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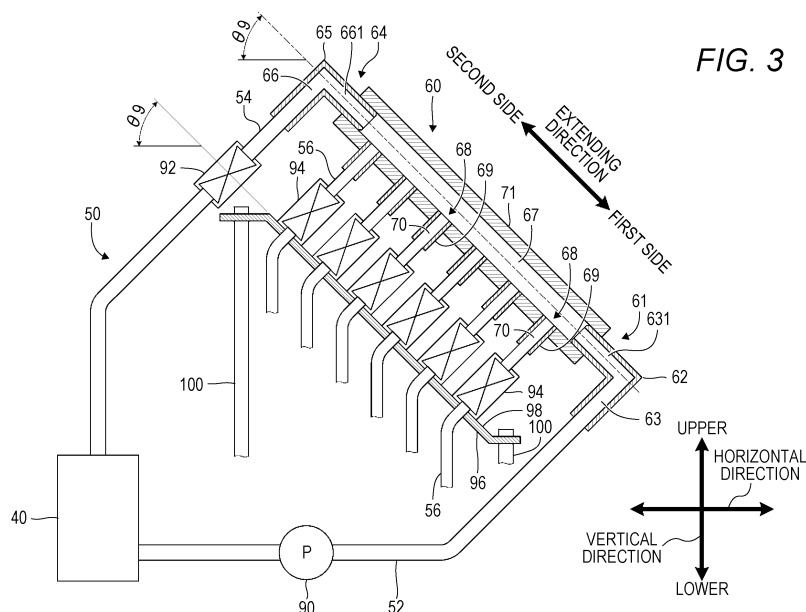
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(54) **INKJET PRINTING DEVICE**

(57) The distributor has a cylindrical shape and distributes ink into a plurality of recording heads. The distributor includes an inflow part, an outflow part, a plurality of supply parts, and a common flow path. The inflow part is provided to a first side end of the distributor. The outflow part is provided to a second side end of the distributor. The common flow path is formed inside the distributor and extends between the first side end and the second side end. The plurality of supply parts is provided to be

aligned at a side surface of the distributor in an extending direction of the common flow path. The distributor is provided so that the second side end is located upper than the first side end in the vertical direction, the extending direction of the common flow path is inclined with respect to the horizontal direction, and the opening direction of the supply port of the supply part is directed downward in the vertical direction than in the horizontal direction.



Description

TECHNICAL FIELD

5 **[0001]** The present invention relates to an inkjet recording apparatus.

BACKGROUND ART

10 **[0002]** Inkjet recording apparatus have been known as the recording apparatus for recording images on various recording media. The inkjet recording apparatus has recording heads in which a plurality of nozzles is aligned in a discharge surface. The inkjet recording apparatus records an image on the recording medium by discharging ink from each nozzle thereto. The ink to be discharged from the nozzle flows through a predetermined path and is supplied to the recording head.

15 **[0003]** Patent literature 1 discloses an image forming apparatus having a distribution tank. In the distribution tank, a common flow path for distributing ink to a plurality of heads is formed within a tank case. The top surface of the common flow path is formed in an inclined surface. An ink supply path from an ink supply port for supplying the ink to the common flow path is provided at one end of the common flow path. The ink supply path is formed in such a shape that rises upward obliquely toward the common flow path. The ink supply path communicates to the common flow path at an output port located in an upper position. The top surface of the common flow path is formed in the inclined surface. A bubble exhaust port is provided in the one end side of the common flow path (the upper side of the top surface). The bubble exhaust port is connected to an exhaust path. Patent literature 1 discloses that, when a bubble is mixed in the ink flowing into the ink supply path, the bubble rises by its buoyancy and is exhausted to the bubble exhaust port due to the inclination of the ink supply path.

25 **[0004]** Patent literature 2 discloses an inkjet printing apparatus having an ink circulation path, an ink distributor, a plurality of inkjet heads, and degassing means. The distributor is provided in the circulation path. The plurality of inkjet heads is provided to the distributor. The degassing means is provided in the circulation path. The distributor has a distributor intake port into which the ink is supplied and a distributor exhaust port from which the ink is discharged. The inner upper surface of the distributor is tapered in a manner that its height increases from at the distributor intake port to at the distributor exhaust port. A valve is provided between the distributor and the inkjet heads. The ink discharged from the distributor exhaust port is supplied into the degassing means. The degassing means is provided at the highest position among the circulation path, the distributor and the inkjet heads. The degassing means has a hollow fiber membranes through which the ink passes and decompression means.

30 **[0005]** Patent literature 3 discloses an inkjet recording apparatus for achieving a stable ink circulation while preventing a bubble from reaching a plurality of head modules.

CITATION LIST

PATENT LITERATURES

40 **[0006]**

PATENT LITERATURE 1: Japanese Patent Application Laid-open No. 2011-46131

PATENT LITERATURE 2: Japanese Patent No. 4784129

45 PATENT LITERATURE 3: Japanese Patent Application Laid-open No. 2011-79169

SUMMARY OF INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

50 **[0007]** There are line-type inkjet recording apparatus and serial-type inkjet recording apparatus in the inkjet recording apparatus. The line-type inkjet recording apparatus has a plurality of recording heads in which nozzles are aligned along the width direction of the recording medium. The plurality of recording heads is provided, fixed at a predetermined area to which the recording medium is conveyed. The conveyance direction of the recording medium is orthogonal to the width direction of the recording medium. The line-type inkjet recording apparatus is the recording apparatus that conveys the recording medium in the conveyance direction and records the image on the conveyed recording medium. The serial-type inkjet recording apparatus has a plurality of recording heads in which nozzles are aligned along the conveyance direction of the recording medium. The plurality of recording heads moves in a reciprocating manner in the width direction of the recording medium (in the direction orthogonal to the conveyance direction). The serial type inkjet recording

apparatus is the recording apparatus that records the image on the conveyed recording medium by repeating the reciprocation move of the recording heads and the conveyance of the recording medium.

[0008] The line-type inkjet recording apparatus and the serial-type inkjet recording apparatus have a distributor. The distributor is a mechanism for supplying the ink to respective recording heads. The distributor is provided on the way of ink flow paths connected to the ink tank. The plurality of recording heads is connected to the distributor via the ink flow paths. The distributor allows for distributing the ink flowing out of the ink tank and for supplying the ink to the respective recording heads, even when the number of the recording heads increases.

[0009] When a bubble is contained in the ink and the ink containing the bubble flows into the inside of the distributor, the ink containing the bubble is undesirably supplied to the recording heads, which may cause an inferior discharge of the ink. It is thus required to remove the bubble contained in the ink that has flowed into the inside of the distributor. In this regard, it is preferable that the distributor itself is formed in a simple shape. Complicated shape makes it difficult to process for obtaining that shape.

[0010] The purpose of the present invention is to provide an inkjet recording apparatus that is able to separate the bubble contained in the ink inside the distributor and preferably exhaust the separated bubble while making the distributor simple.

SOLUTIONS TO THE PROBLEMS

[0011] An inkjet recording apparatus of one aspect of the present invention for recording an image on a recording medium, the inkjet recording apparatus includes: an ink tank configured to store ink of a particular color; a plurality of recording heads in which nozzles configured to discharge the ink are formed; an ink flow path through which the ink flows; a tubular distributor provided on the way of the ink flow path and configured to distribute, to respective of the plurality of recording heads, the ink that flows through the ink flow path and is supplied from the ink tank; and a liquid delivery unit configured to liquid-deliver, via the ink flow path and the distributor, the ink supplied to the plurality of recording heads from the ink tank and collected in the ink tank. The ink flow path includes: an ink inflow path for connecting the ink tank and the distributor and supplying the ink to the distributor from the ink tank; an ink collection flow path for connecting the distributor and the ink tank and collecting, in the ink tank, the ink supplied to the distributor; and a plurality of ink supply flow paths for connecting the distributor and respective of the plurality of recording heads and supplying the ink supplied to the distributor to respective of the plurality of recording heads. The distributor includes: an inflow part including an inflow port to which the ink inflow path is connected and into which the ink flows; an outflow part including an outflow port to which the ink collection flow path is connected and out of which the ink flows; a plurality of supply parts each including supply ports to which respective of the plurality of ink supply flow paths is connected, and out of which the ink flows; and a common flow path formed inside the distributor, communicating with the inflow port, the outflow port, and the plurality of supply ports, and configured to cause the ink flowing out of the inflow port to flow therein and supply the ink to the outflow port and the plurality of supply ports, respectively. The inflow part is provided to a first side end of the tubular distributor. The outflow part is provided to a second side end of the tubular distributor. The common flow path extends between the first side end and the second side end. Respective of the plurality of supply parts are provided so as to be aligned at a side surface of the tubular distributor in an extending direction of the common flow path. The distributor is provided to the inkjet recording apparatus in such an installation state that the second side end is located upper than the first side end in a vertical direction, the extending direction of the common flow path is inclined with respect to a horizontal direction, and an opening direction of the supply port is directed downward in the vertical direction than in the horizontal direction.

