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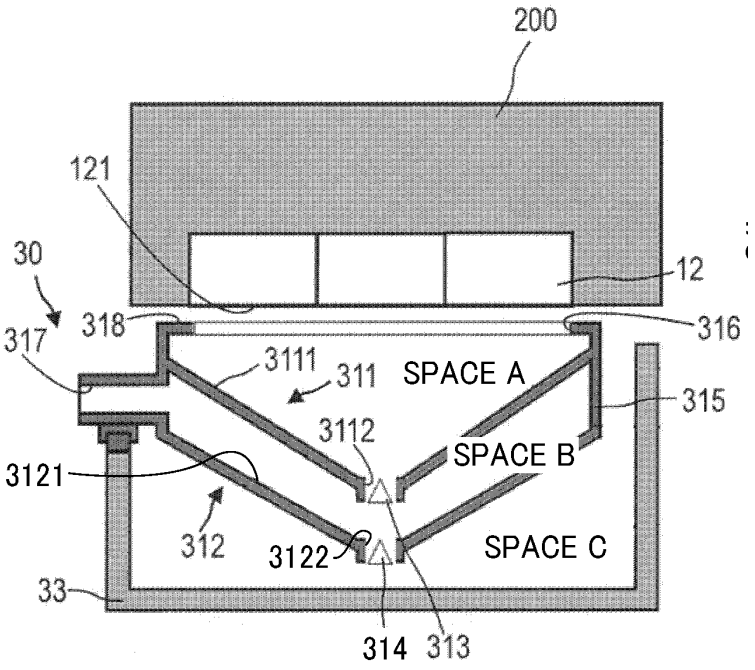
(54) APPARATUS FOR DISCHARGING LIQUID

(57) An apparatus for discharging liquid includes a liquid collecting mechanism (30) to collect liquid from a liquid discharge head (12). The liquid collecting mechanism (30) includes a first funnel-shaped member (311) to contact the liquid discharge head (12), a second funnel-shaped member (312) below the first funnel-shaped member (311), a suction device (32) connected to the second funnel-shaped member (312), and a tray (30) to receive the liquid from the second funnel-shaped member (312).

FIG. 3B



EP 3 708 375 A1

Description

BACKGROUND

Technical Field

[0001] The present invention relates to an apparatus for discharging liquid.

Related Art

[0002] In an ultraviolet (UV) inkjet printer, a technology of collecting residual ink on a nozzle surface by a non-contact suction type considering reduction of wear on the nozzle surface of the liquid discharge head is considered and already known (for example, JP-2016-000516-A).

[0003] In JP-2016-000516-A, a suction pump is used to collect the residual ink, but the collected ink might flow back to the suction pump.

SUMMARY

[0004] An object of the present invention is to reliably collect residual ink.

[0005] In an aspect of the present invention, there is provided an apparatus for discharging liquid. The apparatus includes a liquid collecting mechanism to collect liquid from a liquid discharge head. The liquid collecting mechanism includes a first funnel-shaped member to contact the liquid discharge head, a second funnel-shaped member below the first funnel-shaped member, a suction device connected to the second funnel-shaped member, and a tray to receive the liquid from the second funnel-shaped member.

[0006] According to the present invention, the residual ink can be reliably collected.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The aforementioned and other aspects, features, and advantages of the present disclosure would be better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIGS. 1A and 1B are perspective views illustrating a general arrangement in an example of an apparatus for discharging liquid according to an embodiment of the present invention;

FIG. 2 is a schematic diagram illustrating a basic configuration of a UV inkjet printer to which a liquid collecting mechanism according to one embodiment is applied;

FIGS. 3A and 3B are schematic diagrams illustrating a collecting device when the liquid collecting mechanism of one embodiment is in a standby state;

FIGS. 4A and 4B are schematic diagrams illustrating the collecting device when the liquid collecting mechanism of one embodiment starts collecting residual liquid;

FIGS. 5A and 5B are schematic diagrams illustrating the collecting device when the liquid collecting mechanism of one embodiment is in a sucking state;

FIGS. 6A and 6B are schematic diagrams illustrating the collecting device immediately after the liquid collecting mechanism of one embodiment completes sucking; and

FIGS. 7A and 7B are schematic diagrams for illustrating the collecting device when the liquid collecting mechanism of one embodiment finishes collecting the residual liquid.

[0008] The accompanying drawings are intended to depict embodiments of the present disclosure and should not be interpreted to limit the scope thereof. The accompanying drawings are not to be considered as drawn to scale unless explicitly noted.

DETAILED DESCRIPTION

[0009] In describing embodiments illustrated in the drawings, specific terminology is employed for the sake of clarity. However, the disclosure of this patent specification is not intended to be limited to the specific terminology so selected and it is to be understood that each specific element includes all technical equivalents that operate in a similar manner and achieve similar results.

[0010] Although the embodiments are described with technical limitations with reference to the attached drawings, such description is not intended to limit the scope of the disclosure and all of the components or elements described in the embodiments of this disclosure are not necessarily indispensable.

[0011] Referring now to the drawings, embodiments of the present disclosure are described below. In the drawings for explaining the following embodiments, the same reference codes are allocated to elements (members or components) having the same function or shape and redundant descriptions thereof are omitted below.

[0012] Hereinafter, an embodiment is described referring to the drawings. For clarity of the description, the following description and drawings are omitted or simplified as appropriate. In the drawings, components having the same configuration or function and corresponding parts are assigned with the same reference numerals, and the description thereof is omitted.

