by the arrow A**1** from the state in which the third blade member **61** is in contact with one end of the longitudinal direction of the ink ejection section **211**, to the other end in the longitudinal direction of the ink ejection section **211**. This shift brings the third blade member **61**, the first elastic gear **62**, the second elastic gear **63** and the fourth blade member **64** into contact with the ink ejection section **211** in the order named.

[0066] At this time, the third blade member **61** wipes off the ink at the ink ejection section **211** (the ink wiping step). The ink wiped off by the third blade member **61** is admitted into the exhaust liquid storage section **66***b* through the hole h**5**, and then recovered into the exhaust ink tank **66***n* through the pipe.

[0067] Subsequently, the first elastic gear **62** slidingly contacts the portion from which the ink has been wiped off by the third blade member **61**, and this portion is then cleaned with the water-soluble organic solvent (the first cleaning step). Hereat, the cleaning liquid supplied from the hole **91** is absorbed by the first elastic gear **62**, and the portion of the first elastic gear **62** containing the cleaning liquid causes a rotational shift and contacts the ink ejection surface **212**, thereby cleaning the ink ejection surface **212**. Upon a further rotation of the first elastic gear **62** so as to contact the restriction plate **65***a*, the water-soluble organic solvent that contains the ink by cleaning the ink ejection surface **212** is squeezed from the first elastic gear **62** and admitted into the exhaust liquid storage section **66***b* through the hole h**6**, and then recovered into the exhaust ink tank **66***n* through the pipe. The water-soluble organic solvent excessively supplied from the hole **91** is also exhausted from the hole h**6**. In order to reduce a waste of the water-soluble organic solvent, a sensor to detect the liquid surface level of the stored water-soluble organic solvent may be provided to control the supply amount of the water-soluble organic solvent based on the liquid surface level detected by the sensor.

[0068] Next, the second elastic gear **63** slidingly contacts the portion cleaned with the water-soluble organic solvent,

and this portion is then cleaned with water (the second cleaning step). Hereat, the water supplied from the hole **92** is absorbed by the second elastic gear **63**, and the portion of the second elastic gear **63** containing water causes a rotational shift and contacts the ink ejection surface **212**, thereby cleaning the ink ejection surface **212**. Upon a further rotation of the second elastic gear **63** so as to contact the restriction plate **65***b*, the water that contains the ink by cleaning the ink ejection surface **212** is squeezed from the second elastic gear **63** and admitted into the exhaust liquid storage section **66***b* through the hole h**7**, and then recovered into the exhaust ink tank **66***n* through the pipe. The water excessively supplied from the hole **92** is also exhausted from the hole h**7**. In order to reduce a waste of water, a sensor to detect the water level of the stored water may be provided to control the supply amount of water based on the water level detected by the sensor.

[0069] Thereafter, the fourth blade member **64** wipes off the ink, the cleaning liquid and the water on the ink ejection surface **212** of the ink ejection section **211** (the liquid wiping step). The liquid thus wiped off by the fourth blade member **64** is discharged through the hole h**8**. Otherwise, the cleaning method is identical to that of the first preferred embodiment, and therefore the description thereof is omitted here.

Other Preferred Embodiments

[0070] The shift mechanism for shifting the cleaning units are not limited to those of the foregoing preferred embodiments, and a different mechanism may be employed. Alternatively, the cleaning units may be fixed, and a shift mechanism for shifting the inkjet heads may be employed.

[0071] In the foregoing preferred embodiments, the cleaning units are applied to the image forming apparatus that forms an image on a paper. Alternatively, the cleaning units may be applied to an image forming apparatus that forms an image on an image formation object other than papers.

[0072] Examples of the present invention will be described below. It is understood, however, that the examples are for the purpose of illustration and the invention is not to be regarded as limited to any of the specific materials or condition therein.