[0012] According to this inkjet recording apparatus, the ink that has flowed into the distributor flows from the lower part to the upper part in the vertical direction in the extending direction of the common flow path. In the distributor provided with inclination, the bubble contained in the ink to be supplied to the recording heads flows along the flow of the ink inside the common flow path and moves upward in the vertical direction by the buoyancy. Therefore, it suppresses that the previously-described bubble moves to the supply port side opened downward in the vertical direction than in the horizontal direction, so that the bubble can be preferably separated. The distributor is not required to have a special shape for the separation of the bubble, which allows for the simple distributor. The bubble that has moved upward in the vertical direction can be exhausted smoothly out of the outflow port. The ink with the bubble being separated can be supplied to the recording heads. The preferable discharge of the ink can be achieved and the preferable image recording can be implemented. This allows for obtaining the inkjet recording apparatus that is able to separate the bubble contained in the ink inside the distributor and preferably exhaust the separated bubble while making the distributor simple.

[0013] In the inkjet recording apparatus, the followings are preferable: the inflow part may include a first joint part connected to the ink inflow path and formed with the inflow port, the outflow part may include a second joint part connected to the ink collection flow path and formed with the outflow port, the first joint part may be provided to the first side end such that a predetermined range of the common flow path side in the inflow port is inclined by as much as an inclination angle made by the extending direction of the common flow path with respect to the horizontal direction, and the second

joint part may be provided to the second side end such that a predetermined range of the common flow path side in the outflow port is inclined by as much as the inclination angle. This allows the ink liquid-delivered via the ink inflow path to flow smoothly into the common flow path. Among the ink supplied into the common flow path, the ink which is not supplied to the recording heads but collected in the ink tank can be exhausted smoothly out of the common flow path and flow

into the ink collection flow path. The preferable ink circulation can be achieved.

[0014] For the plurality of ink supply flow paths, lengths of respective flow paths through which the ink flows out of the supply port and is supplied to the recording head may be set to be the same. This allows the ink flowing out of each supply port to flow in the same manner for respective of the plurality of ink supply flow paths. When the ink is supplied to the plurality of recording heads via the different ink supply flow paths, the ink can be supplied to each recording head under the same state.

[0015] The inkjet recording apparatus may include: a plurality of supply side valves provided on the way of respective of the plurality of ink supply flow paths and configured to open and shut the respective of the ink supply flow paths; and a fixing part including a fixing surface to which the plurality of supply side valves is fixed, respectively. The fixing part may be provided to the inkjet recording apparatus such that the fixing surface is inclined by as much as an inclination angle made by the extending direction of the common flow path with respect to the horizontal direction. The plurality of supply side valves may be fixed to the fixing surface so that, in the distributor in the installation state, the supply side valve provided on the way of the ink supply flow path that is connected to the supply part provided at an upper position in the vertical direction is located upper in the vertical direction. According to this, the state where the ink is not supplied to respective recording heads can be achieved by shutting respective of the plurality of supply side valves. The plurality of supply side valves provided on the way of respective ink supply flow paths is provided in a manner that they are provided along the extending direction of the common flow path. Further, the alignment of the plurality of supply side valves can be corresponded to the alignment of the supply parts connected to the supply side valves via the ink supply flow paths. Therefore, even when the supply side valves are provided on the way of the ink supply flow paths, respective of the plurality of ink supply flow paths can be set to have the same flow path length. In other words, for the plurality of ink supply flow paths, the same flow path length can be obtained between the supply ports and the supply side valves, and the same flow path length can be obtained between the supply side valves and the recording heads.

[0016] The inkjet recording apparatus may further include: a collection side valve provided on the way of the ink collection flow path and configured to open and shut the ink collection flow path. When an image is recorded on a recording medium in the inkjet recording apparatus, the liquid delivery unit may be driven, the collection side valve may be either opened or shut, and the plurality of supply side valves may be opened, respectively. When no image is recorded on a recording medium in the inkjet recording apparatus, the liquid delivery unit may be driven, the collection side valve may be opened, and the plurality of supply side valves may be shut, respectively. According to this, the ink can be preferably supplied to respective of the plurality of recording heads when the image is recorded on the recording medium in the inkjet recording apparatus. On the other hand, the ink can be collected in the ink tank and preferably circulated when no image is recorded on the recording medium in the inkjet recording apparatus. The ink is circulated when no image is recorded on the recording medium in the inkjet recording apparatus, which can suppress the precipitation of various components including the colorant contained in the ink.

[0017] When an image is recorded on a recording medium in the inkjet recording apparatus, the collection side valve may have an opening degree between open and shut depending on an amount of the ink that flows in respective of the plurality of ink supply flow paths to be supplied to respective of the plurality of recording heads. This allows for the adjustment of the amount of the ink supplied to respective recording heads.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

FIG. 1 is a plan view of an example of a schematic configuration of an inkjet recording apparatus.

FIG. 2 is a diagram illustrating an example of a recording unit including a plurality of recording heads, and in the diagram, and the recording unit is viewed from a discharge surface side of the recording heads formed with nozzles.

FIG. 3 is a diagram illustrating supply of ink to the recording heads and circulation of the ink.

FIG. 4 is a diagram illustrating an example of a schematic configuration of a distributor.

FIG. 5 is a cross-sectional diagram along the D-D line in FIG. 4.

FIG. 6 is a diagram illustrating another example of schematic configuration of the distributor.

FIG. 7 is a cross-sectional diagram along the E-F-G-H line in FIG. 6.

DESCRIPTION OF EMBODIMENTS

[0019] Embodiments to implement the present invention will be described. The present invention is not limited to the

configuration described below, but can adopt various configurations in the same technical idea. For example, a part of the following configurations may be omitted, or replaced with other configurations and so on. Other configurations may be included.

< Inkjet recording apparatus >

[0020] An inkjet recording apparatus 1 will be described with reference to FIG. 1 and FIG. 2. The inkjet recording apparatus 1 is a line-type inkjet recording apparatus. The inkjet recording apparatus 1 is able to record full-color image on a recording medium 2. In the present embodiment, description will be provided by using an example of recording the full-color image by respective colors of yellow, magenta, cyan, and black. The inkjet recording apparatus 1 has a conveying unit 10, recording units 20Y, 20M, 20C, and 20K, a control box 30, ink tanks 40Y, 40M, 40C, and 40K, ink flow paths 50Y, 50M, 50C, and 50K, and distributors 60Y, 60M, 60C, and 60K.

[0021] The conveying unit 10 is configured with a conveying mechanism such as a conveyor. The conveying unit 10 passes and conveys the recording medium 2 from the upstream side of the conveying unit 10 through the recording units 20Y, 20M, 20C, and 20K to the downstream side of the conveying unit 10. The conveying unit 10 has the same configuration as conveying units of inkjet recording apparatus that have already been implemented. Therefore, further description of the conveying unit 10 will be omitted.

[0022] The recording unit 20Y is a recording unit configured to record an image by a yellow ink. The recording unit 20M is a recording unit configured to record an image by a magenta ink. The recording unit 20C is a recording unit configured to record an image by a cyan ink. The recording unit 20K is a recording unit configured to record an image by a black ink. The recording unit 20Y includes a plurality of recording heads 22Y arranged as illustrated in FIG. 2. The recording head 22Y has a plurality of nozzles 24Y formed therein that discharge the yellow ink. The recording unit 20M includes a plurality of recording heads 22M arranged as illustrated in FIG. 2. The recording head 22M has a plurality of nozzles 24M formed therein that discharge the magenta ink. The recording unit 20C includes a plurality of recording heads 22C arranged as illustrated in FIG. 2. The recording head 22C has a plurality of nozzles 24C formed therein that discharge the cyan ink. The recording unit 20K includes a plurality of recording heads 22K arranged as illustrated in FIG. 2. The recording head 22K has a plurality of nozzles 24K formed therein that discharge the black ink.

[0023] With respect to the arrangement and the total number of the respective recording heads 22Y, 22M, 22C, and 22K included respectively in each of the recording units 20Y, 20M, 20C, and 20K, it is illustrated in FIG. 2 that three per column by two columns results in six in total. However, this is a mere example. The arrangement and the total number of the recording heads 22Y, 22M, 22C, and 22K may be properly determined taking various conditions into consideration. With respect to the arrangement and the total number of the respective nozzles 24Y, 24M, 24C, and 24K formed respectively in each one of recording heads 22Y, 22M, 22C, and 22K, it is illustrated in FIG. 2 that three per column by two columns results in six in total. However, this is a mere example. The arrangement and the total number of the nozzles 24Y, 24M, 24C, and 24K may be properly determined taking various conditions into consideration.