[0013] First, a general arrangement of one embodiment of an apparatus for discharging liquid according to an embodiment of the present invention is described. FIGS. 1A and 1B are perspective views illustrating a general arrangement of a UV inkjet printer (also referred to as an "inkjet recording apparatus") as an example of the apparatus for discharging liquid. FIG. 1A is a perspective view as seen from a front side of the apparatus. FIG. 1B is a perspective view as seen from a back side of the apparatus.

[0014] A UV inkjet printer 10 includes a carriage 200 and a table (also referred to as a "stage") 13 on which a recording medium is placed. The carriage 200 is an inkjet type carriage including a plurality of liquid discharge heads provided with a plurality of nozzles, and discharges liquid from the nozzles of recording heads to form an image. The nozzle is provided on a surface facing the table 13. In this embodiment, the liquid has an ultraviolet curable property as an example.

[0015] On the surface facing the table 13 of the carriage 200, an irradiation unit 400 which is a light source for emitting ultraviolet rays is provided. The irradiation unit 400 (an example of an irradiator) emits light of a wavelength which cures the liquid discharged from the nozzle.

[0016] A gantry (also referred to as a "guide rod") 19 is stretched between right and left side plates 18a and 18b, and the gantry 19 holds the carriage 200 so as to be movable in an X direction (main-scanning direction). The carriage 200, the gantry 19, and the side plates 18a and 18b are integrally movable in a Y direction (sub-scanning direction) along a guide rail 29 provided below the table 13. The carriage 200 is held so as to be movable in a Z direction (vertical direction).

[0017] Next, a relationship between an entire liquid discharge apparatus and a liquid collecting mechanism of one embodiment is described referring to FIG. 2. FIG. 2 is a schematic diagram illustrating a basic configuration in which the liquid collecting mechanism of one embodiment is applied to the UV inkjet printer. In FIG. 2, as for the UV inkjet printer 10 (hereinafter also referred to as a "printer" as appropriate) as an example of the apparatus for discharging liquid, an apparatus body 11, a liquid discharge head (hereinafter also referred to as a "head" as appropriate) 12, the table 13, the gantry 19, a liquid collecting mechanism 30, and the carriage 200 are schematically illustrated, and a state in which a medium (recording medium) 9 is placed on the table 13 is illustrated.

[0018] As described above, an operation principle of the printer is that printing is performed on a surface of the medium 9 placed on the table 13 by combination of movement of the gantry 19 in the Y (longitudinal) direction and movement of the carriage 200 in the X (horizontal) direction. Since it is required to keep a gap between the surface of the medium 9 and a nozzle surface of the head 12 within a certain range at the time of printing, it is necessary to adjust the carriage in the Z (vertical) direction according to a thickness of the medium 9.

[0019] The apparatus body 11 includes a driver that moves the carriage 200 and the like to a desired position and a controller that controls the entire apparatus. The controller controls the entire apparatus by various programs, for example. Detailed description is herein omitted.

[0020] The liquid collecting mechanism 30 includes at least a collecting device 31 and a suction pump 32 as a suction device. The printer includes a moving device for moving the collecting device 31 of the liquid collecting mechanism 30 based on the position of the carriage 200 including the liquid discharge head 12. The moving device moves the liquid collecting mechanism 30 to a desired position without moving the carriage 200 (in a state in which the carriage 200 is fixed) when collecting residual liquid (waste ink and waste liquid). The moving device is controlled by the controller. In this manner, the mechanism becomes simple. By returning the position of the carriage 200 to a height origin without being restricted by the arrangement of the liquid discharge head 12, a gap between the liquid discharge head 12 and the liquid collecting mechanism 30 can be managed.

[0021] Next, the collecting device 31 of the liquid collecting mechanism of one embodiment is described. FIGS. 3A and 3B illustrate the collecting device 31 in a standby state before the residual liquid is collected. FIG. 3A is a schematic diagram as seen from the front, and FIG. 3B is a schematic diagram as seen from a right side. The carriage 200 and the liquid collecting mechanism 30 stand by at origin positions in the Z (vertical) direction and in the X (horizontal) direction, respectively, by the controller.

[0022] Herein, a configuration example of the liquid collecting mechanism 30 is described. The collecting device 31 includes a funnel-shaped member 311 as a first funnel-shaped member and a funnel-shaped member 312 as a second funnel-shaped member. The funnel-shaped member 311 includes a nip 318 in contact with the liquid discharge head 12, an inclination 3111 which receives the liquid, and an opening 3112 provided downstream of the inclination to discharge the liquid. The nip 318 is brought into contact with the nozzle surface 121, so that a space A is formed in the funnel-shaped member 311. The funnel-shaped member 312 includes an inclination 3121 which receives the liquid and an opening 3122 provided downstream of the inclination to discharge the liquid. The funnel-shaped member 312 is arranged below the funnel-shaped member 311 to form a space B between a bottom surface of the funnel-shaped member 311 (a back surface side of the inclination 3111) and the inclination 3121. It is sufficient that the funnel-shaped member has a shape capable of at least receiving the liquid flowing from above and guiding the liquid to the openings 3112 and 3122 by the inclination or the like, and the shape thereof can be changed as appropriate. The liquid collecting mechanism 30 includes a tray (also referred to as a "tray") 33 which receives the liquid collected by the collecting device 31, a holder 34 which holds the collecting device 31, a block 35 which supports the holder 34, and a linear guide 36 which guides (defines) a moving direction of the collecting device 31.

[0023] The funnel-shaped members 311 and 312 are provided with one-way valves 313 and 314 at a bottom, respectively. Each of the funnel-shaped members 311 and 312 has a funnel shape in which an opening area (inner diameter) of an upper opening facing the head 12 at the time of residual liquid collection is larger than an opening area (inner diameter) of the bottom. The funnel-shaped members 311 and 312 are overlapped with a gap

through which air (gas) flows therebetween, and include a joint 315 which joins the upper openings of the funnel-shaped members 311 and 312.

