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(71) Applicant: **Konica Minolta, Inc.**
Tokyo 100-7015 (JP)

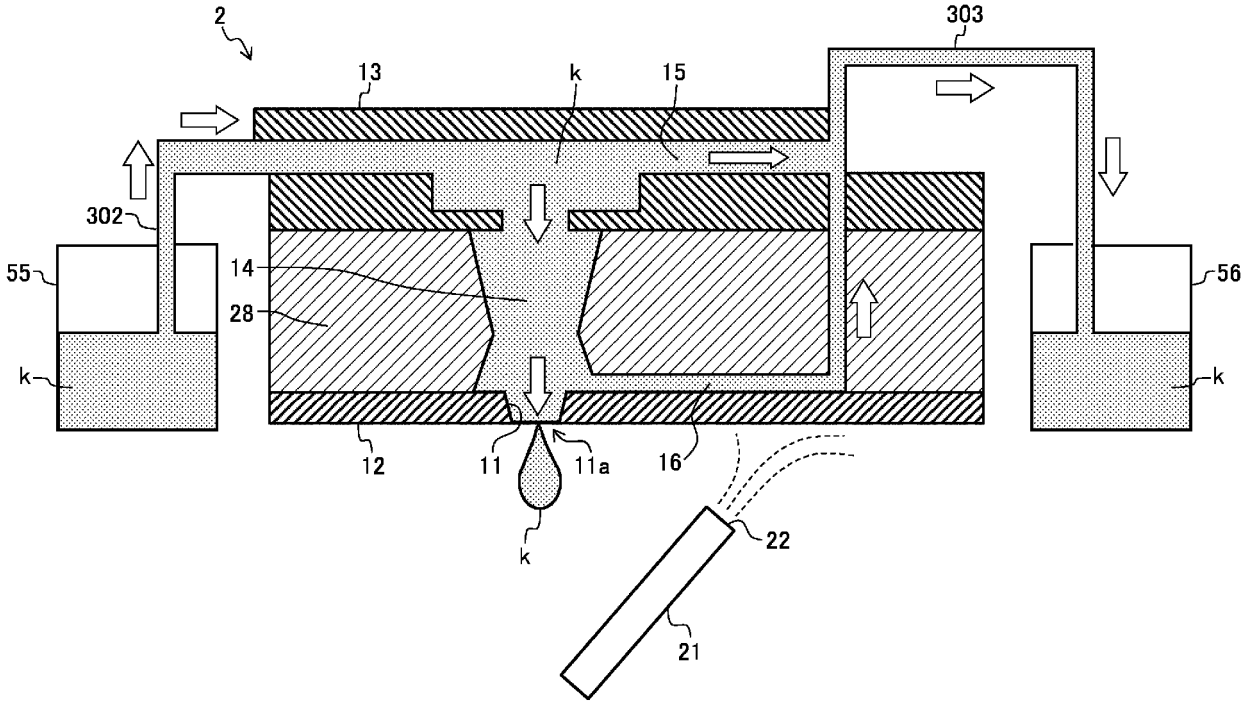
(72) Inventor: **TSUBOTANI, Shingo**
Tokyo, 100-7015 (JP)

(74) Representative: **Gille Hrabal**
Partnerschaftsgesellschaft mbB
Patentanwälte
Brucknerstraße 20
40593 Düsseldorf (DE)

(54) **INKJET RECORDING APPARATUS AND INKJET RECORDING METHOD**

(57) An inkjet recording apparatus includes an inkjet head (2) for ejecting ink k from an ink nozzle (11), a circulating device for circulating the ink (k) between the inkjet head (2) and its outside, an air blowing device (21) for blowing air toward an ink nozzle surface (11a) of the inkjet head (2) to blow off foreign matters and mist generated from the ejected ink (k), and a controller that controls the circulating device (29) to make a circulation differential pressure for circulating the ink k lower when the air blowing device (21) is blowing the air compared to when the inkjet head (2) is driven to form an image.

FIG. 1



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Description

BACKGROUND

Technical Field

[0001] The present invention relates to an inkjet recording apparatus and an inkjet recording method.

Related Art

[0002] An inkjet head used in an inkjet recording apparatus ejects ink from ink nozzles to form an image. When ink is ejected from the ink nozzles, mist containing minute ink particles derived from the ink swirls in the air. The ink particles in the mist adhere to the ink nozzle surface of the inkjet head. Furthermore, a foreign substance such as dust also adheres to the ink nozzle surface due to the adhered ink. If these mists or foreign substances adhering to the ink nozzle face remain, the mists or foreign substances interfere with ink ejection from the nozzles or bend the ink ejection direction.

SUMMARY

[0003] In order to address this problem, Patent Document 1 (Japanese Unexamined Patent Publication No. H 4-16356) discloses a technique for blowing off the mist in the air by bowing air, thereby preventing adhesion of mist and foreign matters to the ink nozzle surface. Furthermore, Patent Document 1 also mentions circulating ink in an inkjet head.

[0004] With the technology of Patent Document 1, the above-described problem of adhesion of mist and foreign matter to the ink nozzle surface can be addressed. However, when air is blown to the ink nozzle surface as in the technology of Patent Document 1, the ink nozzle surface gets dried by the air. In addition, when air is drawn in the ink nozzle, a defect is likely to occur in the ejection of the ink from the ink nozzle. On the other hand, if the ink in the vicinity of the nozzles in the inkjet head is circulated between the inside of the inkjet head and the outside of the inkjet head, it is possible to suppress the drying of the ink nozzle surface and the entrainment of air into the ink nozzles. Thus, it can be expected that occurrence of failure in ink ejection from the nozzles will be suppressed.

[0005] However, in the above-described blowing of the air, the air is blown to substantially all the nozzles of the inkjet head. If the circulation differential pressure when circulating the ink is large, the large circulation differential pressure increases the flow of the ink in the inkjet head, which results in inrease in the amount of air entrained in the inkjet head from the ink nozzle. For this reason, there is a problem that it is not possible to sufficiently prevent the occurrence of defects in the ejection of ink from the ink nozzles. Therefore, an object of the present invention is to provide an inkjet recording apparatus and an inkjet recording method capable of sufficiently preventing the occurrence of a defect in ink ejection from an ink nozzle.

(1) The present invention is an inkjet recording apparatus including: an inkjet head that ejects ink from ink nozzles; a circulation device that circulates the ink between the inkjet head and an outside thereof; an air blowing device that is directed to an ink nozzle surface of the inkjet head; and a controller that controls the circulation device to make a circulation pressure difference for circulating the ink lower when the air blowing device is blowing air compared to when the inkjet head is driven to form an image.

(2) The inkjet recording apparatus according to (1) may be configured in such a manner that the circulation device circulates the ink by a pressure difference between an inlet side of the inkjet head and an outlet side of the inkjet head.

(3) In addition, the inkjet recording apparatus according to (1) may be a scan type, wherein the air blowing device may blow the air when the inkjet head is at a position other than a position at which the image formation is performed.

(4) The inkjet recording apparatus according to (3), wherein the air blowing device may blow the air after a carriage that moves the inkjet head has moved to a maintenance section.

(5) Furthermore, the inkjet recording apparatus according to (1) may be a single-pass type, wherein a plurality of air nozzles of the air blowing device may be arranged corresponding to a plurality of the inkjet heads.

(6) In addition, the inkjet recording apparatus according to (1) may include a moving device that moves the air nozzles of the air blowing devices in the subscanning direction along the arrangement of the plurality of inkjet heads.

(7) In addition, the inkjet recording apparatus according to (1) may be configured in such a manner that the air blowing device is capable of changing the wind speed of the blown air, and the controller may increase the circulation differential pressure in accordance with an increase in the wind speed.

(8) The inkjet recording apparatus according to (1) may further include a shield member that prevents a foreign substance and a mist blown off by the air from the air blowing device from adhering to an image forming medium that is an object on which the image is formed by ejection of the ink.

(9) In addition, the inkjet recording apparatus accord-

ing to (1) may be configured in such a manner that the controller may set the circulation differential pressure to be equal to or lower than a break pressure.