[0024] The recording units 20Y, 20M, 20C, and 20K have the same configuration, and the recording heads 22Y, 22M, 22C, and 22K have the same configuration. In the present embodiment, when the recording units 20Y, 20M, 20C, and 20K are not distinguished to each other (when the ink colors are not distinguished) or when they are collectively represented, they are denoted as "recording unit(s) 20". Similarly, the recording heads 22Y, 22M, 22C, and 22K are denoted as "recording head(s) 22". The nozzles 24Y, 24M, 24C, and 24K are denoted as "nozzle(s) 24".

[0025] The recording unit 20 for each color is provided to the upper position of a conveyance surface 12. In the recording unit 20 for each color, the surface (the discharge surface) of the recording heads 22 formed with the nozzles 24 face a recording surface 3 of the recording medium 2 that is set on the conveyance surface 12 of the conveying unit 10 and conveyed. The recording units 20 for respective colors are aligned neighboring to each other in the conveyance direction of the recording medium 2 in the conveying unit 10. The recording units 20 for respective colors may be aligned in the different order than illustrated in FIG. 1 and FIG. 2. The alignment order of the recording units 20 for respective colors is properly determined taking various conditions into consideration. When the recording of the image is made by the inkjet recording apparatus 1, the ink of each color is discharged from the nozzles 24, which are formed in the recording heads 22 each included in the recording unit 20 for each color, toward the recording surface 3 of the recording medium 2, which is set on the conveyance surface 12 and conveyed. The ink of each color discharged from the nozzle 24 is dropped on the recording surface 3.

[0026] The control box 30 includes a control unit 32 and a connection interface (connection I/F) 34, for example. The control unit 32 controls the inkjet recording apparatus 1. The control unit 32 controls the processing for the inkjet recording process regarding the image recording and the like, for example. The control unit 32 includes a circuit board on which electronic parts are mounted, electrical wirings, and so on. At least a part of the components included in the control unit 32 may be provided to the upper part of the recording unit 20. The connection interface 34 is an interface configured to data-communicably connect the inkjet recording apparatus 1 (the control box 30) to an external device 36 such as a personal computer. For example, image data that corresponds to the image to be recorded is inputted to the inkjet

recording apparatus 1 from the external device 36 via the connection interface 34. The control unit 32 controls the processing for the inkjet recording process according to the inputted image data.

[0027] The ink tanks 40Y, 40M, 40C, and 40K store the above-described ink of respective colors used for the image recording, respectively. The ink tank 40Y is an ink tank for storing the yellow ink. The ink tank 40M is an ink tank for storing the magenta ink. The ink tank 40C is an ink tank for storing the cyan ink. The ink tank 40K is an ink tank for storing the black ink. The ink tanks 40Y, 40M, 40C, and 40K have the same configuration. In the present embodiment, when the ink tanks 40Y, 40M, 40C, and 40K are not distinguished to each other (when the ink colors are not distinguished) or when they are collectively represented, they are denoted as "ink tank(s) 40".

[0028] The ink flow paths 50Y, 50M, 50C, and 50K are flow paths through each of which the ink of each color flows. The ink flow path 50Y is a flow path through which the yellow ink flows. The yellow ink that has flowed out of the ink tank 40Y flows through the ink flow path 50Y and is supplied to the plurality of recording heads 22Y included in the recording unit 20Y. The ink flow path 50M is a flow path through which the magenta ink flows. The magenta ink that has flowed out of the ink tank 40M flows through the ink flow path 50M and is supplied to the plurality of recording heads 22M included in the recording unit 20M. The ink flow path 50C is a flow path through which the cyan ink flows. The cyan ink that has flowed out of the ink tank 40C flows through the ink flow path 50C and is supplied to the plurality of recording heads 22C included in the recording unit 20C. The ink flow path 50K is a flow path through which the black ink flows. The black ink that has flowed out of the ink tank 40K flows through the ink flow path 50K and is supplied to the plurality of recording heads 22K included in the recording unit 20K. The ink flow paths 50Y, 50M, 50C, and 50K have the same configuration. In the present embodiment, when the ink flow paths 50Y, 50M, 50C, and 50K are not distinguished to each other (when the ink colors are not distinguished) or when they are collectively represented, they are denoted as "ink flow path(s) 50". Further description of the ink flow paths 50 will be provided later. In FIG. 1, the ink flow paths 50Y, 50M, 50C, and 50K are depicted in a simplified manner.

[0029] The distributors 60Y, 60M, 60C, and 60K are provided on the way of the ink flow paths 50Y, 50M, 50C, and 50K of the corresponding colors, respectively. The distributors 60Y, 60M, 60C, and 60K distribute the ink of respective colors to the recording heads 22Y, 22M, 22C, and 22K, respectively. The distributors 60Y, 60M, 60C, and 60K each has a tubular configuration having a space formed therein. The distributors 60Y, 60M, 60C, and 60K have the same configuration. In the present embodiment, when the distributors 60Y, 60M, 60C, and 60K are not distinguished to each other (when the ink colors are not distinguished) or when they are collectively represented, they are denoted as "distributor(s) 60". Further description of the distributors 60 will be provided later.

< Ink supply and ink circulation >

[0030] In the inkjet recording apparatus 1, by referring to FIG. 3 to FIG. 7, described will be the configuration in which the ink of each color each stored in the ink tank 40 for each color is supplied from the ink tank 40 to the plurality of recording heads 22 included in the recording unit 20 of the corresponding color. Further, by referring to FIG. 3 to FIG. 7, described will be the configuration in which the ink of each color each stored in the ink tank 40 for each color is circulated. The ink is supplied from the ink tank 40 to the recording heads 22 by the following configuration regardless of the ink color. Therefore, in the followings, the description will be provided without specifying the ink color.

[0031] The inkjet recording apparatus 1 has respective units as illustrated in FIG. 3. Each of these units is a mechanism for supplying the ink of a particular color from the ink tank 40 to the plurality of recording heads 22 included in the recording units 20 and circulating it. Specifically, the inkjet recording apparatus 1 has a pump 90, a collection side valve 92, a plurality of supply side valves 94, and a fixing part 96, in addition to the ink flow paths 50 and distributors 60 described above.

[0032] The ink flow path 50 includes an ink inflow path 52, an ink collection flow path 54, and a plurality of ink supply flow paths 56. Each of the ink inflow path 52, the ink collection flow path 54, and the ink supply flow paths 56 is made of a tube, a steel pipe, or the like. The ink inflow path 52 connects the ink tank 40 and the distributor 60. The ink inflow path 52 is a flow path for supplying the ink from the ink tank 40 to the distributor 60. The ink collection flow path 54 connects the distributor 60 and the ink tank 40. The ink collection flow path 54 is a flow path for collecting, in the ink tank 40, the ink that has been supplied to the distributor 60.

[0033] The ink supply flow paths 56 connect the distributor 60 and the plurality of recording heads 22, respectively. That is, the ink supply flow paths 56 are flow path for supplying, to respective of the plurality of recording heads 22, the ink which has been supplied to the distributor 60. In FIG. 3, the depiction of the plurality of recording heads 22 is omitted. Furthermore, in FIG. 3, for each of the plurality of ink supply flow paths 56, depicted is the part up to the half way toward the recording heads 22 side. The ink supply flow paths 56 are provided for the number corresponding to the number of the recording heads 22. For example, as illustrated in FIG. 2, the recording unit 20 for a particular color includes six recording heads 22. In this case, six ink supply flow paths 56 are provided correspondingly to the six recording heads 22. The plural number of the ink supply flow paths 56 may be provided to one recording head 22. For example, the number of the ink supply flow paths 56 to one recording head 22 may be two. In this case, twelve ink supply flow paths

56 are provided to six recording heads 22. The number of the ink supply flow paths 56 is properly determined taking various conditions into consideration. The plurality of ink supply flow paths 56 is set so that the same length is obtained for respective flow paths through which the ink flows out of supply ports 70 of supply parts 68 provided to the distributor 60 described later and is supplied to the recording heads 22.

5 **[0034]** The flow path diameter (the inner diameter) of each flow path of the ink inflow path 52, the ink collection flow path 54, and the ink supply flow paths 56 may be preferably set as follows. For example, the flow path diameter of the ink supply flow path 56 may be preferably set to be smaller than each flow path diameter of the ink inflow path 52 and the ink collection flow path 54. Each flow path diameter of the ink inflow path 52 and the ink collection flow path 54 may be preferably set to the same or close to each other.