[0024] The collecting device 31 includes a suction inlet (also referred to as a "suction port") 316 to take in the air and a suction outlet to exhaust the air sent from the suction inlet 316. The suction inlet 316 is provided on an upper part of the upper opening of the funnel-shaped member 311. In FIG. 3B, the joint 315 (wall surface joining the funnel-shaped members 311 and 312) extends to the upper part of the upper opening of the funnel-shaped member 311 and is formed to have an opening area (cross-sectional area) smaller than the upper opening of the funnel-shaped member 311. The suction outlet 317 is formed at the joint 315 (its location does not matter as long as this is in any part of the space B) so that the air flowing through the gap between the funnel-shaped member 311 and the funnel-shaped member 312 is exhausted. The suction outlet 317 is formed such that air may be blown to create a flow opposite to an air flow at the time of residual liquid collection. The opposite flow is described later referring to FIGS. 7A and 7B.

[0025] The suction pump 32 takes in air from the suction inlet 316 and exhausts the air from the suction outlet 317 to generate an air flow. The suction pump 32 sucks air to generate (change) an air pressure, thereby opening and closing the one-way valve.

[0026] The opening area (cross-sectional area) of the suction inlet 316 is larger than the opening area (cross-sectional area) at the bottom of the funnel-shaped members 311 and 312. The collecting device 31 preferably has at least a portion having a cross-sectional area perpendicular to a direction of flow of the air (air flow) that is larger than a cross-sectional area of the suction inlet 316 perpendicular to the direction of flow of the air. For example, FIG. 3B illustrates an example in which the opening area of the upper opening of the funnel-shaped member 311 is one of the cross-sectional areas perpendicular to the direction in which the air flows and is larger than the cross-sectional area of the suction inlet 316. In this manner, when sucking with the suction pump 32, an air flow velocity can be modulated. In detail, in order to prevent the liquid from flowing along with the airflow, the suction inlet is narrowed to form a strong airflow, and air can flow gently in other portions. The one-way valves 313 and 314 of the funnel-shaped members 311 and 312, respectively, may be arranged in positions lower than the suction outlet 317. In this manner, a risk that the liquid flows back to the suction inlet 316 can be reduced.

[0027] As described above, the collecting device 31 has a double funnel structure in which the two funnel-shaped members 311 and 312 are stacked. In this manner, due to the presence of the funnel-shaped member 311, the liquid dripped from the funnel-shaped member 311 is easily guided to the bottom (the lowest position) that is the central portion of the funnel-shaped member 312. As a result, it can be expected that an effect of preventing the backflow of the liquid is further increased.

[0028] Hereinafter, an example of a mechanism by which the liquid collecting mechanism 30 performs the residual liquid collection from the standby state is described. At that time, the direction in which the air flows in the collecting device 31 is described using the space A, space B, and space C illustrated in FIGS. 3A and 3B. As in FIGS. 3A and 3B, FIGS. 4A, 5A, 6A, and 7A are schematic diagrams as seen from the front and FIGS. 4B, 5B, 6B, and 7B are schematic diagrams as seen from a right side.

[0029] FIGS. 4A and 4B illustrate a state in which the liquid collecting mechanism 30 starts the residual liquid collection. Arrows in the drawing indicate the air flow. When an appropriate amount of liquid is pushed out from the nozzle of the head 12 and the suction pump 32 starts sucking, an air flow is generated in the order from the suction inlet 316, the space A, the space B, and the suction outlet 317. As a result, the pushed waste ink falls into the space C. The one-way valve opens and closes automatically by the air pressure.

[0030] FIGS. 5A and 5B illustrate a state in which, after the liquid collecting mechanism 30 starts sucking the residual liquid, the collecting device 31 moves. As the collecting device 31 moves in the Z (horizontal) direction, the residual ink on the nozzle surface of the liquid discharge head 12 is sequentially collected to be collected in the space B. During this time, the one-way valve 314 of the funnel-shaped member 312 opens and closes when the air pressure fluctuates due to the suction by the suction pump 32, and the collected ink moves to the tray 33. The tray 33 receives the liquid drained from the funnel-shaped member 312.

[0031] FIGS. 6A and 6B illustrate a state immediately after the collection of the residual ink on the nozzle surface of the head 12 is completed. The collected waste ink is accumulated at the bottom of the funnel-shaped member 312.

[0032] FIGS. 7A and 7B illustrate a state when the residual liquid recovery is finished. By forming the air flow in a blowing direction (opposite direction) from the suction outlet 317, the waste ink accumulated in the space B is allowed to flow into the space C, and the collection of the waste ink is completed. The one-way valve opens and closes automatically by the air pressure. In this manner, the waste ink is reliably guided to the tray 33.

[0033] As described above, the liquid collecting mechanism of one embodiment collects the residual ink by a fully non-contact system with respect to a plurality of liquid discharge heads with a single suction mechanism. Such a configuration is compatible with various arrangements of the nozzles of the liquid discharge heads, and is not limited by the arrangement of the nozzles. The waste ink is collected by the double funnel structure without flowing back to the suction pump. In this manner, it becomes possible to reliably collect the waste ink. Since a mechanical mechanism which collects droplets on the nozzle surface of the liquid discharge head becomes simple, a highly reliable non-contact type liquid collecting

mechanism can be provided at a low cost. For example, the related art has a disadvantage that the suction mechanism is required for each head and the gap between the nozzle surface of the liquid discharge head and the suction mechanism is difficult, so that a printer manufacturing cost is high and reliability is low. Since a strong suction force is generally required, there is a disadvantage that the sucked ink might flow back to the suction pump. Using the liquid collecting mechanism of one embodiment can resolve the disadvantages.