(10) Furthermore, the inkjet recording apparatus according to (1) may be configured in such a manner that the controller may determine an inkjet head whose frequency of use is higher than or equal to a predetermined degree among a plurality of inkjet heads based on image data for forming the image with the inkjet heads, and the controller controls the air blowing device to blow the air exclusively to the determined inkjet head.

(11) In addition, the inkjet recording apparatus according to (1) may be a scanning type, wherein the air blowing device may blow off the foreign matter and the mist to a scanning direction side by the air when the inkjet head moves for scanning.

(12) The inkjet recording apparatus according to (1) may be a scanning type, wherein the air blowing device may blow the air in every scanning.

(13) The inkjet recording apparatus according to (1) may be a scanning type, wherein air nozzles of the air blowing device may be directed away from an image forming medium that is an object on which image formation is performed by ejection of the ink, and the air blowing device may blow the air when a carriage that moves the inkjet head moves to the side of the image forming medium.

(14) Another aspect of the present invention is an inkjet recording method performed by an inkjet recording apparatus including : an inkjet head that ejects ink from ink nozzles; a circulation device to circulate the ink between the inkjet head and an outside thereof; an air blowing device that blows air toward an ink nozzle face of the inkjet head, and a controller, the method including a step of allowing the controller to controll the circulation device to reduce a circulation differential pressure of the ink when the air blowing device blows the air compared to when the inkjet head is driven to form an image.

Advantageous Effects

[0006] According to the present invention, it is possible to provide an inkjet recording apparatus and an inkjet recording method that can sufficiently prevents occurrence of failure in ink ejection from ink nozzles.

BRIEF DESCRIPTION OF DRAWINGS

[0007]

Fig. 1 is a conceptual diagram illustrating a structure of an inkjet head used in an inkjet recording apparatus according to the first embodiment of the present invention and the periphery thereof.

Fig. 2 is a system diagram illustrating a configuration of a circulation device used in the inkjet recording apparatus according to the first embodiment of the present invention.

Fig. 3 is a longitudinal sectional view of essential parts of the inkjet recording apparatus according to the first embodiment of the present invention.

Fig. 4 is a block diagram schematically illustrating the electrical connection of the control system of the inkjet recording apparatus according to the first embodiment of the present invention.

Fig. 5 is a flowchart illustrating control executed by the inkjet recording apparatus according to the first embodiment of the present invention.

Fig. 6 is a longitudinal sectional view of an inkjet recording apparatus according to the second embodiment of the present invention.

Fig. 7 is a plan view of an air blowing device of an inkjet recording apparatus according to the second embodiment of the present invention.

Fig. 8 is a side view of an air blowing device of an inkjet recording apparatus according to the second embodiment of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS

[0008] Hereinafter, a plurality of embodiments of the present invention will be described.

<First Embodiment>

[0009] The inkjet recording apparatus according to the first embodiment of the present invention is a scanning-type inkjet recording apparatus. That is, the inkjet recording apparatus is an apparatus in which an inkjet head moves to form an image.

[0010] Fig. 1 is a conceptual diagram of an inkjet head used in an inkjet recording apparatus according to the first embodiment and a peripheral structure thereof. The inkjet head 2 of the inkjet recording apparatus 1 (Fig. 3) includes a nozzle plate 12 in which ink nozzles 11 for ejecting ink are formed. In general, the inkjet recording apparatus 1 is provided with a plurality of ink nozzles 11 corresponding to a plurality of colors of ink, respectively. In Fig. 1, only a single ink nozzle 11 is illustrated for convenience of the explanation. The inner peripheral surface of the ink nozzle 11 and the surface of the nozzle plate 12 in the vicinity thereof are herein referred to as ink

nozzle surface 11a. Provided in the housing 13 of the inkjet head 2 are a channel 14 that guides the ink k to the ink nozzle 11 and an actuator 28 such as a piezoelectric element that is capable of changing the volume of the channel 14 to cause the ink k to be ejected from the ink nozzle 11.

[0011] The ink k is supplied to the channel 14 from the first sub-tank 55 via the channel 302. The flow of the ink k in each portion is indicated by outlined arrows in Fig. 1. The ink k is circulated between the inkjet head 2 and the outside thereof by a circulation device 29 (details will be described later with reference to Fig. 2). For circulation of the ink k, a manifold circulation channel 15 is provided. The manifold circulation channel 15 is a channel which discharges the ink k from the upper portion of the channel 14 in the housing 13 to the outside of the inkjet head 2. Furthermore, a nozzle circulation channel 16 is also provided, which is a channel that discharges the ink k from the ink nozzle 11 side (the vicinity of the ink nozzle 11) to the outside of the inkjet head 2 at the lower portion of the channel 14. The manifold circulation channel 15 and the nozzle circulation channel 16 join together on their respective downstream sides. The merged channel is connected to a channel 303. The ink k in the inkjet head 2 is discharged to the second sub-tank 56 via the channel 303.

[0012] The air blowing device 21 blows air from the air nozzle 22 to the ink nozzle surface 11a in accordance with the operation of the inkjet head 2. The air blowing device 21 blows air by using an actuator 42 (Fig. 4) such as a pump as a driving source. The air blowing device 21 blows air to the the ink nozzle surface 11a to blow off mist including minute ink particles generated from the ink k ejected from the ink nozzles 11 and floating in the air. Thus, the adhesion of mist and foreign matter such as dust caused by the mist to the ink nozzle surface 11a is prevented. A more detailed configuration of the air blowing device 21 will be described later.

[0013] Fig. 2 is a system diagram illustrating the configuration of a circulation device used in the inkjet recording apparatus according to the first embodiment. The circulation device 29 includes a main tank 54, a first sub tank 55, a second sub tank 56, a deaeration module 61, a filter 62, an air pressure controller 66, and the like. The main tank 54 and the first sub-tank 55 are connected to each other by a channel 301. The first sub-tank 55 and the inkjet head 2 are connected to each other by a channel 302. The inkjet head 2 and the second sub-tank 56 are connected to each other by a channel 303. The second sub tank 56 and the main tank 54 are connected to each other by a channel 304. The channels 301 to 304 are, for example, tube-shaped members through which the ink k passes.

[0014] The inkjet head 2 ejects a part of the ink k supplied from the first sub-tank 55 from the ink nozzle 11, and discharges the remaining ink k to the second sub-tank 56. The main tank 54 stores the ink k to be circulated to each section of the circulation device 29. The first sub tank 55 stores the ink k supplied from the main tank 54, and the stored ink k is supplied to the inkjet head 2. The first sub-tank 55 is a tank-shaped container that is sealed except for various connection portions. The first sub-tank 55 has an ink layer 55a and an air layer 55b. The second sub-tank 56 stores the ink collected from the inkjet head 51. The second sub-tank 56 is a tank-shaped container which is sealed except for various connection portions. The second sub tank 56 has an ink layer 56a and an air layer 56b.

[0015] A deaeration module 61 is provided in the channel 301. The deaeration module 61 performs deaeration of the ink k passing through the channel 301. The deaeration module 61 removes gasses dissolved in the ink k which is in contact with a gas permeable membrane through the gas permeable membrane. More specifically, the deaeration module 61 is configured in such a manner that the ink k is allowed to flow down to one side of the deaeration module 61 which is partitioned by the gas permeable membrane and the air pressure on the other side of the deaeration module 61 is reduced by a vacuum pump to remove the gasses dissolved in the ink k. The channel 302 is provided with the filter 62. The filter 62 removes foreign matters such as dust contained in the ink k passing through the channel 302. It is preferable that the diameter of the holes of the filter 62 is set such that the filter 62 is capable of removing foreign substances having a particle diameter equal to or greater than the nozzle diameter of the nozzles of the inkjet head 2.

[0016] The channel 301 is provided with a pump 63. The pump 63 supplies the ink k from the main tank 54 to the first sub-tank 55. The pump 63 is a displacement pump such as a diaphragm pump, or a tube pump. The channel 304 is provided with a pump 64. The pump 64 supplies the ink k from the second sub-tank 56 to the main tank 54. The pump 64 is a displacement pump such as a diaphragm pump, or a tube pump.