10 **[0035]** As illustrated in FIG. 3, the distributor 60 includes an inflow part 61, an outflow part 64, a common flow path 67, a plurality of supply parts 68, and a tubular member 71. The inflow part 61 is provided to a first side end of the distributor 60 (a first side end of the tubular member 71). The inflow part 61 includes a first joint part 62. The first joint part 62 is fixed at the position corresponding to the first side end of the distributor 60 by, for example, being screwed into the tubular member 71. The ink inflow path 52 is connected to the inflow part 61. The connection of the inflow part 61 and the ink inflow path 52 is made by the ink inflow path 52 being connected to the first joint part 62. The first joint part 62 includes an inner flow path formed therein. This inner flow path functions as an inflow port of the ink that flows through the ink inflow path 52 and is supplied to the distributor 60 (hereafter, the inner flow path formed in the first joint part 62 is denoted as "inflow port 63"). That is, the ink supplied from the ink inflow path 52 passes through the inflow port 63 formed inside the first joint part 62 and is supplied to the inside (the common flow path 67) of the distributor 60.

20 **[0036]** The outflow part 64 is provided to a second side end of the distributor 60 (a second side end of the tubular member 71). The outflow part 64 includes a second joint part 65. The second joint part 65 is fixed at the position corresponding to the second side end of the distributor 60 by being screwed into the tubular member 71, for example. The ink collection flow path 54 is connected to the outflow part 64. The connection of the outflow part 64 and the ink collection flow path 54 is made by the ink collection flow path 54 being connected to the second joint part 65. The second joint part 65 includes an inner flow path formed therein. This inner flow path functions as an outflow port of the ink that flows through the inside (the common flow path 67) of the distributor 60 and flows out of the distributor 60 (hereafter, the inner flow path formed in the second joint part 65 is denoted as "outflow port 66"). That is, the ink flowing out of the inside of the distributor 60 passes through the outflow port 66 formed inside the second joint part 65 and is collected in the ink tank 40.

30 **[0037]** The common flow path 67 is formed inside the distributor 60, specifically, inside the tubular member 71. The common flow path 67 communicates with the inflow port 63 of the first joint part 62, the outflow port 66 of the second joint part 65, and each supply port 70 of the plurality of supply parts 68 described later. The ink that has passed through the inflow port 63 flows in the common flow path 67 and is supplied to the outflow port 66 and each of the plurality of supply ports 70. The common flow path 67 extends between the first side end and the second side end of the distributor 60. With respect to the shape of the common flow path 67, the sectional shape orthogonal to the extending direction of the common flow path 67 (hereafter, denoted as "extending direction") is constant along the extending direction. The sectional shape orthogonal to the extending direction is a circle as illustrated in FIG. 5 and FIG. 7, for example. In this case, the common flow path 67 is a tubular space with a constant inner diameter. The sectional shape orthogonal to the extending direction may be an ellipse or a polygon, for example, other than a circle.

40 **[0038]** The plurality of supply parts 68 is provided so as to be aligned in the extending direction at the side surface of the tubular distributor 60 formed by the side surface of the tubular member 71. The supply parts 68 are provided for the number corresponding to the number of the recording heads 22. This is the same as the case of the ink supply flow paths 56 described above. The description in this regard will be omitted. Each supply part 68 includes a third joint part 69. The third joint parts 69 are fixed at the side surface of the tubular distributor 60 by being screwed into the tubular member 71, respectively, for example. The plurality of supply parts 68 is fixed to be vertical to the side surface (the extending direction) of the distributor 60, for example. The ink supply flow paths 56 are connected to respective supply parts 68. The connection of the supply parts 68 and the ink supply flow paths 56 is made by the ink supply flow paths 56 being connected to the third joint parts 69. The third joint part 69 has an inner flow path formed therein. This inner flow path functions as the supply port (the supply port 70) for the ink that flows inside the distributor 60 (the common flow path 67) and flows out of the distributor 60. That is, the ink flowing out of the inside of the distributor 60 passes through the supply port 70 formed inside the third joint part 69 and is supplied to the recording head 22. The tubular member 71 is a straight tubular member. The first joint part 62 and the second joint part 65 are screwed into both ends of the tubular member 71, respectively, as described above. Further, the plurality of third joint parts 69 is screwed into the side surface of the tubular member 71. The inside of the tubular member 71 forms the common flow path 67.

55 **[0039]** In the side surface of the distributor 60, the plurality of supply parts 68 is aligned straight on a virtual line L4 in the extending direction as illustrated in FIG. 4, for example. As illustrated in FIG. 2, FIG. 4 corresponds to the case where the recording unit 20 for a particular color includes six recording heads 22, and thus illustrates six supply parts 68 (the same applies to FIG. 6). In addition, the plurality of supply parts 68 may be aligned in a staggered manner as illustrated

in FIG. 6, for example. In this case, the plurality of supply parts 68 is divided into two groups with half the number thereof, and is aligned on two virtual lines L5 and L6 in the extending direction, respectively. The staggered alignment allows the supply parts 68 to be properly aligned at the side surface of the distributor 60 in case the larger number of the recording heads 22 are included in the recording unit 20 for a particular color, or in case the plural number of the ink supply flow paths 56 are connected to one recording head 22 or in other cases. The supply parts 68 aligned on the virtual line L5 and the supply parts 68 aligned on the virtual line L6 are provided inclined by an angle $\theta 8$ with respect to a reference line L7 so that the opening directions of the supply ports 70 are opposite, as illustrated in FIG. 7. In FIG. 4 and FIG. 6, the depiction of the inflow part 61 and the outflow part 64 at the first side end and the second side end of the distributor 60 is omitted.

[0040] As illustrated in FIG. 3, the distributor 60 is provided to the inkjet recording apparatus 1 in such an installation state that the extending direction inclines with respect to the horizontal direction. Under this installation state, the distributor 60 is set such that the second side end of the distributor 60 is located upper than the first side end in the vertical direction. Under this installation state, the distributor 60 is installed so that the opening direction of the supply port 70 is directed downward in the vertical direction than in the horizontal direction. The inclination angle $\theta 9$ made by the extending direction with respect to the horizontal direction is properly determined taking various conditions into consideration. The inventors conducted an experiment in view of preferably separating the bubble that is contained in the ink supplied to the recording head 22. From this experiment, the inventors have concluded that 45 degrees is one of the preferable angles for the inclination angle $\theta 9$.

[0041] As illustrated in FIG. 3, the first joint part 62 has a such structure that a predetermined range of the common flow path 67 side in the inflow port 63 (see the range labeled with the reference sign "631" in FIG. 3 and, hereafter, denoted as "range 631") has a straight shape. The first joint part 62 is provided to the first side end of the distributor 60 so that the range 631 is in a state inclined by the inclination angle $\theta 9$ with respect to the horizontal direction. The second joint part 65 has a such structure that a predetermined range of the common flow path 67 side in the outflow port 66 (see the range labeled with the reference sign "661" in FIG. 3 and, hereafter, denoted as "range 661") has a straight shape, as illustrated in FIG. 3. The second joint part 65 is provided to the second side end of the distributor 60 so that the range 661 is in a state inclined by the inclination angle $\theta 9$ with respect to the horizontal direction.

[0042] The sectional area of the common flow path 67 (the area of the cross section of the above-described common flow path 67) is preferably set larger than the sectional area of the inflow port 63. The flow velocity of the ink that has passed through the inflow port 63 and flowed into the common flow path 67 can be reduced in the common flow path 67. The reduced flow velocity allows for improved efficiency in the separation of the bubble contained in the ink. The sectional area of the inflow port 63 is an area of the cross section orthogonal to the extending direction in the predetermined range 631 of the common flow path 67 side in the inflow port 63, for example. The opening area of one supply port 70 is preferably smaller than the sectional area of the common flow path 67. This can suppress that the bubble contained in the ink flowing in the common flow path 67 is mixed in the supply port 70.

[0043] The pump 90 functions as a liquid delivery unit for liquid-delivering the ink via the ink flow path 50 and the distributor 60. The pump 90 is provided on the way of the ink inflow path 52, as illustrated in FIG. 3. Upon the pump 90 being driven, the ink stored in the ink tank 40 flows out of the ink tank 40. The ink then flows through the ink inflow path 52, the distributor 60, and the ink supply flow path 56 and is supplied to the plurality of recording heads 22. Further, the ink that has flowed out of the ink tank 40 by the pump 90 being driven flows through the ink inflow path 52, the distributor 60, and the ink collection flow path 54 and is collected in the ink tank 40. In this case, the ink is circulated through the previously-described flow paths and the like.