[0034] The "apparatus for discharging liquid" is the apparatus including the liquid discharge head or the liquid discharge unit to drive the liquid discharge head to discharge liquid. Examples of the apparatus for discharging liquid include not only an apparatus capable of discharging the liquid to a material to which the liquid can adhere but also an apparatus which discharges the liquid toward gas or into liquid.

[0035] In embodiments of the present invention, the "apparatus for discharging liquid" is, for example, the apparatus including the liquid discharge head or the liquid discharge unit and drives the liquid discharge head to discharge liquid. Examples of the apparatus which discharges liquid include not only an apparatus capable of discharging the liquid to a material to which the liquid can adhere but also an apparatus which discharges the liquid toward gas or into liquid.

[0036] The "apparatus for discharging liquid" may include a device relating to feeding, conveying, and ejecting the material to which the liquid can adhere and also include a preprocessing device and a post-processing device.

[0037] For example, the "apparatus for discharging liquid" may include an image forming apparatus which discharges ink to form an image on paper, and a stereoscopic fabrication apparatus (three-dimensional fabrication apparatus) which discharges fabrication liquid to a powder layer obtained by forming powder into a layer for fabricating a stereoscopic fabrication object (three-dimensional fabrication object).

[0038] The "apparatus for discharging liquid" is not limited to an apparatus which visualizes a meaningful image such as a character or a figure by the discharged liquid. For example, an apparatus which forms a meaningless pattern, or an apparatus which fabricates a three-dimensional image are also included.

[0039] The "material to which the liquid can adhere" described above is intended to mean the material to which the liquid can adhere at least temporarily, the material to which the liquid adheres to be fastened, or the material to which the liquid adheres to permeate. Specific examples include recording media such as paper, recording paper, a recording sheet, a film, and cloth, electronic components such as an electronic substrate and a piezoelectric element, and media such as a powder layer, an organ model, and a testing cell; all the materials to which the liquid adheres are included unless limited in particular.

[0040] The "material to which the liquid can adhere" described above may be any material as long as the liquid can adhere thereto even if temporarily such as paper, thread, fiber, cloth, leather, metal, plastic, glass, wood, and ceramics.

[0041] The "liquid" is not limited in particular as long as this has viscosity and surface tension capable of being discharged from the head, but the viscosity is preferably 30 mPa · s or less at room temperature and normal pressure, or by heating or cooling. More specifically, this is solution, suspension, emulsion and the like including solvents such as water and organic solvents, colorants such as dyes and pigments, functional materials such as polymerizable compounds, resins, and surfactants, biocompatible materials such as deoxyribonucleic acid (DNA), amino acids, proteins, and calcium, edible materials such as natural pigments and the like; they may be used as, for example, ink for inkjet, surface treatment liquid, formation liquid of components of electronic elements and light emitting elements, and electronic circuit resist pattern, and material liquid for three-dimensional fabrication.

[0042] The "apparatus for discharging liquid" may include an apparatus in which the liquid discharge head and the material to which the liquid can adhere relatively move; however, this is not limited to such an apparatus. Specific examples include a serial type apparatus which moves the liquid discharge head, and a line type apparatus which does not move the liquid discharge head.

[0043] The "apparatus for discharging liquid" also includes a treatment liquid applying apparatus for discharging a treatment liquid onto paper for applying the treatment liquid to the surface of the paper for the purpose of modifying the surface of the paper, an injection granulating apparatus which granulates fine particles of a raw material by injecting a composition liquid obtained by dispersing the raw material in a solution through a nozzle and the like.

[0044] Numerous additional modifications and variations are possible in light of the above teachings. It is therefore to be understood that, within the scope of the above teachings, the present disclosure may be practiced otherwise than as specifically described herein. With some embodiments having thus been described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the scope of the present disclosure and appended claims, and all such modifications are intended to be included within the scope of the present disclosure and appended claims.

Claims

1. An apparatus for discharging liquid, the apparatus comprising a liquid collecting mechanism (30) to collect liquid from a liquid discharge head (12),
the liquid collecting mechanism (30) including:

a first funnel-shaped member (311) to contact the liquid discharge head (12);
a second funnel-shaped member (312) below the first funnel-shaped member (311);
a suction device (32) connected to the second funnel-shaped member (312); and
a tray (30) to receive the liquid from the second funnel-shaped member (312).

2. The apparatus according to claim 1, further comprising a moving device configured to move the first funnel-shaped member (311) and the second funnel-shaped member (312).

3. The apparatus according to claim 1 or 2, further comprising a collecting device (31) including the first funnel-shaped member (311) and the second funnel-shaped member (312),

wherein the collecting device (31) includes:

a suction inlet (316) to take in air ; and
a suction outlet (317) to exhaust the air, and

wherein the collecting device (31) includes a portion having a cross-sectional area perpendicular to a direction of flow of the air that is larger than a cross-sectional area of the suction inlet (316) perpendicular to the direction of flow of the air.

4. The apparatus according to any one of claims 1 to 3, wherein the first funnel-shaped member (311) includes a one-way valve (313) at a bottom of the first funnel-shaped member (311).

5. The apparatus according to any one of claims 1 to 4, wherein the second funnel-shaped member (312) includes a one-way valve (314) at a bottom of the second funnel-shaped member (312).