[0017] The air pressure controller 65 is connected to the first sub tank 55. The air pressure controller 65 is an actuator that adjusts the pressure of the air layer 55b in the first sub tank 55. The air pressure controller 66 is connected to the second sub tank 56. The air pressure controller 66 adjusts the pressure of the air layer 56b in the second sub-tank 56. Under the control of the air pressure controller 65 and the air pressure controller 66, it is possible to adjust the pressure of the ink k flowing from the first sub tank 55 to the inkjet head 2 and the pressure of the ink k flowing from the inkjet head 2 to the second sub tank 56. That is, the ink k can be circulated by the differential pressure (circulation differential pressure) between the pressure of the inlet side and the pressure of the outlet side of the inkjet head 2, and the flow rate of the ink k in the inkjet head 2 can be adjusted. Furthermore, under the control of the air pressure controller 65 and the air pressure controller 66, the pressure in the ink nozzles 11 of the inkjet head 2 can be brought into the negative pressure state. As a result, it is possible to prevent the ink from leaking from the ink nozzles 11 when

image formation and various kinds of maintenance works are not performed.

[0018] With such a configuration, in the circulation device 29, the ink k is circulated in the order of the main tank 54-the first sub tank 55-the inkjet head 2-the second sub tank 56-the main tank 54. Such circulation of the ink k by the circulation device 29 is basically continued when the inkjet recording apparatus 1 is on standby, regardless of whether the image forming operation by the inkjet head 2 is being performed or the image forming operation is stopped.

[0019] Fig. 3 is a longitudinal sectional view of a main part of the inkjet recording apparatus according to the first embodiment. The inkjet recording apparatus 1 includes a conveyance belt 31 on which an image forming medium c, which is an object on which an image is formed, such as a cloth or a sheet, is placed. The conveyance belt 31 conveys the image forming medium c in a sub-scanning direction (a direction perpendicular to the plane of Fig. 3). Provided above the image forming medium c and the conveyance belt 31 is a carriage rail 32 whose longitudinal direction is a scanning direction (a main scanning direction. a horizontal direction in Fig. 3). The carriage 33 which is supported by the carriage rail 32 and moves in the longitudinal direction of the carriage rail 32 is also provided above the image forming medium c and the conveyance belt 31. The carriage 33 is provided with the inkjet head 2, and the inkjet head 2 is moved in a scanning direction by the carriage 33. Generally, in the carriage 33, a plurality of inkjet heads 2 corresponding to the respective colors of ink k are provided side by side in the scanning direction.

[0020] A region 34 on the conveyance belt 31 is an area where the inkjet head 2 forms an image while moving. The maintenance section 35 is located outside of the area 34. The maintenance section 35 is a section where a predetermined maintenance work is performed on the inkjet head 2. The air blowing device 21 is arranged below the maintenance section 35 (e.g., a side of the conveyance belt 31). The air blowing device 21 blows air to the ink nozzle surface 11a of the inkjet head 2 positioned in the maintenance section 35. The air nozzles 22 are directed away from the image forming medium c side on the conveyance belt 31. In this example, the air nozzle 22 faces in a direction inclined from the region 34 side to the maintenance section 35 side. Thus, the air blowing device 21 blows off the mist and the foreign matters to the scanning direction side.

[0021] In addition, a shield member 36 which is a wall-like member is provided in a predetermined region between the region 34 and the maintenance section 35. The shield member 36 serves as a shield that prevents foreign substances and mist blown off by the air of the air blowing device 21 from being adhered to the image forming medium c.

[0022] Next, the control executed by the inkjet recording apparatus 1 of the first embodiment will be described. Fig. 4 is a block diagram schematically illustrating electrical connection of a control system that executes the present control. The control system is mainly configured by a control device 41 (controller) configured by a microcomputer, and an application specific integrated circuit (ASIC). Various actuators such as the actuator 42 of the air blowing device 21, the air pressure controller 65 and 66, and the motor 43 serving as a driving source of the carriage 33, and various sensors are connected to the control device 41 via a predetermined interface.

[0023] Fig. 5 is a flowchart of control executed by the inkjet recording apparatus 1 of the first embodiment. By this processing, the inkjet recording method of the present invention is performed. As described above, the circulation device 29 circulates the ink k through the route described above with reference to Fig. 2. At that time, the controller 41 controls the air pressure controllers 65 and 66 to perform control such that the above-described circulation differential pressure of the ink k is equal to or less than the break pressure. The break pressure refers to a critical pressure for a meniscus of the ink k to be correctly formed.

[0024] The flowchart of Fig. 5 illustrates control relating to air blowing by the air blowing device 21. Such a process is started at a timing when the carriage 33 starts to move from the maintenance section 35 to the region 34 side for the next scanning operation after one scanning operation of the carriage 33 (the inkjet head 2) is finished. That is, the processing of Fig. 5 is performed for each scan.

[0025] As described above, the inkjet heads 2 of the inks k of the respective colors are generally provided side by side in the scanning direction on the carriage 33. The control device 41 performs a selection process of selecting the inkjet head 2 to which the air is blown by the air blowing device 21 (step S1). In such a process, a process of selecting an inkjet head 2 whose use frequency is equal to or higher than a predetermined degree among the plurality of inkjet heads 2 is performed on the basis of image data for forming an image by the inkjet head 2. Before such processing, the carriage 33 has performed one scanning operation. How many ink droplets have been ejected from each inkjet head 2 for an image formed in the one scanning operation, that is, how often each inkjet head 2 has been used in the one scanning operation, can be determined based on the image data. Thus, by referring to the image data, the inkjet head 2 whose frequency of use is higher than a predetermined level is selected as the inkjet head 2 to be blown with air. The step S 1 may be completed before starting the driving of the carriage 33 for the next scan.

[0026] Next, the controller 41 determines whether the inkjet head 2 selected in step S1 is at a predetermined position (step S2). The position each inkjet head 2 is currently present can be determined by the controller 41 based on the number of rotations of the motor 43. The predetermined position is a position at which the air from the air nozzle 22 is appropriately blown to each ink nozzle 11 of one inkjet head 2. When the inkjet head 2 selected

in Step S1 is at the predetermined position (Yes in Step S2), the controller 41 controls the actuators 42 to blow air to the inkjet head 2 that has reached the predetermined position (Step S3). At the same time, when the air is blown, the controller 41 controls the air pressure controllers 65 and 66 to reduce the aforementioned circulation diffenrential pressure when the ink k is circulated compared to when the inkjet head 2 is driven to perform image formation (ejection of the ink k) (step S3). By the processing of step S3, since the air nozzles 22 are arranged as described above, when the inkjet head 2 moves for scanning, the foreign matters and the mist are blown off to the scanning direction side by the air.

[0027] When the inkjet head 2 selected in step S1 is not at the predetermined position (No in step S2), the controller 41 proceeds to step S4. The controller 41 also proceeds to step S3 when the processing of step S4 is completed. In step S4, the controller 41 determines whether all of the inkjet heads 2 have passed the predetermined position. When there remains an inkjet head 2 that has not passed the predetermined position (no in step S4), the controller 41 returns to the processing in step S2. When the control device 41 determines that all the inkjet heads 2 have passed the predetermined position (Yes in step S4), the control device 41 returns the circulation differential pressure to the original value (step S5), and ends the process of Fig. 5.

[0028] Further, the control device 41 may control the actuator 42 to vary the velocity of the air blown from the air nozzle 22. For example, when there is an inkjet head 2 which is determined to have a particularly high frequency of use in the previous scan in the process of step S 1, the air speed of the air blown from the air nozzle 22 may be made faster than usual when the air is blown to the inkjet head 2. When the controller 41 increases the speed of the air blown out from the nozzle 22, the controller 41 may increase the above-described circulation differential pressure greater than usual.