[0044] The collection side valve 92 is provided on the way of the ink collection flow path 54. The collection side valve 92 is a valve for opening and shutting the ink collection flow path 54. The collection side valve 92 is made of an electromagnetic valve, for example. The plurality of the supply side valves 94 is provided on the way of respective of the plurality of ink supply flow paths 56. The number of the supply side valves 94 of the inkjet recording apparatus 1 corresponds to the number of the ink supply flow paths 56. The supply side valve 94 is a valve for opening and shutting the ink supply flow path 56 to which each supply side valve 94 is provided. The supply side valve 94 is made of an electromagnetic valve, for example.

[0045] The fixing part 96 is a component for fixing the plurality of supply side valves 94 thereto. The fixing part 96 is formed by processing the plate-like member, for example. The fixing part 96 is attached to stays 100 provided to a frame (not shown) of the inkjet recording apparatus 1 by a screwing and the like, for example. At this time, the fixing part 96 is in a state where a fixing surface 98 to which respective supply side valves 94 are fixed is inclined by the inclination angle $\theta 9$ with respect to the horizontal direction. That is, the fixing part 96 is provided to the inkjet recording apparatus 1 so that the fixing surface 98 is in a state arranged along the side surface of the distributor 60.

[0046] The plurality of supply side valves 94 is aligned and fixed to the fixing surface 98 so as to be in an alignment state (an arrangement state) that corresponds to the alignment (the arrangement) of the plurality of supply parts 68 connected via the ink supply flow paths 56. Therefore, the plurality of supply side valves 94 is fixed to the fixing surface 98 so that, in the distributor 60 in the above-described installation state, the supply side valve 94 provided on the way

of the ink supply flow path 56 that is connected to the supply part 68 provided at an upper position in the vertical direction is located upper in the vertical direction. When the plurality of supply parts 68 is aligned as illustrated in FIG. 4 and FIG. 5, the plurality of supply side valves 94 are aligned straight correspondingly to the plurality of supply parts 68 aligned straight on the virtual line L4. When the plurality of supply parts 68 is aligned as illustrated in FIG. 6 and FIG. 7, the plurality of supply side valves 94 is aligned in a staggered manner correspondingly to the plurality of supply parts 68 aligned in a staggered manner based on the virtual lines L5 and L6. The plurality of supply side valves 94 is the valves common to each other. Thus, even under the state where the supply side valves 94 are provided on the way of respective ink supply flow paths 56, the lengths of the flow paths through which the ink flows out of the supply port 70 and is supplied to the recording heads 22 (the lengths of the ink supply flow paths 56) are the same. In the fixing part 96, the fixing surface 98 may be formed stepwise along the inclination angle $\theta 9$. This case also allows for the same flow path length of the ink supply flow paths 56, as described previously.

[0047] The opening and shutting of the collection side valve 92 and the supply side valves 94 and the opening degrees when opened are controlled by the control unit 32 included in the control box 30. Described will be the opening and shutting of the collection side valve 92 and the supply side valves 94 for the case where the ink is supplied to the recording heads 22 and for the case where the ink is circulated without being supplied to the recording heads 22. When the image is recorded on the recording medium 2 in the inkjet recording apparatus 1, the pump 90 is in a driving state. The collection side valve 92 is either opened or shut. The plurality of supply side valves 94 is opened, respectively. At this time, the plurality of supply side valves 94 is opened at a predetermined opening degree, respectively. The opening and shutting of the collection side valve 92 is controlled depending on the total supply amount to the recording heads 22. For example, when the amount of the ink discharged from the nozzles 24 increases and, as a result, much ink is supplied to respective recording heads 22, the collection side valve 92 is in a shut state or in a slightly opened state. On the other hand, when the amount of the ink discharged from the nozzles 24 decreases and, as a result, less ink is supplied to respective recording heads 22, the collection side valve 92 is in a fully opened state or close to a fully opened state, for example. The opening degrees for all the supply side valves 94 may be the same. Alternatively, the opening degrees of respective supply side valves 94 may be adjusted to be different degrees for respective supply side valves 94.

[0048] When no image is recorded on the recording medium 2 in the inkjet recording apparatus 1, the pump 90 is in a driving state. The collection side valve 92 is opened. The plurality of supply side valves 94 is shut, respectively. The opening and shutting of the collection side valve 92 and the supply side valves 94 and the opening degrees when opened may be controlled by color. For example, when a monochrome image is recorded on the recording medium 2, the collection side valve 92 and the supply side valve 94 for the supply and circulation of the black ink only is to be controlled. The collection side valve 92 and the supply side valves 94 for the supply and circulation for the colors other than black are controlled similarly to the case where no image is recorded in the inkjet recording apparatus 1. Also when a color image is recorded on the recording medium 2, the opening and shutting of the collection side valve 92 and the supply side valves 94 and the opening degrees when opened may be controlled by color.

< Advantages by the present embodiment >

[0049] The present embodiment allows for the following advantages.

[0050]

(1) The distributor 60 is provided to the inkjet recording apparatus 1 so as to be in the state (the installation state) as illustrated in FIG. 3. This installation state is the state where the second side end of the distributor 60 is located upper than the first side end in the vertical direction, the extending direction is inclined with respect to the horizontal direction, and the opening direction of the supply port 70 is directed downward in the vertical direction than in the horizontal direction. The ink that has flowed in the distributor 60 flows in the common flow path 67 from the lower part to the upper part thereof in the vertical direction along the extending direction. The bubble that is contained in the ink to be supplied to the recording heads 22 flows along the flow of the ink inside the common flow path 67 and moves upward in the vertical direction by the buoyancy. This suppresses that the bubble moves to the supply port 70 side opened downward in the vertical direction than in the horizontal direction, so that the bubble can be preferably separated. The distributor is not required to have a special shape for the separation of the bubble, which allows for the simple distributor 60. The bubble that has moved upward in the vertical direction can be exhausted smoothly from the outflow port 66.

(2) The range 631 of the inflow port 63 and the range 661 of the outflow port 66 that communicate with the common flow path 67 are inclined by the inclination angle $\theta 9$ which is the same angle as the extending direction of the common flow path 67, with respect to the horizontal direction. This allows the ink liquid-delivered via the ink inflow path 52 to smoothly flow into the common flow path 67. The ink which has flowed into the common flow path 67 and is collected in the ink tank 40 without being supplied to the recording heads 22 can be smoothly exhausted from the common flow path 67 and flow into the ink collection flow path 54. This allows for the preferable circulation of the ink.

(3) The plurality of ink supply flow paths 56 respectively has the same length of the flow paths through which the ink flows out of the supply port 70 of the supply part 68 provided to the side surface of the distributor 60 and is supplied to the recording heads 22. This allows the ink flowing out of respective supply ports 70 to flow in the same manner for respective of the plurality of ink supply flow paths 56. When the ink is supplied to the plurality of recording heads 22 via different ink supply flow paths 56, the ink can be supplied to respective recording heads 22 in the same state.

The supply side valves 94 are provided on the way of respective of the plurality of ink supply flow paths 56. The plurality of supply side valves 94 is fixed in the following manner to the fixing part 96 of which the fixing surface 98 is inclined by the inclination angle θ_9 with respect to the horizontal direction. That is, the plurality of supply side valves 94 is fixed in the alignment state (the arrangement state) corresponding to the alignment (the arrangement) of the plurality of supply parts 68 connected via the ink supply flow paths 56. Thus, even when the supply side valves 94 are provided on the way of the ink supply flow paths 56, respective of the plurality of ink supply flow paths 56 can be set to have the same flow path length. In other words, for respective of the plurality of ink supply flow paths 56, the same flow path length can be obtained between the supply port 70 and the supply side valve 94, and the same flow path length can be obtained between the supply side valve 94 and the recording heads 22.

(4) When an image is recorded on the recording medium 2 in the inkjet recording apparatus 1, the pump 90 is driven, the collection side valve 92 is either opened or shut, and the plurality of supply side valves 94 is opened, respectively. The collection side valve 92 has an opening degree between open and shut depending on an amount of the ink that flows in respective of the plurality of ink supply flow paths 56 to be supplied to respective of the plurality of recording heads 22. Therefore, when the image is recorded on the recording medium 2 in the inkjet recording apparatus 1, the ink can be preferably supplied to respective of the plurality of recording heads 22. The ink amount supplied to the plurality of recording heads 22 can be adjusted, respectively. When no image is recorded on the recording medium 2 in the inkjet recording apparatus 1, the pump 90 is driven, the collection side valve 92 is opened, and the plurality of supply side valves 94 is shut, respectively. Therefore, when no image is recorded on the recording medium 2 in the inkjet recording apparatus 1, the ink can be collected in the ink tank 40 and preferably circulated. When no image is recorded on the recording medium 2 in the inkjet recording apparatus 1, the circulation of the ink can suppress the precipitation of respective components including the colorant contained in the ink.

< Modified examples >

[0051] The present embodiment can be modified as follows.