6. The apparatus according to claim 1 or 2, further comprising a collecting device (31) including the first funnel-shaped member (311) and the second funnel-shaped member (312),

wherein the first funnel-shaped member (311) includes a first one-way valve (313) at a bottom of the first funnel-shaped member (311),
wherein the second funnel-shaped member (312) includes a second one-way valve (314) at a bottom of the second funnel-shaped member (312),
wherein the collecting device (31) includes:

a suction inlet (316) to take in air; and
a suction outlet (317) to exhaust the air, and

wherein at least one of the first one-way valve (313) and the second one-way valve (314) is located at a position lower than the suction outlet.

FIG. 1A

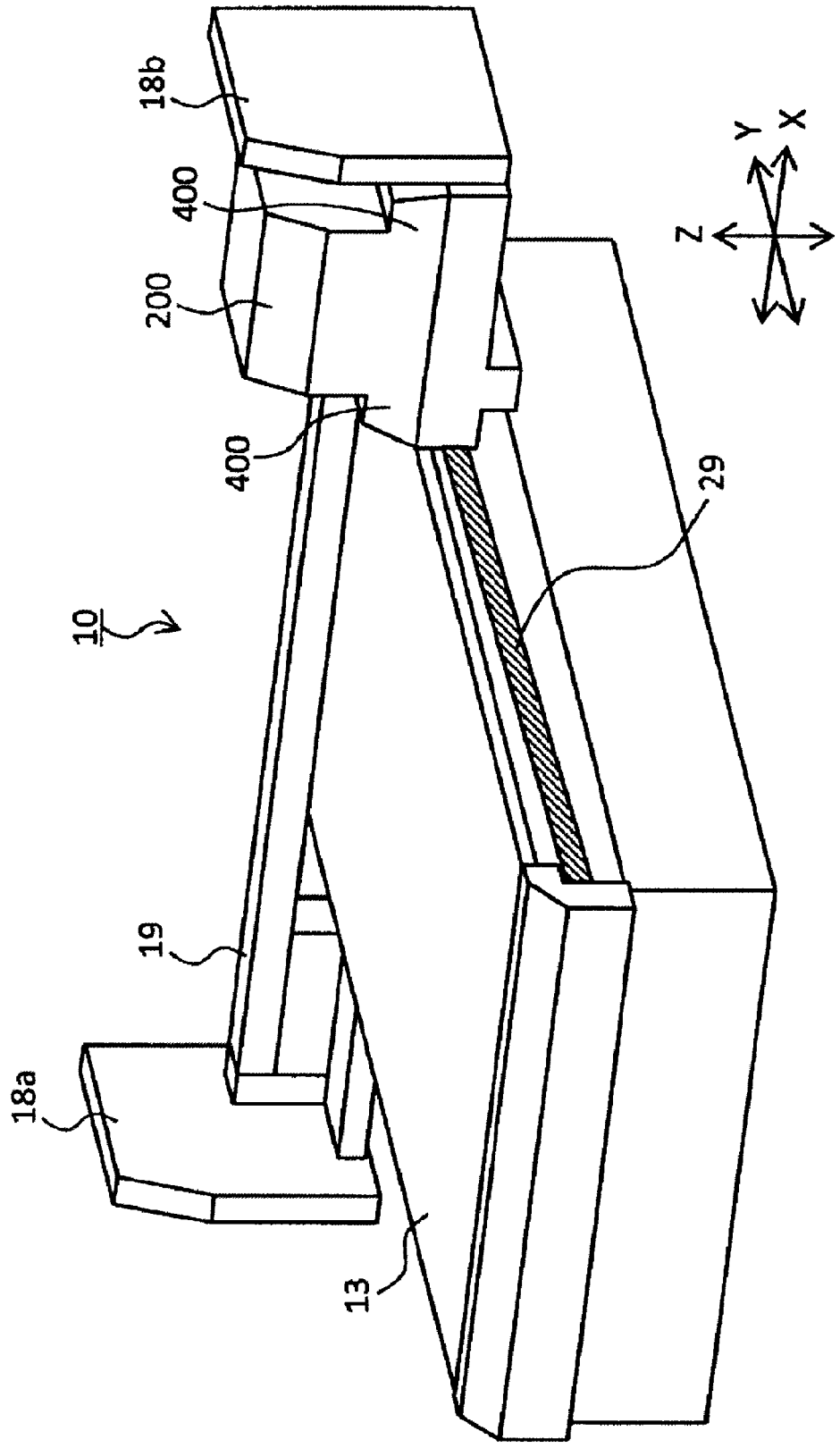


FIG. 1B

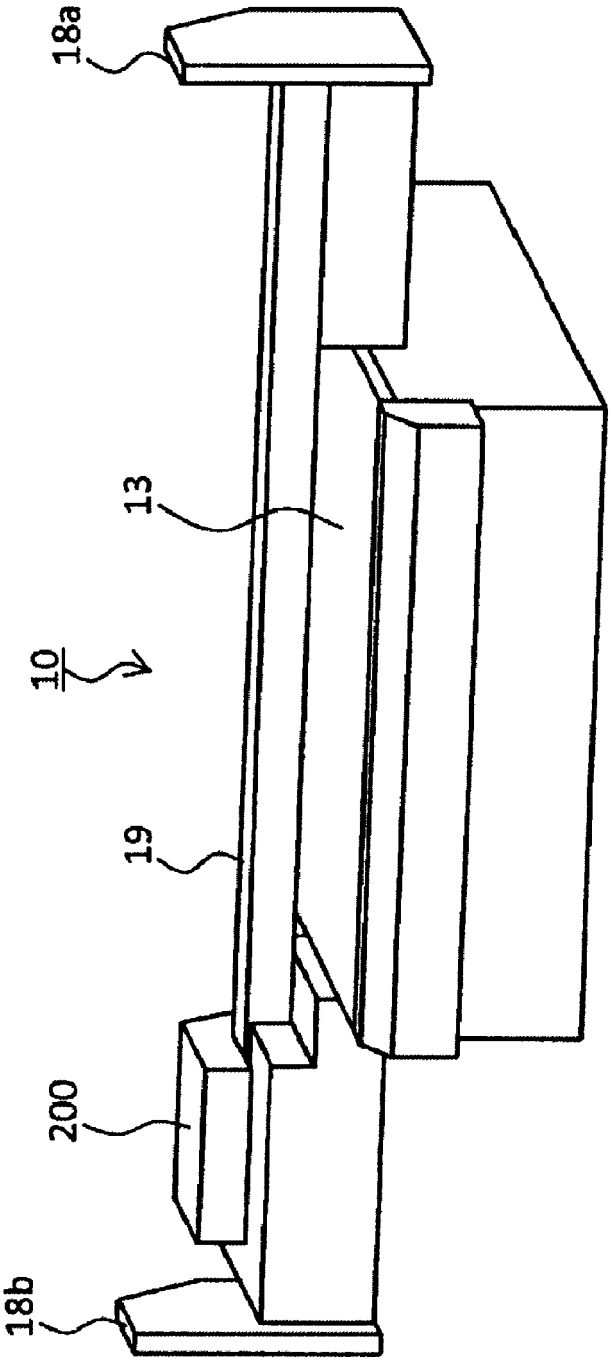


FIG. 2