EXAMPLES

Example 1

Preparation of Pigment Dispersion Liquid

[0073] A pigment dispersion liquid was prepared by mixing 30% by weight of C.I. pigment red 122 as a pigment, 30% by weight of styrene-acrylic resin ("JONCRYL61" manufactured by Johnson Polymer Corporation), 10% by weight of glycerin and 35% by weight of an ion exchanged water, and dispersing this mixture with 0.5 mm zirconia beads by using a ball mill until the mean particle size became 100 nm. The SP value of the used styrene-acrylic resin was 8 to 12. The mean particle size was measured by a dynamic light scattering particle size distribution measuring apparatus ("LB-550" manufactured by HORIBA Ltd.) after the pigment dispersion liquid was diluted five times with the ion exchanged water.

<Preparation of Ink>

[0074] An ink was prepared by mixing 0.5% by weight of ethylene oxide addition product of acetylene diol as being surfactant ("Olfine E1010" manufactured by Nisshin Chemical Industry Co., Ltd.), 5% by weight of triethylene glycol monobuthyl ether, 5% by weight of 2-pyroridone, 20% by weight of the above-mentioned pigment dispersion liquid and 69.5% by weight of water, and sufficiently stirring the mixture, followed by filtering with a filter having a hole diameter of 5 μm.

<Cleaning>

[0075] Under the environment of 25° C. and 50% RH, the ink ejection surfaces of the inkjet heads filled with the ink were exposed to the air and left for a week. Thereafter, the cleaning of the ink ejection surfaces was carried out by the cleaning method of the first preferred embodiment by using triethylene glycol monobuthyl ether (8.5 in SP value) as a water-soluble organic solvent. After cleaning, the ink ejection surfaces were pressed and purged, and recleaned by the same method as the above cleaning method.

Example 2

[0076] Cleaning was carried out in the same manner as in Example 1, except that instead of triethylene glycol monobuthyl ether, 2-pyroridone (13.8 in SP value) was used as a cleaning agent.

Example 3

[0077] Cleaning was carried out in the same manner as in Example 1, except that instead of triethylene glycol monobuthyl ether, glycerin (18.1 in SP value) was used as a cleaning agent.

Examples 4 and 5

[0078] An ink was prepared in the same manner as in Example 1, except that a pigment dispersion liquid was prepared by mixing 30% by weight of C.I. pigment red 122 as a pigment, 30% by weight of acrylic resin ("Acrylpolymer T540" manufactured by To a Gosei Kagaku Co., Ltd.), 10% by weight of glycerin and 35% by weight of an ion exchanged water. Subsequently, cleaning was carried out in the same manner as in Example 1, except that triethylene glycol monobuthyl ether and 2-pyroridone were used as a water-soluble organic solvent for cleaning. The SP value of the used acrylic resin was 8 to 12.

Example 6

[0079] Cleaning was carried out in the same manner as in Example 4 or 5, except that glycerin (18.1 in SP value) was used as a cleaning agent.

Comparative Example 1

[0080] Cleaning was carried out in the same manner as in Example 1, except that water (23.4 in SP value) was used as a cleaning liquid.

Comparative Example 2

[0081] Cleaning was carried out in the same manner as in Example 4 or 5, except that water (23.4 in SP value) was used as a cleaning liquid.

<Evaluation Test and Evaluation Method>

[0082] After the cleaning was terminated, the non-ejection of the ink was confirmed by printing a 1 (one)-dot and 1 (one)-space vertical line on a glazed paper under the condi-

tions that the drive frequency of the inkjet heads was 20 kHz, the distance between the nozzle ejection surface and a recording medium was 1.0 mm, and the transfer speed of the recording medium was 847 mm/sec. Further, the line width was measured to confirm whether the line width error was less than ±20 μm. Table 1 shows these results.