[0052]

(1) In the above description, a line-type inkjet recording apparatus has been described as the example of the inkjet recording apparatus 1. However, the inkjet recording apparatus may be a serial-type inkjet recording apparatus. The above-described advantages can be obtained also in the serial-type inkjet recording apparatus which employs the same configuration as respective parts as described above.

(2) In the above description, yellow, magenta, cyan, and black have been described as the example for the colors of the ink used in the image recording. However, the ink of different colors than these colors may be used. For example, in addition to the four colors or in place of any one of these colors, light cyan, light magenta, and light yellow which are the light color system of each color of cyan, magenta, and yellow, and/or clear may be used. In this case, the inkjet recording apparatus 1 has the same respective components as described above corresponding to the ink of the added or replaced colors. This also allows for the advantages as described above.

(3) In the above description, the inkjet recording apparatus 1 in which one distributor 60 is provided to one recording unit 20 has been described. However, a plurality of distributors 60 may be provided to one recording unit 20. For example, as illustrated in FIG. 2, it is assumed that the recording unit 20 for a particular color includes six recording heads 22. In this case, provided may be two distributors 60 each including supply parts 68 the number of which corresponds to three recording heads 22. Also, provided may be three distributors 60 each including supply parts 68 the number of which corresponds to two recording heads 22. The plurality of distributors 60 is provided to the inkjet recording apparatus 1 such that respective distributors 60 are in a state aligned in a predetermined direction and in the above-described installation state.

The ink inflow path 52 includes, at a predetermined position, branch flow paths that are divided into the number corresponding to the number of the distributors 60. Respective branch flow paths of the ink inflow paths 52 are connected to the inflow parts 61 provided to respective of the plurality of distributors 60. The ink collection flow path 54 includes branch flow paths that are divided into the number corresponding to the number of the distributors 60. Respective branch flow paths of the ink collection flow paths 54 are connected to the outflow parts 64 provided to respective of the plurality of distributors 60. The branch flow paths of the ink collection flow paths 54 connected to respective outflow parts 64 are joined into one flow path at a predetermined position. The ink inflow paths 52 and/or

the ink collection flow paths 54 the number of which corresponds to the number of the distributors 60 may be provided. In this case, the plurality of distributors 60 and the ink tanks 40 are connected by the ink inflow paths 52 the number of which corresponds to the number of the distributors 60 and/or the ink collection flow paths 54 the number of which corresponds to the number of the distributors 60. When the ink inflow paths 52 are provided for the number corresponding to the number of the distributors 60, the pump 90 or the following liquid delivery unit is provided at a position on the way of respective ink inflow paths 52. This also allows for the above-described advantages.

(4) In the above description, the pump 90 has been described as the example of the liquid delivery unit for liquid-delivering the ink via the ink flow path 50 and the distributor 60. The liquid delivery of the ink may be implemented by a pressure transfer system. In this case, the liquid delivery unit in the inkjet recording apparatus 1 includes a pressure tank and the like in addition to the pump 90. In the liquid delivery unit in the pressure transfer system, the pump 90 may be a smaller pump compared to in the case of the above-described configuration. The pressure tank is provided at a position on the way of the ink inflow path 52 that is the distributor 60 side of the pump 90. Upon the pump 90 being driven, the ink flows out of the ink tank 40. The ink that has flowed out flows through the inflow path 52 and flows into the pressure tank. The pressure tank is the tank for pressurizing the ink flowing in the ink flow path 50. The pressurization of the ink in the pressure tank is done by the pressurization mechanism connected to the pressure tank. The pressurization mechanism pressurizes the ink stored in the pressure tank by sending a compressed air to the inside of the pressure tank to cause the inner pressure of the pressure tank to be higher than the atmospheric pressure. Such liquid delivery unit of the pressure transfer system is driven by that the compressed air is supplied to the pressure tank with a predetermined amount of the ink being stored in the pressure tank. The ink that has been stored and pressurized in the pressure tank flows out of the pressure tank and again flows in the ink inflow path 52 and the like, as described above. This also allows for the advantages as described above.

DESCRIPTION OF REFERENCE SIGNS

[0053]

1	Inkjet recording apparatus
2	Recording medium
3	Recording surface
10	Conveying unit
12	Conveyance surface
20, 20Y, 20M, 20C, 20K	Recording unit
22, 22Y, 22M, 22C, 22K	Recording head
24, 24Y, 24M, 24C, 24K	Nozzle
30	Control box
32	Control unit
34	Connection interface
36	External device
40, 40Y, 40M, 40C, 40K	Ink tank
50, 50Y, 50M, 50C, 50K	Ink flow path
52	Ink inflow path
54	Ink collection flow path
56	Ink supply flow path
60	Distributor
61	Inflow part
62	First joint part
63	Inflow port
64	Outflow part
65	Second joint part
66	Outflow port
67	Common flow path
68	Supply part
69	Third joint part
70	Supply port
71	Tubular member
90	Pump
92	Collection side valve

94	Supply side valve
96	Fixing part
98	Fixing surface
100	Stay
5 631, 661	Range

Claims

- 10 1. An inkjet recording apparatus for recording an image on a recording medium, the inkjet recording apparatus comprising:

an ink tank configured to store ink of a particular color;
 a plurality of recording heads in which nozzles configured to discharge the ink are formed;
 15 an ink flow path through which the ink flows;
 a tubular distributor provided on the way of the ink flow path and configured to distribute, to respective of the plurality of recording heads, the ink that flows through the ink flow path and is supplied from the ink tank; and
 a liquid delivery unit configured to liquid-deliver, via the ink flow path and the distributor, the ink supplied to the plurality of recording heads from the ink tank and collected in the ink tank,
 20 wherein the ink flow path includes:

an ink inflow path for connecting the ink tank and the distributor and supplying the ink to the distributor from the ink tank;

an ink collection flow path for connecting the distributor and the ink tank and collecting, in the ink tank, the ink supplied to the distributor; and

a plurality of ink supply flow paths for connecting the distributor and respective of the plurality of recording heads and supplying the ink supplied to the distributor to respective of the plurality of recording heads,

wherein the distributor includes:

an inflow part including an inflow port to which the ink inflow path is connected and into which the ink flows;
 an outflow part including an outflow port to which the ink collection flow path is connected and out of which the ink flows;

a plurality of supply parts each including supply ports to which respective of the plurality of ink supply flow paths is connected, and out of which the ink flows; and

a common flow path formed inside the distributor, communicating with the inflow port, the outflow port, and the plurality of supply ports, and configured to cause the ink flowing out of the inflow port to flow therein and supply the ink to the outflow port and the plurality of supply ports, respectively,

wherein the inflow part is provided to a first side end of the tubular distributor,

wherein the outflow part is provided to a second side end of the tubular distributor,

wherein the common flow path extends between the first side end and the second side end,

wherein respective of the plurality of supply parts are provided so as to be aligned at a side surface of the tubular distributor in an extending direction of the common flow path, and

wherein the distributor is provided to the inkjet recording apparatus in such an installation state that the second side end is located upper than the first side end in a vertical direction, the extending direction of the common flow path is inclined with respect to a horizontal direction, and an opening direction of the supply port is directed downward in the vertical direction than in the horizontal direction.

2. The inkjet recording apparatus according to claim 1,

wherein the inflow part includes a first joint part connected to the ink inflow path and formed with the inflow port,
 wherein the outflow part includes a second joint part connected to the ink collection flow path and formed with the outflow port,

wherein the first joint part is provided to the first side end such that a predetermined range of the common flow path side in the inflow port is inclined by as much as an inclination angle made by the extending direction of the common flow path with respect to the horizontal direction, and

wherein the second joint part is provided to the second side end such that a predetermined range of the common flow path side in the outflow port is inclined by as much as the inclination angle.

3. The inkjet recording apparatus according to claim 1 or 2, wherein, for the plurality of ink supply flow paths, lengths of respective flow paths through which the ink flows out of the supply port and is supplied to the recording head are set to be the same.

4. The inkjet recording apparatus according to claim 3 further comprising:

a plurality of supply side valves provided on the way of respective of the plurality of ink supply flow paths and configured to open and shut the respective of the ink supply flow paths; and
a fixing part including a fixing surface to which the plurality of supply side valves is fixed, respectively,
wherein the fixing part is provided to the inkjet recording apparatus such that the fixing surface is inclined by as much as an inclination angle made by the extending direction of the common flow path with respect to the horizontal direction, and
wherein the plurality of supply side valves is fixed to the fixing surface so that, in the distributor in the installation state, the supply side valve provided on the way of the ink supply flow path that is connected to the supply part provided at an upper position in the vertical direction is located upper in the vertical direction.