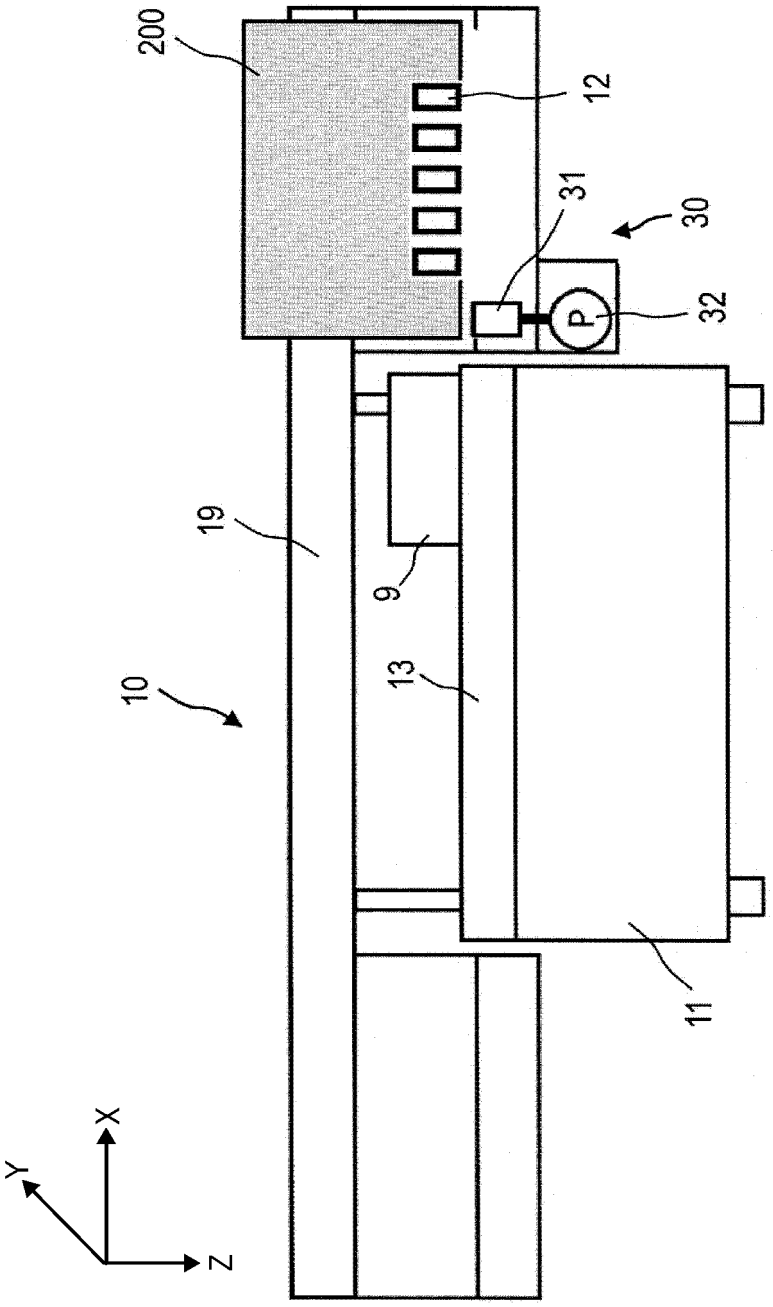


FIG. 3B

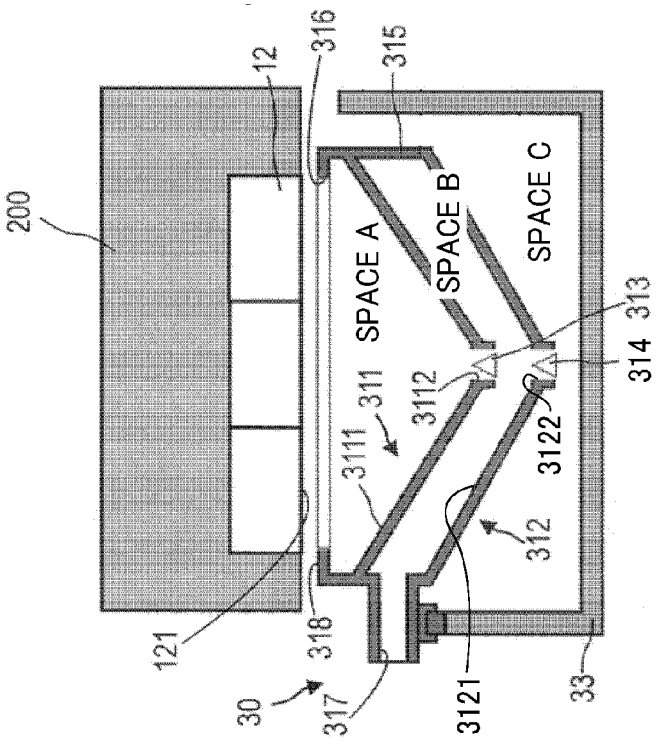

200
12
316
315
SPACE A
SPACE B
SPACE C
313
314
311
3112
3111
3122
312
121
318
30
317
3121
33

FIG. 3A

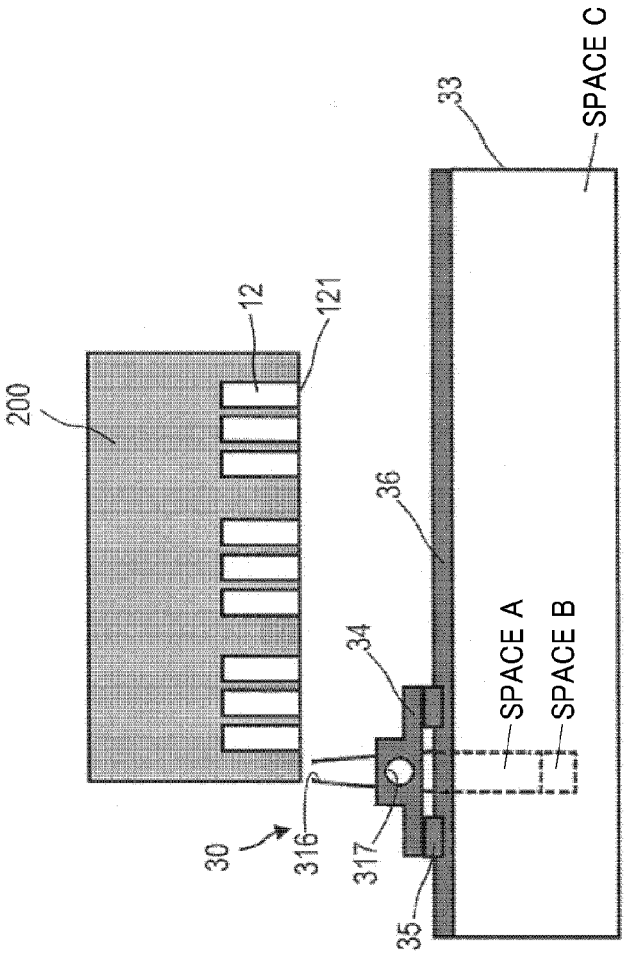

200
12
121
33
SPACE C
36
34
SPACE A
SPACE B
30
316
317
35

FIG. 4B

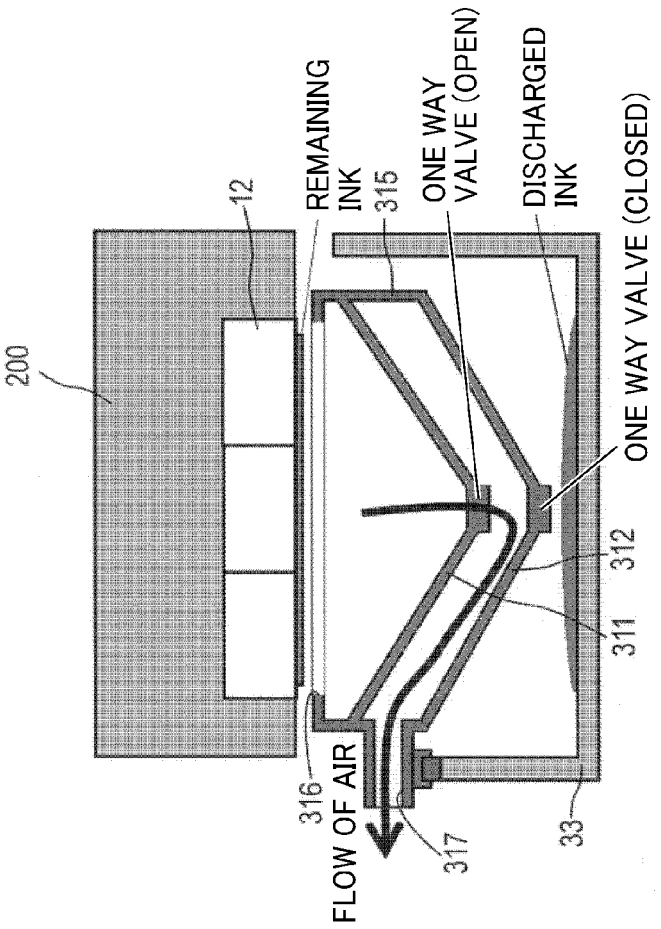

200
12
REMAINING INK
315
ONE WAY VALVE (OPEN)
DISCHARGED INK
ONE WAY VALVE (CLOSED)