[0029] Next, operational effects of the first embodiment will be described. First, by performing blowing of air with the air blowing device 21, the problem of adherence of mist or foreign matter to the ink nozzle face 11a can be addressed. However, this dries the ink nozzle surface 11a and also entrains air into the nozzles, causing failure in ejection of the ink k from the ink nozzles 11. In order to address this problem, the ink k is circulated as described above. This prevents drying of the ink nozzle surface 11a and entrainment of air into the ink nozzle 11. Thus, it can be expected that occurrence of failure in ink ejection from the ink nozzles 11 will be suppressed.

[0030] However, by the above-described blowing of the air, the air is blown to substantially all of the ink nozzles 11 of the inkjet head 2. Therefore, if the circulation differential pressure is large when the ink is circulated, this large circulation differential pressure promotes the flow of the ink k in the inkjet head 2, and entrainment of air from the ink nozzle 11 side into the inkjet head 2 increases. Therefore, there is a problem in that it is not possible to sufficiently suppress the occurrence of defects in the discharge of the ink k from the ink nozzles 11.

[0031] Therefore, in the inkjet recording apparatus 1, when the air blowing device 21 is blowing air, the aforementioned circulation differential pressure when the ink k is circulated is reduced compared to when the inkjet head 2 is driven to perform image formation (ejection of the ink k) (step S3). In this way, it is possible to suppress entrainment of air into the inkjet head 2 due to circulation of the ink k. Therefore, it is possible to sufficiently suppress the occurrence of defects in the ink discharge from the ink nozzles 11.

[0032] Further, the air blowing device 21 blows air when the inkjet head 2 is at a position (the maintenance section 35) other than the position (the region 34) where image formation is performed. Therefore, it is possible to prevents the mist or the foreign matter blown off by the air from adhering to the image forming medium c. When the air blowing device 21 increases the wind speed of the blown air more than usual, the control device 41 increases the circulation differential pressure more than usual. Accordingly, it is possible to suppress the ink nozzle surface 11a from being excessively dried due to an increase in the wind velocity of the air.

[0033] Further, due to the presence of the shield member 36, it is possible to prevent the mist and the foreign matter blown off by the air from adhering to the image forming medium c. In addition, since the circulation differential pressure is equal to or less than the break pressure, the meniscus of the ink k can be correctly formed. The inkjet recording apparatus 1 performs the selection process (step S 1) to blow air only to the inkjet head 2 which has been frequently used (step S3). Therefore, it is possible to suppress drying of the ink nozzle 11 of the inkjet head 2 to which the mist or foreign matter does not seem to be adhered so much.

[0034] The air blowing device 21 blows off foreign matter and mist to the scanning direction side by air when the inkjet head 2 moves for scanning. Therefore, it is possible to prevent the foreign matter or the like from being blown off in the sub-scanning direction to contaminate the image forming medium c. In addition, the mist and the foreign matter can be carefully removed from the ink nozzle surface 11a by blowing the air for each scan. The air nozzles 22 are directed away from the image forming medium c side, and the air blowing device 21 blows air when the carriage 33 moving the inkjet head 2 moves to the image forming medium c side. Therefore, it is possible to prevent the image forming medium c from being contaminated by the mist or the foreign substance blown off by the air.

Second Embodiment

[0035] An inkjet recording apparatus according to a second embodiment of the present invention is a single-pass inkjet recording apparatus. The inkjet recording apparatus is an apparatus which performs image formation

with the inkjet head being fixed at a predetermined position. In the description of the second embodiment, members common in the first embodiment will be denoted by common reference signs, and detailed description thereof will be omitted. However, all the configurations of the first embodiment which can be applied to the second embodiment are also provided in the second embodiment.

[0036] Fig. 6 is a longitudinal cross-sectional view of the inkjet recording apparatus according to the second embodiment. The inkjet recording apparatus 401 includes a supply unit 410, an image forming unit 420, and an output unit 430. The supply section 410 supplies the image forming medium c on which an image is to be formed to the image forming unit 420. The supply section 410 includes a sheet feed tray 411 that holds the image forming medium c and a conveyance unit 412 that supplies the image forming medium c to the image forming unit 420.

[0037] The sheet feed tray 411 is a plate-like member provided so that one or a plurality of image forming media c can be placed thereon. The sheet feed tray 411 is provided so as to move up and down in accordance with the amount of the placed image forming media c, and is held at a position where the uppermost image forming medium c is conveyed by the conveyance unit 412. The conveyance unit 412 feeds the uppermost one of the image forming media c placed on the sheet feed tray 411 onto a belt 123, and rotationally drives the belt 123 with rollers 121 and 122 to convey the image forming medium c on the belt 123.

[0038] The image forming unit 420 forms an image by ejecting the ink k onto the image forming medium c supplied from the supply unit 410. The image forming unit 420 includes an image forming drum 421, a handover unit 422, a sheet heating unit 423, a head unit 424, an irradiator 425, and a delivery unit 426. The image forming drum 421 carries the image forming medium c along the cylindrical outer peripheral surface, and conveys the image forming medium c in accordance with the counterclockwise rotation of the image forming drum 421. The outer circumferential surface of the image forming drum 421 faces the sheet heating unit 423, the head units 424, and the irradiator 425.

[0039] The handover unit 422 hands over the image forming medium c conveyed by the conveyance unit 412 to the image forming drum 421. The handover unit 422 includes a swing arm portion 221 that carries one end of the image forming medium c and a cylindrical handover drum 222. The handover unit 422 picks up the image forming medium c on the conveyance unit 412 with the swing arm section 221, guides the image forming medium c in a direction along the outer circumferential surface of the image forming drum 421 with the handover drum 222, and hands over the image forming medium c to the image forming drum 421.

[0040] The sheet heating unit 423 heats the image forming medium c carried by the image forming drum 421. The sheet heating unit 423 includes, for example, an infrared heater that generates heat in response to energization. The sheet heating unit 423 is provided in the vicinity of the outer circumferential surface of the image forming drum 421 on the upstream side of the head unit 424 in the conveyance direction of the image forming medium c. The sheet heating unit 423 is controlled such that the image forming medium c carried by the image forming drum 421 and passing through the vicinity of the sheet heating unit 423 has a predetermined temperature.

[0041] The head units 424 eject the ink k onto the image forming medium c carried on the image forming drum 421 to form an image. The plurality of head units 424, the four head units 424 in this example, eject the different colors of ink k, respectively. In each of the head units 424 having different colors of the ink k, a plurality of inkjet heads 2 are arranged in a row in the barrel length direction of the image forming drum 421 (the direction perpendicular to the paper surface of Fig. 6).

[0042] The irradiator 425 irradiates the image forming medium c with energy rays for curing the ink k after the ink k has been ejected onto the image forming medium c. The irradiator 425 includes, for example, a fluorescent tube such as a low-pressure mercury lamp. The irradiator 425 is provided in the vicinity of the outer circumferential surface of the image forming drum 421 on the downstream side of the head unit 424 in the conveyance direction of the image forming medium c.

[0043] The delivery unit 426 conveys the image forming medium c from the image forming drum 421 to the output unit 430. The delivery unit 426 delivers the image forming medium c carried by the image forming drum 421 to the belt 263 by the delivery drum 264. The delivery unit 426 rotationally drives the belt 263 by the rollers 261, 262 to carry the image forming medium c on the belt 263. The output unit 430 includes a sheet output tray 431 having a plate shape, and stores the image forming medium c conveyed from the image forming unit 420.

[0044] Fig. 7 is a plan view of an air blowing device used in the second embodiment. Fig. 8 is a side view of the same. The air blowing device 451 includes a pair of rails 452 (a moving device). As illustrated in Fig. 8, the rail 452 is curved in an arc shape so as to follow the arc shape of the outer periphery of the image forming drum 421 (for the sake of convenience, the rail is illustrated linearly in Fig. 7). A shaft-like nozzle support portion 453 is supported by the pair of rails 452. The nozzle support portion 453 is movable on the pair of rails 452 along the length direction of the rails 452 by driving of the motor 454. The nozzle support portion 453 is provided with a plurality of air nozzles 22 in a row in the length direction of the nozzle support portion 453. Each of the air nozzles 22 blows out air similarly to that in the first embodiment.