5. The inkjet recording apparatus according to claim 4 further comprising:

a collection side valve provided on the way of the ink collection flow path and configured to open and shut the ink collection flow path,
wherein, when an image is recorded on a recording medium in the inkjet recording apparatus,
the liquid delivery unit is driven,
the collection side valve is either opened or shut, and
the plurality of supply side valves is opened, respectively, wherein, when no image is recorded on a recording medium in the inkjet recording apparatus,
the liquid delivery unit is driven,
the collection side valve is opened, and
the plurality of supply side valves is shut, respectively.

6. The inkjet recording apparatus according to claim 5, wherein, when an image is recorded on a recording medium in the inkjet recording apparatus, the collection side valve has an opening degree between open and shut depending on an amount of the ink that flows in respective of the plurality of ink supply flow paths to be supplied to respective of the plurality of recording heads.

FIG. 1

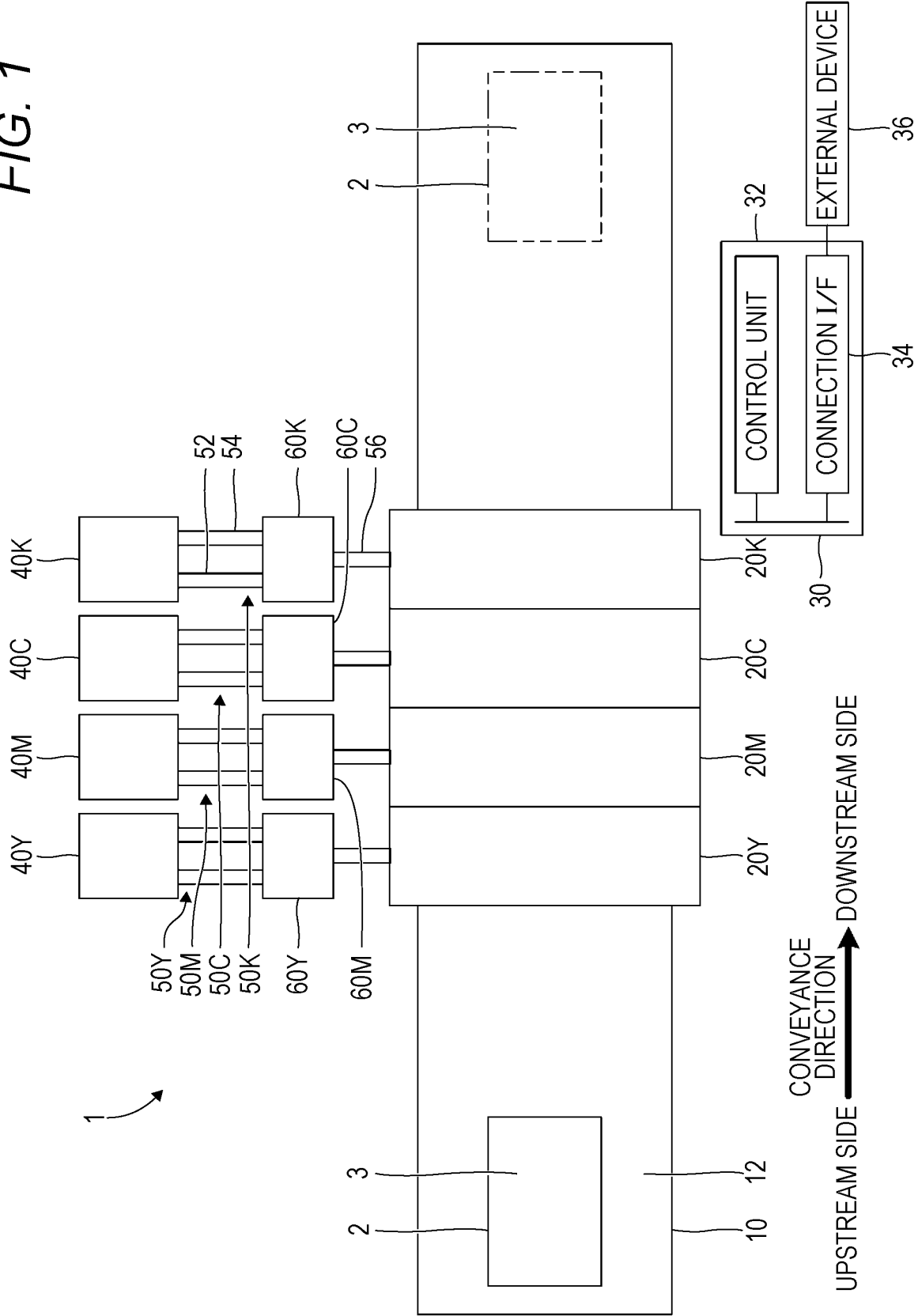


FIG. 2

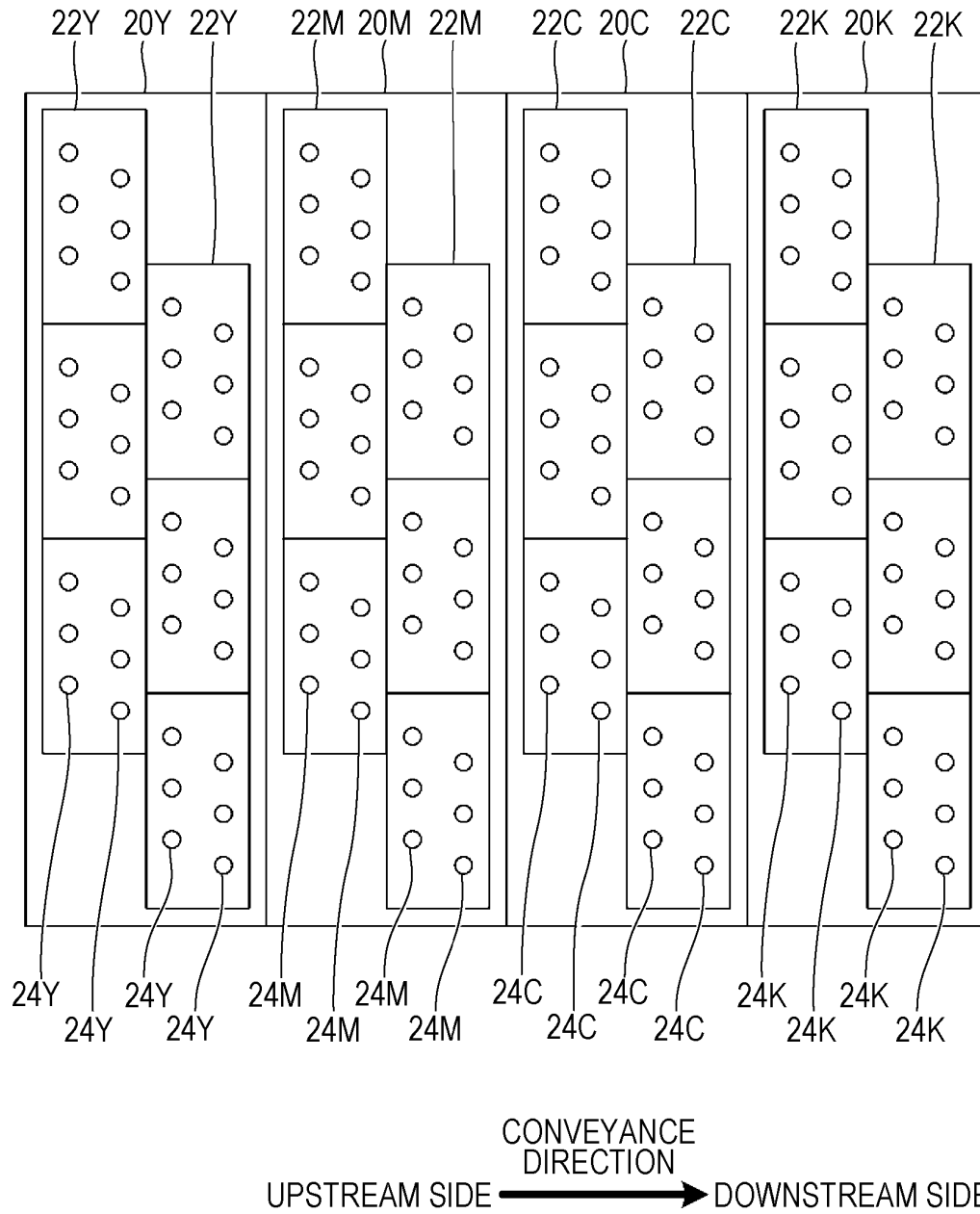


FIG. 3

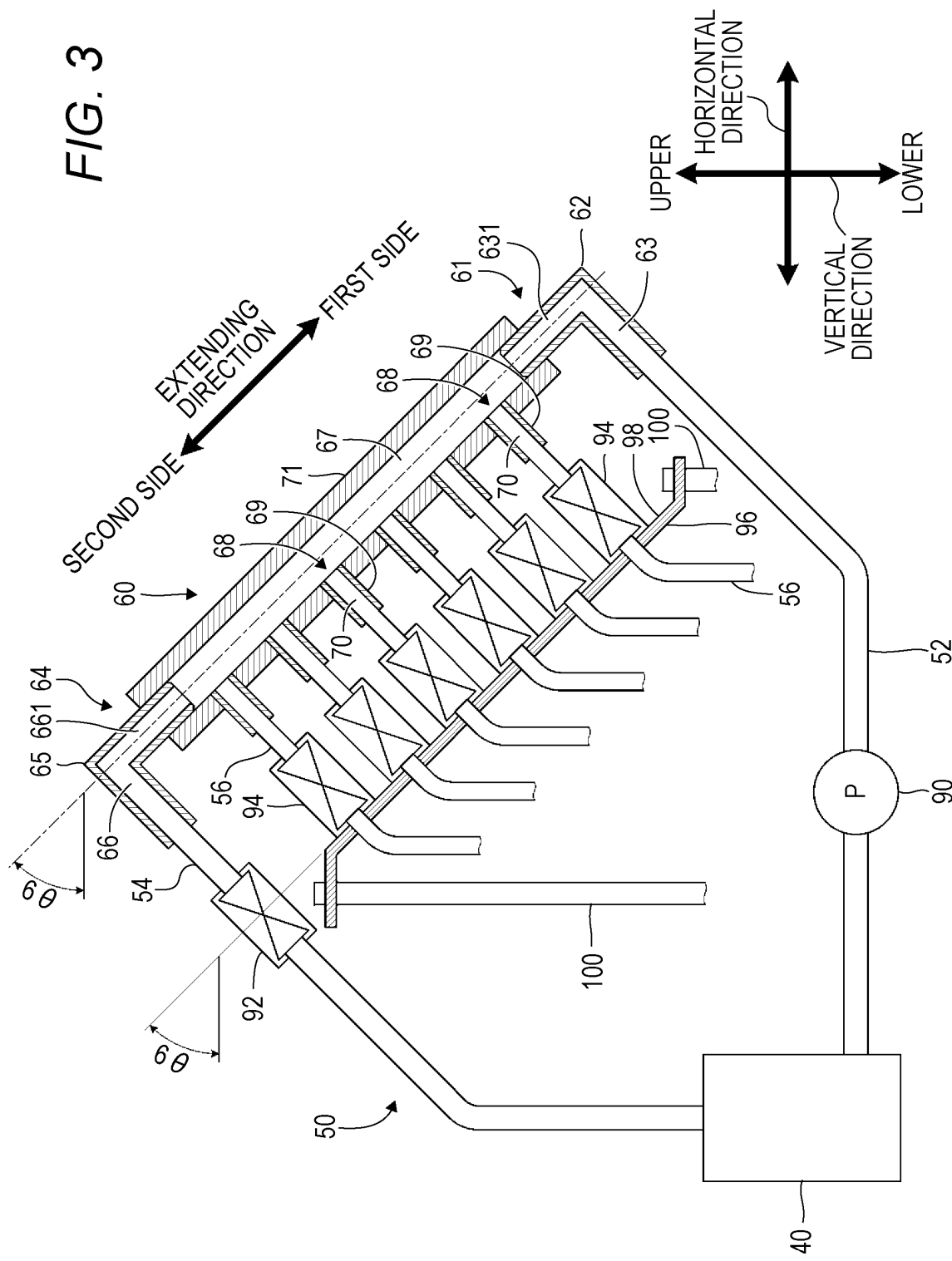


FIG. 4

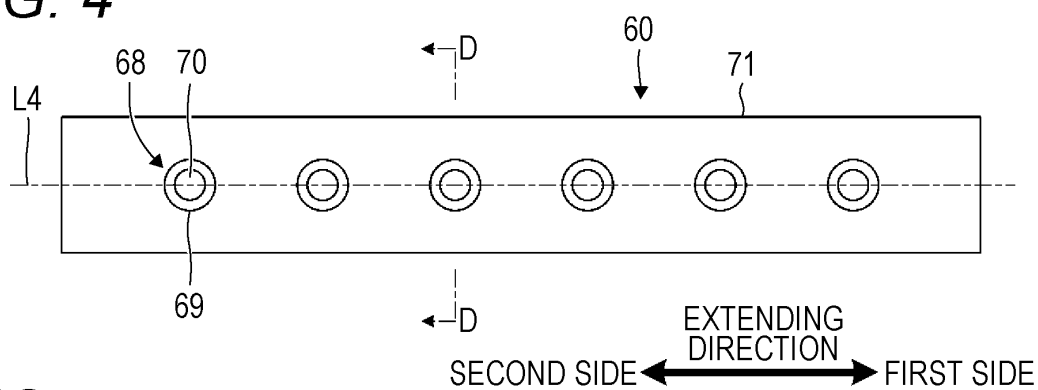


FIG. 5

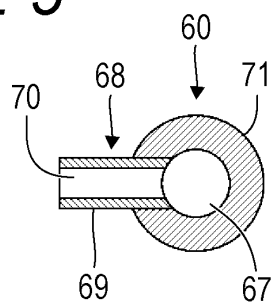


FIG. 6

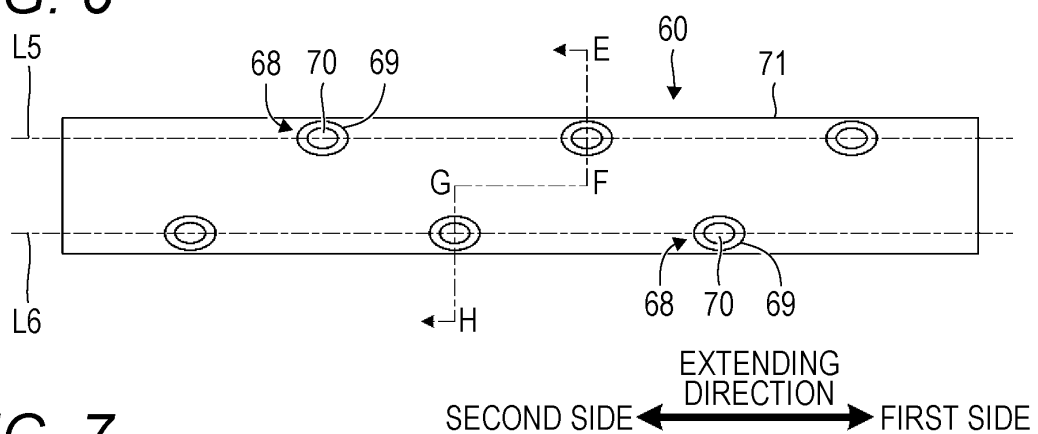
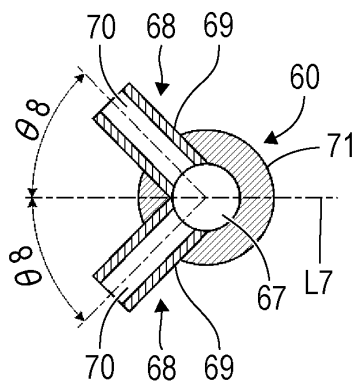


FIG. 7



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/050286

A. CLASSIFICATION OF SUBJECT MATTER

B41J2/175 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B41J2/175