TABLE 1

	Water-soluble organic solvent	Resin used for pigment dispersion liquid	SP value of water-soluble organic solvent	Evaluation results
Example 1	Triethylene glycol monobuthyl ether	JONCRYL61	8.5	◎
Example 2	2-pyroridone	JONCRYL61	13.8	○
Example 3	glycerin	JONCRYL61	18.12	Δ
Example 4	Triethylene glycol monobuthyl ether	Acrylpolymer T540	8.5	◎
Example 5	2-pyroridone	Acrylpolymer T540	13.8	○
Example 6	glycerin	Acrylpolymer T540	18.12	Δ
Comparative Example 1	water	JONCRYL61	23.4	X
Comparative Example 2	water	Acrylpolymer T540	23.4	X

"◎" denotes the absence of the non-ejection and the line width error of less than ±20 μm.
"○" denotes the absence of the non-ejection and the line width error of not less than ±20 μm.
"Δ" denotes a slight non-ejection at such a level as not to cause any problem, and the line width error of not less than ±20 μm.
"X" denotes the presence of the non-ejection.

[0083] As shown in Table 1, both Comparative Example 1 and Comparative Example 2 caused the non-ejection of the ink. On the other hand, none of Examples 1 to 4 caused the non-ejection of the ink.

What is claimed is:

1. A method of cleaning an ink ejection section in an image forming apparatus that forms an image by ejecting an ink from the ink ejection section, comprising the steps of:
- an ink wiping step for wiping off the ink on the surface of the ink ejection section;
- a first cleaning step for cleaning the surface of the ink ejection section with a water-soluble organic solvent;
- a second cleaning step for cleaning with water the surface of the ink ejection section cleaned with the water-soluble organic solvent; and
- a liquid wiping step for wiping off the liquid on the surface of the ink ejection section cleaned through the second cleaning step.

2. The method of cleaning an ink ejection section according to claim **1**, wherein the water-soluble organic solvent has a solubility parameter (SP value) of 7 to 14.

3. The method of cleaning an ink ejection section according to claim **1**, wherein the ink contains a coloring agent, a resin and a solvent, and the resin has a solubility parameter (SP value) of 7 to 14.

4. The method of cleaning an ink ejection section according to claim **3**, wherein the SP value difference between the resin and the water-soluble organic solvent is not exceeding 0.5.

5. The method of cleaning an ink ejection section according to claim **1**, wherein the first cleaning step is carried out by using a porous member impregnated with a water-soluble organic solvent.

6. The method of cleaning an ink ejection section according to claim **5**, wherein the ink ejection section is cleaned with the water-soluble organic solvent by shifting the porous member impregnated with the water-soluble organic solvent while bringing it into contact with the ink ejection section.

7. The method of cleaning an ink ejection section according to claim **1**, wherein the second cleaning step is carried out by using a porous member impregnated with water.

8. The method of cleaning an ink ejection section according to claim **7**, wherein the ink ejection section is cleaned with water by shifting the porous member impregnated with water while bringing it into contact with the ink ejection section.

9. The method of cleaning an ink ejection section according to claim **1**, wherein the ink wiping step is carried out by using a blade member shifting the surface of the ink ejection section.

10. The method of cleaning an ink ejection section according to claim **1**, wherein the liquid wiping step is carried out by using a blade member shifting the surface of the ink ejection section.

11. A cleaning unit of an ink ejection section shiftably mounted in an image forming apparatus provided with an ink ejection section having an ink ejection surface capable of ejecting an ink, the cleaning unit comprising:
- a first blade member for wiping off ink contactable with the ink ejection surface;
- a first porous member impregnated with a water-soluble organic solvent;
- a second porous member impregnated with water; and
- a second blade member for wiping off liquid contactable with the ink ejection surface, wherein
- the first blade member, the first porous member, the second porous member and the second blade member are arranged in the order named along the shift direction of the cleaning unit.

12. The cleaning unit of an ink ejection section according to claim **11**, wherein the first blade member, the first porous member, the second porous member and the second blade member are supported by a housing.

13. The cleaning unit of an ink ejection section according to claim **11**, wherein the first porous member is arranged on at least either of the surface of a roller or the surface of the blade parts extending radially from a tubular part of an elastic gear.

14. The cleaning unit of an ink ejection section according to claim **11**, wherein the second porous member is arranged on at least either of the surface of a roller or the surface of the blade parts extending radially from the tubular part of an elastic gear.

15. An image forming apparatus comprising an image formation section provided with an ink ejection section having an ink ejection surface capable of ejecting an ink, and the cleaning unit according to claim **11**.

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