[0045] Such a mechanism allows the plurality of air nozzles 22 (the nozzle support portion 453) to move in the space between the head unit 424 and the image forming drum 421 in the circumferential direction of the image forming drum 421 (the sub-scanning direction). As illustrated by arrows in Figs. 7 and 8, the nozzle support por-

tion 453 is movable in both forward and backward along the longitudinal direction of the rail 452. Therefore, the longitudinal direction of the nozzle support portion 453, which is the arrangement direction of the plurality of air nozzles 22, is a direction intersecting (orthogonal to) the sub-scanning direction. When the nozzle support portion 453 is positioned directly below one of the head units 424, each of the air nozzles 22 faces each of the ink nozzles of a plurality of the inkjet heads 2 in the one of the head units 424 in an one on one manner. Thus, air can be blown from each of the air nozzles 22 to the each of the ink nozzle surfaces 11a of the plurality of the inkjet heads 2. Furthermore, the second embodiment also includes a circulation device 29 similar to the circulation device 29 of the first embodiment. Note that in a case where the space between the head units 424 and the image forming drum 421 is narrow and the nozzle support portion 453 cannot pass therethrough, a mechanism may be provided which retracts each head unit 424 from the image forming drum 421 side when the nozzle support portion 453 passes through the space. Fig. 6 illustrates a state in which a space between the head unit 424 and the image forming drum 421 is narrow during image formation. The rails 452 are provided at positions on both sides of the image forming drum 421 so as not to interfere with image formation. When image formation is performed, the nozzle support portion 453 retracts to a region where it does not interfere with the image formation.

[0046] In such a configuration, in order to blow air to the ink nozzle surfaces 11a of each inkjet head 2, the nozzle support portion 453 is driven to blow air from each of the air nozzles 22 to each of the ink nozzle surfaces 11a of each inkjet head 2 of each head unit 424. During such blowing of air from the air nozzles 22, the circulation device 29 is controlled to adjust the circulatory pressure difference in the same manner as in the first embodiment.

[0047] In the second embodiment, a plurality of air nozzles 22 are provided on the nozzle support portion 453 so as to correspond to the arrangement of a plurality of the inkjet heads 2 in each head unit 424. Therefore, it is possible to blow air onto all of the plurality of inkjet heads 2 of each head unit 424.

[0048] In addition, since the nozzle support portion 453 passes under all the head units 424, it is possible to blow air to all the inkjet heads 2 of all the head units 424 arranged in the sub-scanning direction. Note that each of the above-described embodiments is merely an embodiment of the present invention and does not limit the present invention.

Claims

1. An inkjet recording apparatus (1) comprising:

an inkjet head (2) configured to eject ink from ink nozzles (11);
a circulation device (29) configured to circulate the ink between the inkjet head (2) and an outside of the inkjet head (2);
an air blowing device (21) directed to an ink nozzle surface (11a) of the inkjet head (2); and
a controller (41) configured to control the circulation device (29) to make a circulation differential pressure for circulating the ink lower when the air blowing device (21) is blowing air compared to when the inkjet head (2) is driven to form an image.

2. The inkjet recording apparatus (1) according to claim 1, wherein the circulation device (29) is configured to circulate the ink by a pressure difference between an inlet side of the inkjet head (2) and an outlet side of the inkjet head (2).

3. The inkjet recording apparatus (1) according to claim 1, wherein the inkjet recording apparatus (1) is a scan type; and the air blowing device (21) is configured to blow the air when the inkjet head (2) is at a position other than a position at which an image formation is performed.

4. The inkjet recording apparatus (1) according to claim 3, wherein the air blowing device (21) blows the air after a carriage (33) configured to move the inkjet head (2) has moved to a maintenance section (35).

5. The inkjet recording apparatus (401) according to claim 1, wherein the inkjet recording apparatus (401) is a single-pass type; and a plurality of air nozzles (22) of the air blowing device (21) for blowing the air are arranged corresponding to a plurality of inkjet heads (424).

6. The inkjet recording apparatus (401) according to claim 1, wherein the inkjet recording apparatus (401) is a single-pass type; and the inkjet recording apparatus (401) further comprising a moving device (452) configured to move an air nozzle (22) of the air blowing device (21) for blowing the air in a sub-scanning direction along an arrangement of the plurality of inkjet heads (424).

7. The inkjet recording apparatus (1) according to claim 1, wherein the air blowing device (21) is capable of changing a wind speed of the blown air, and the controller (41) controls the circulation differential pressure to be increased in accordance with an increase in the wind speed.

8. The inkjet recording apparatus (1) according to claim 1, further comprising a shield member (36) that is configured to prevent a foreign substance and a mist blown off by the air from the air blowing device (21) from adhering to an image forming medium (c) that is an object on which the image is formed by ejection

of the ink.

9. The inkjet recording apparatus (1) according to claim 1, wherein the controller (41) sets the circulation differential pressure to be equal to or lower than a break pressure.

10. The inkjet recording apparatus (1) according to claim 1, wherein the controller (41) determines an inkjet head (2) whose frequency of use is higher than or equal to a predetermined degree among a plurality of inkjet heads (2) based on image data for forming the image with the inkjet heads (2), and the controller (41) controls the air blowing device (21) to blow the air exclusively to the determined inkjet head (2).

11. The inkjet recording apparatus (1) according to claim 1, wherein the inkjet recording apparatus (1) is a scan type; and the air blowing device (21) is configured to blow off a foreign substance and a mist in a scanning direction with the air when the inkjet head (2) moves for scanning.

12. The inkjet recording apparatus (1) according to claim 1, wherein the inkjet recording apparatus (1) is a scan type; and the air blowing device (21) is configured to blow the air for each scanning.

13. The inkjet recording apparatus (1) according to claim 1, wherein the inkjet recording apparatus (1) is a scan type; and a nozzle (22) of the air blowing device (21) from which the air is blown is directed away from an image forming medium (c) that is an object on which the image is formed by ejection of the ink; and the air blowing device (21) is configured to blow the air when a carriage (33) that moves the inkjet head moves toward the image forming medium (c).

14. An inkjet recording method performed by an inkjet recording apparatus (1, 401) including:

an inkjet head (2) configured to eject ink from ink nozzles (11);
a circulation device (29) configured to circulate an ink between the inkjet head (2) and an outside of the inkjet head (2);
an air blowing device (21) configured to blow air toward an ink nozzle surface (11a) of the inkjet head (2); and a controller (41); the method comprising a step of allowing
the controller (41) to control the circulation device (29) to make a circulation differential pressure lower when the ink is circulated compared to when the inkjet head (2) is driven to form an image.