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2013
Kokai Jitsuyo Shinan Koho	1971-2013	Toroku Jitsuyo Shinan Koho	1994-2013

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2006-281532 A (Toppan Printing Co., Ltd.), 19 October 2006 (19.10.2006), entire text; all drawings (Family: none)	1-6
A	JP 2009-51046 A (Canon Inc.), 12 March 2009 (12.03.2009), entire text; all drawings & US 2009/0219334 A1	1-6
A	JP 2011-79169 A (Fujifilm Corp.), 21 April 2011 (21.04.2011), entire text; all drawings & US 2011/0080456 A1 & EP 2305472 A1	1-6

☒ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

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Date of the actual completion of the international search
21 February, 2013 (21.02.13)Date of mailing of the international search report
05 March, 2013 (05.03.13)Name and mailing address of the ISA/
Japanese Patent Office

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/050286

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2011-46131 A (Ricoh Co., Ltd.), 10 March 2011 (10.03.2011), entire text; all drawings & US 2011/0050814 A1	1-6
A	JP 2008-30333 A (Ricoh Co., Ltd.), 14 February 2008 (14.02.2008), entire text; all drawings (Family: none)	1-6
A	JP 2007-75753 A (Toppan Printing Co., Ltd.), 29 March 2007 (29.03.2007), entire text; all drawings (Family: none)	1-6

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REFERENCES CITED IN THE DESCRIPTION

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- JP 2011046131 A [0006]
- JP 4784129 B [0006]
- JP 2011079169 A [0006]