FIG. 1

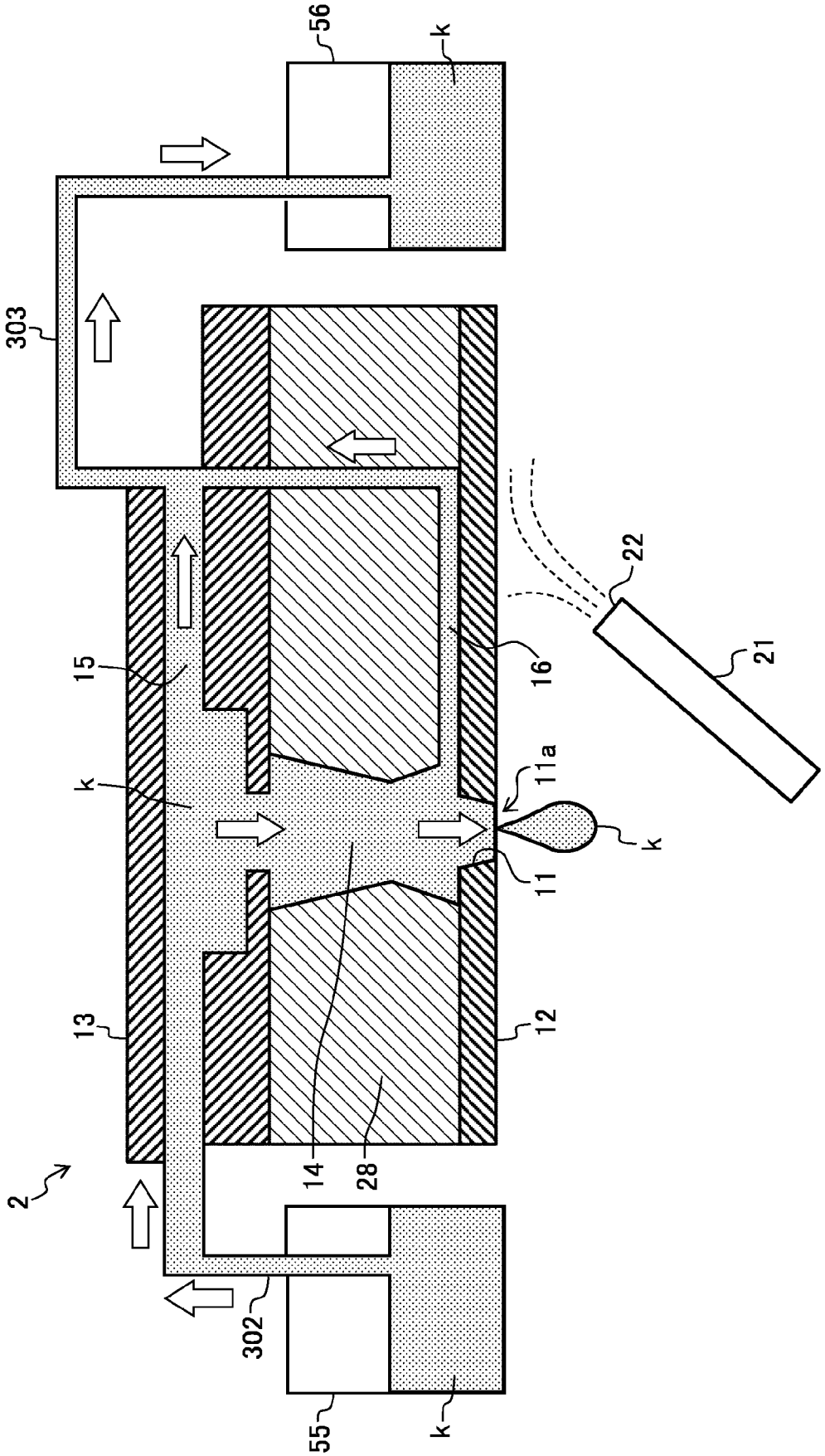
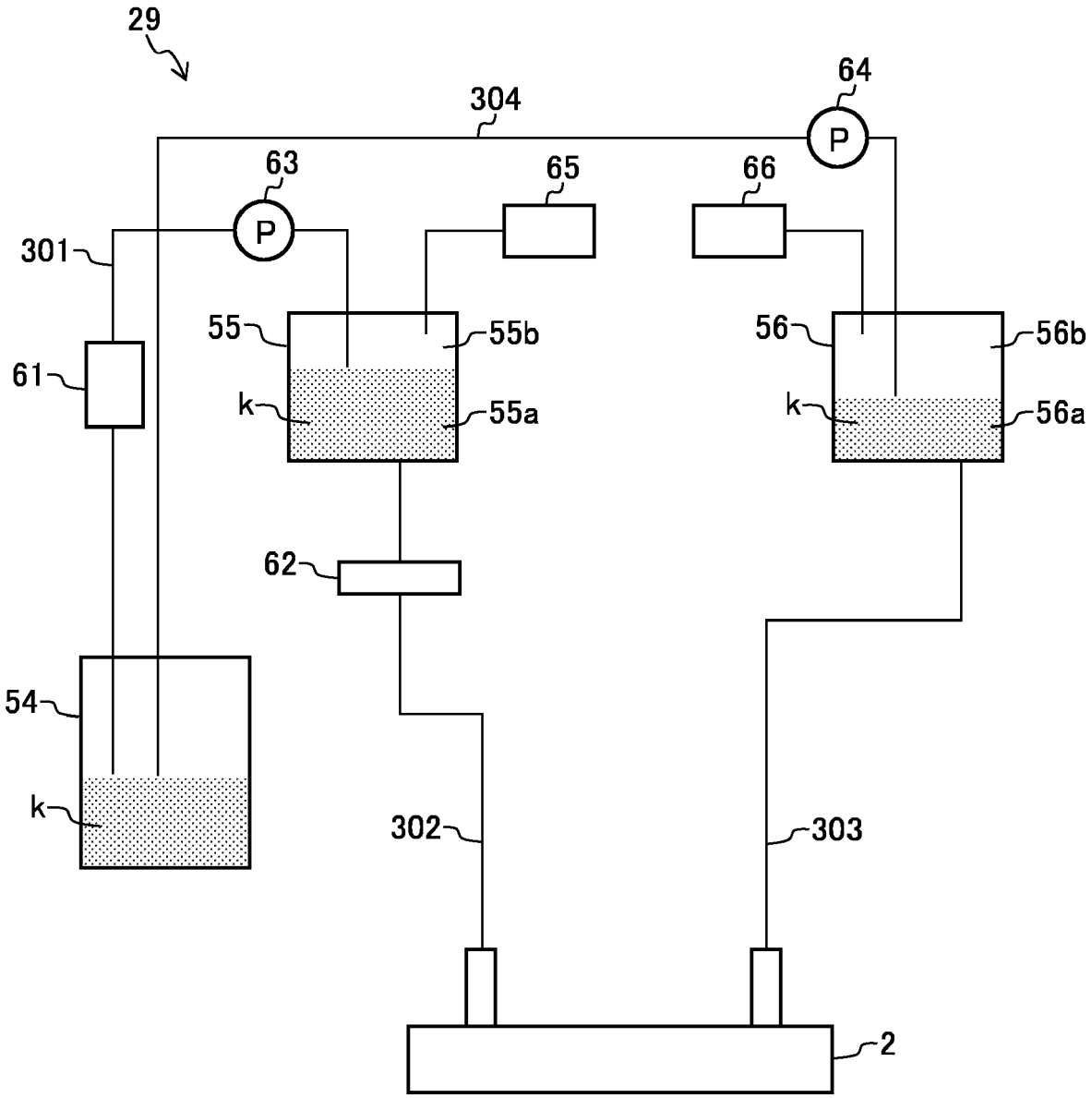


FIG. 2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304
64
P
63
65
66
P
301
55
55b
56
56b
61
k
55a
k
56a
62
54
k
302
303
2

FIG. 3

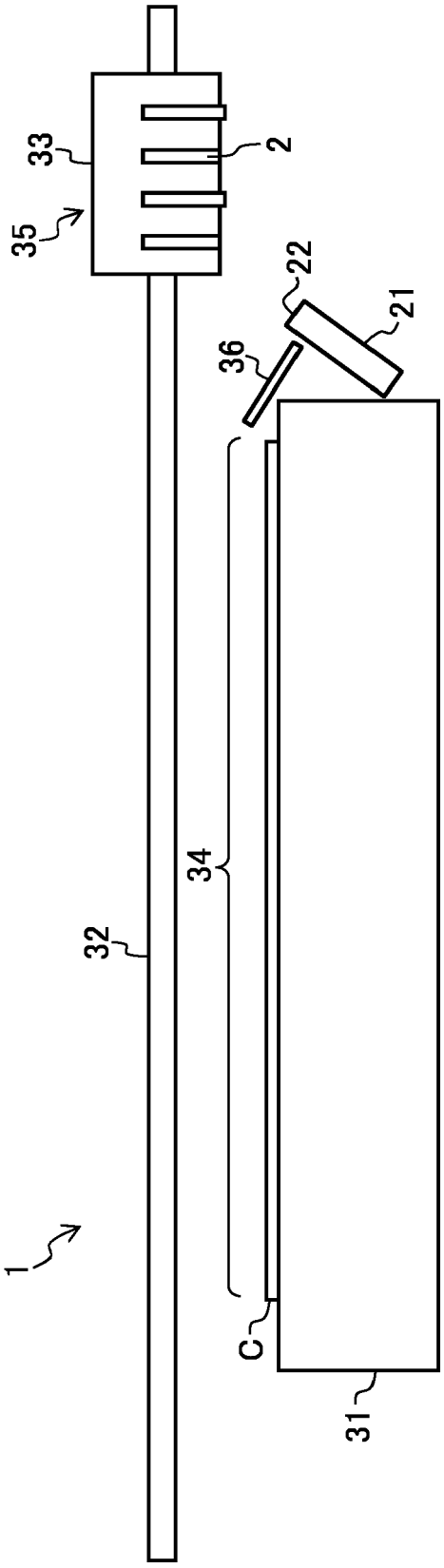


FIG. 4

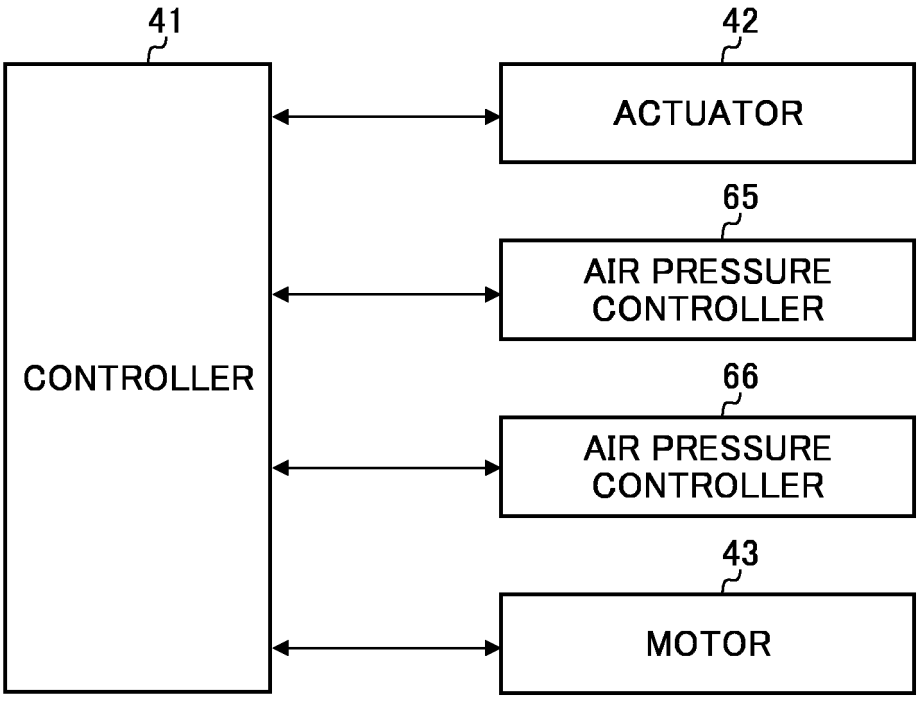

41
42
ACTUATOR
65
AIR PRESSURE CONTROLLER
CONTROLLER
66
AIR PRESSURE CONTROLLER
43
MOTOR

FIG. 5

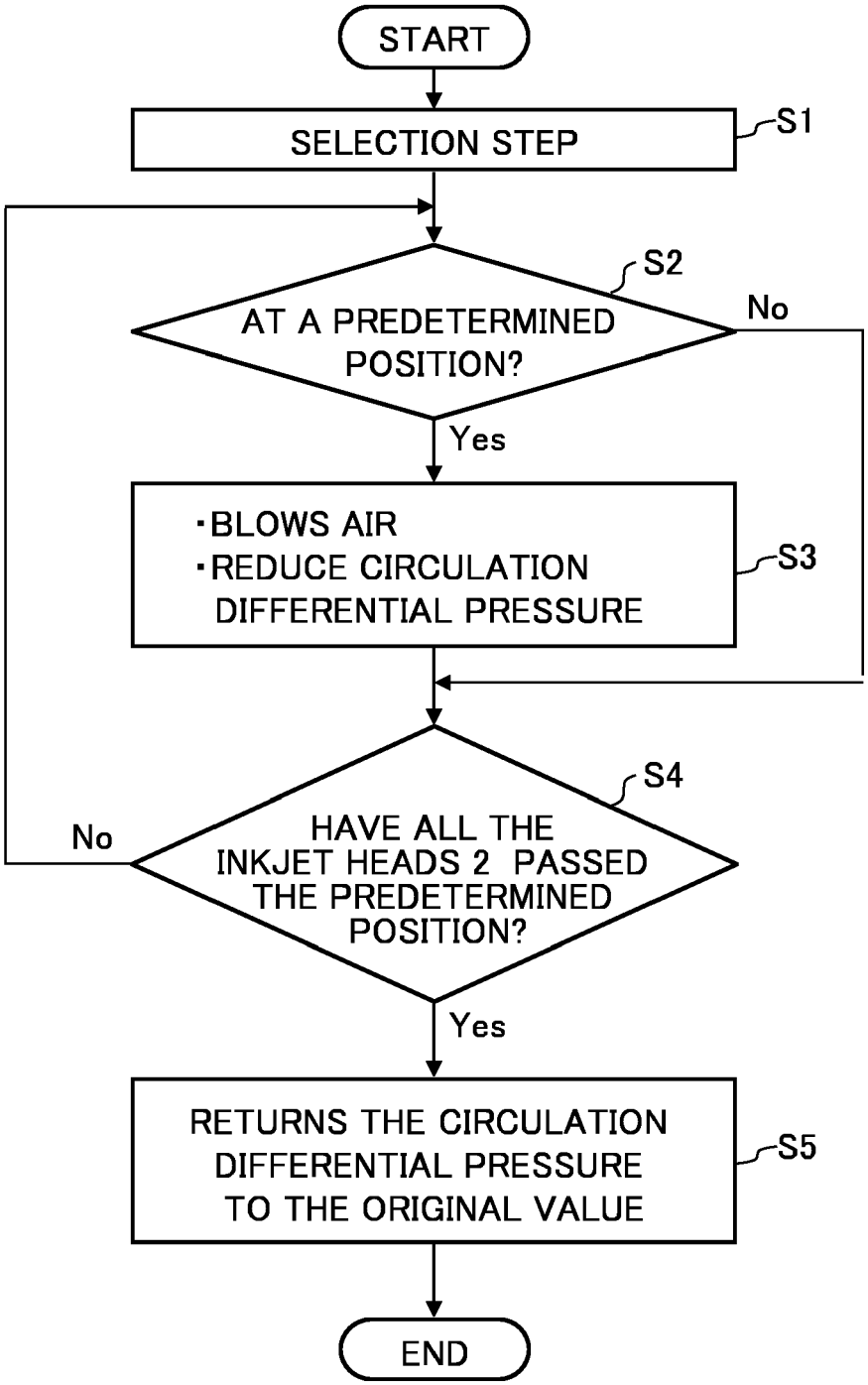
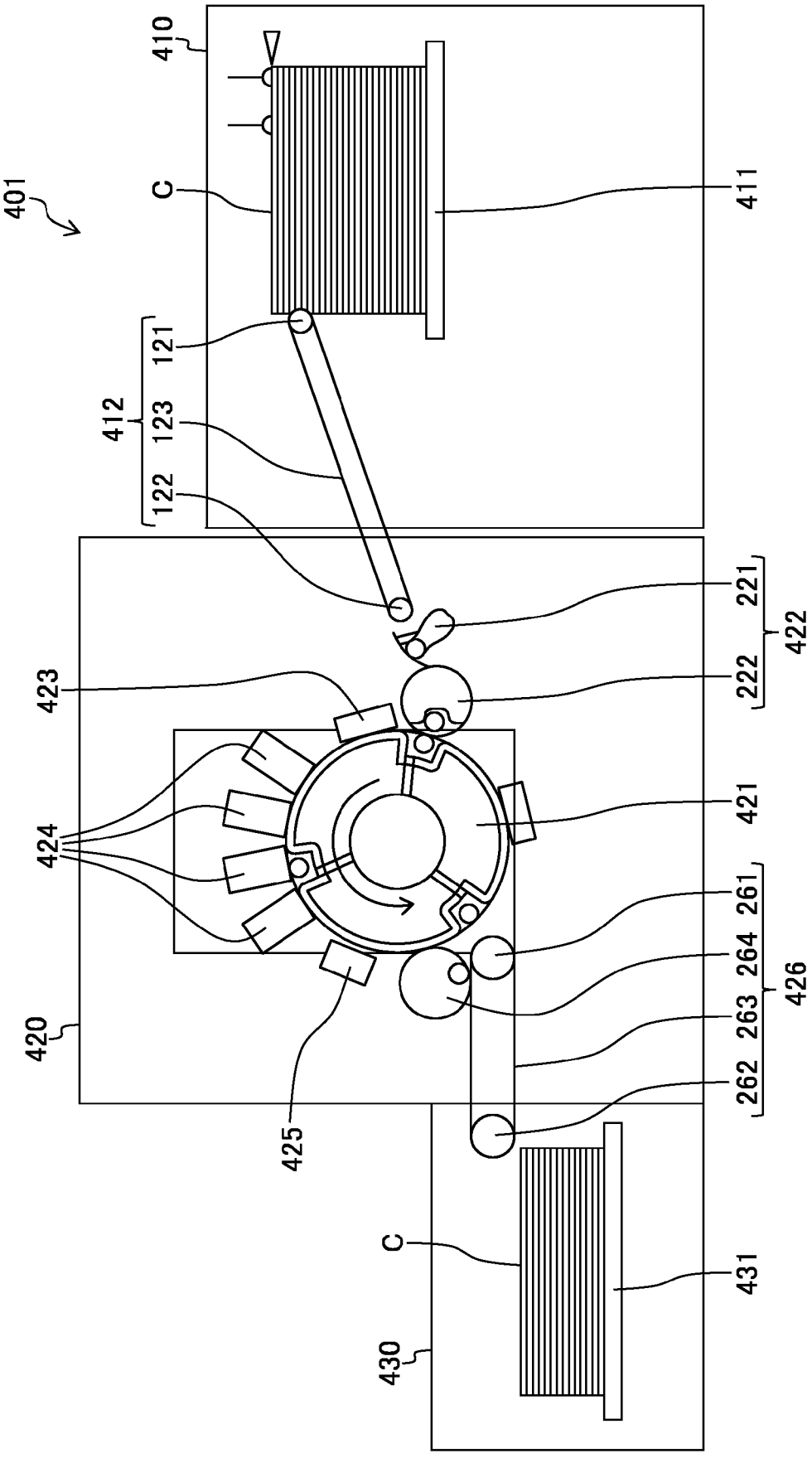

START
SELECTION STEP
S1
S2
AT A PREDETERMINED POSITION?
No
Yes
・BLOWS AIR
・REDUCE CIRCULATION DIFFERENTIAL PRESSURE
S3
S4
No
HAVE ALL THE INKJET HEADS 2 PASSED THE PREDETERMINED POSITION?
Yes
RETURNS THE CIRCULATION DIFFERENTIAL PRESSURE TO THE ORIGINAL VALUE
S5
END

FIG. 6


401
410
C
411
121
412
123
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423
421
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261
264
426
263
262
420
425
C
431
430

FIG. 7

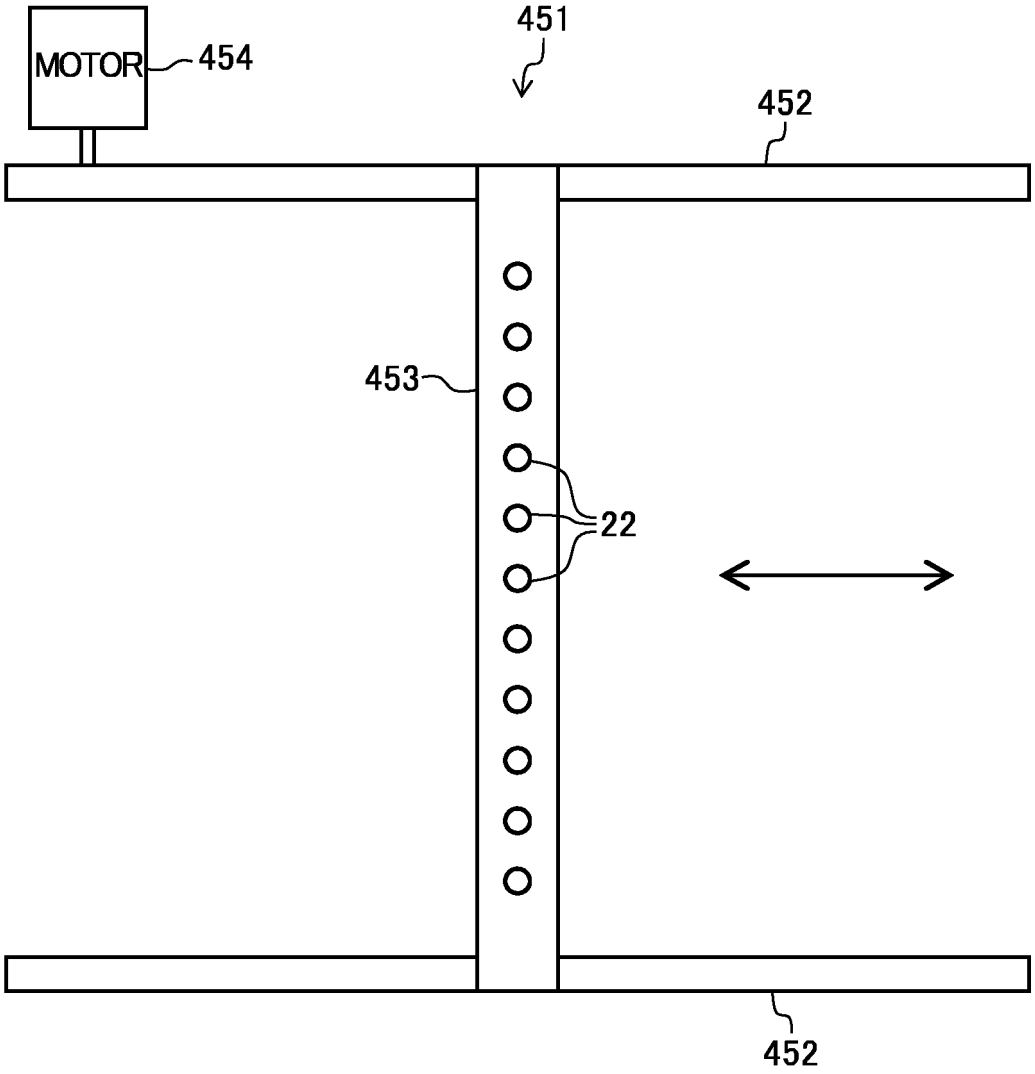
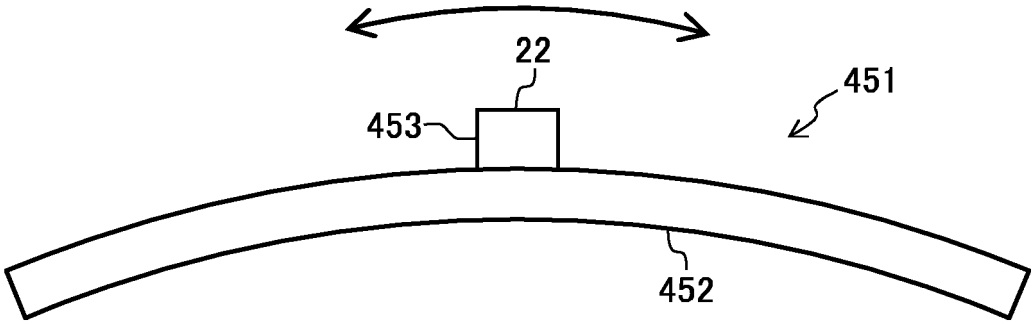


FIG. 8



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EUROPEAN SEARCH REPORT

Application Number
EP 24 17 8818

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B41J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	16 September 2024	Cavia Del Olmo, D

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16-09-2024

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		JP 2015066717 A	13-04-2015
		US 8991973 B1	31-03-2015

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