312
311
316
FLOW OF AIR
317
33

FIG. 4A

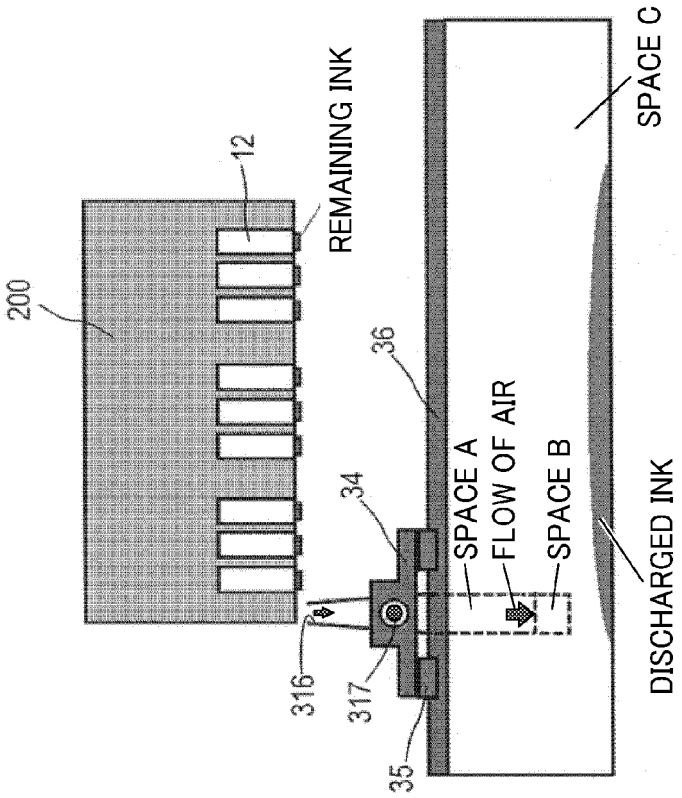

200
12
REMAINING INK
36
SPACE C
34
SPACE A
FLOW OF AIR
SPACE B
316
317
35
DISCHARGED INK

FIG. 5B

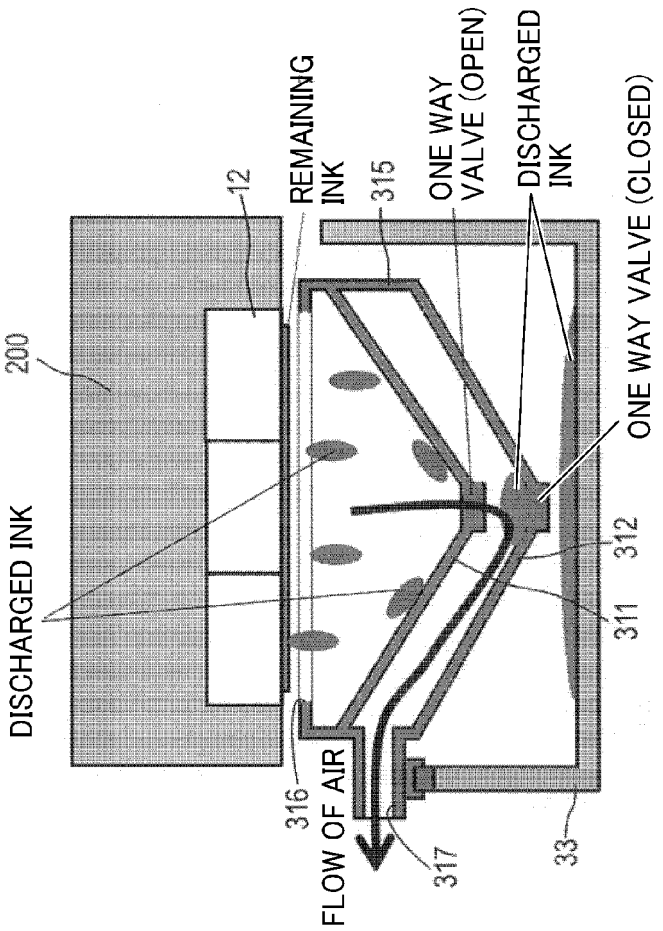

200
12
REMAINING INK
315
ONE WAY VALVE (OPEN)
DISCHARGED INK
ONE WAY VALVE (CLOSED)
DISCHARGED INK
312
311
316
FLOW OF AIR
317
33

FIG. 5A

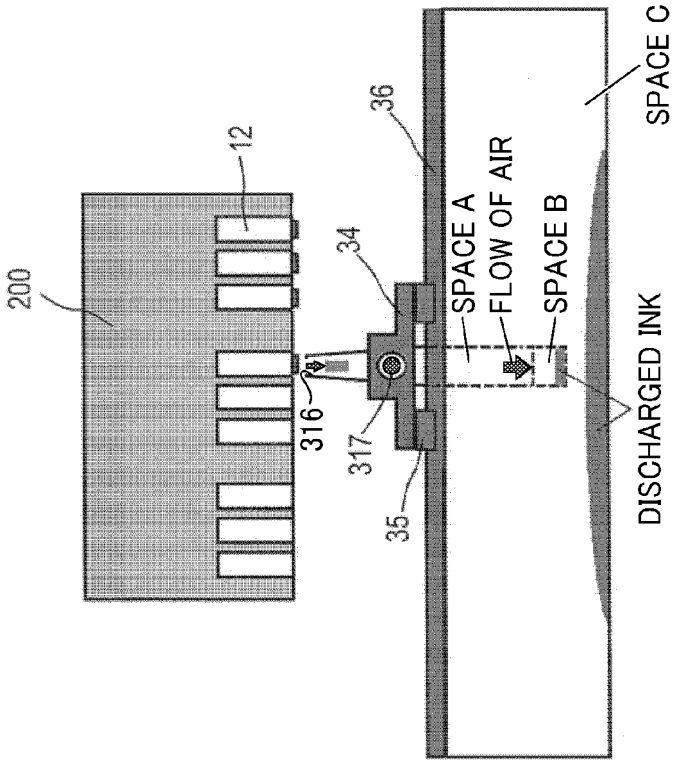

200
12
36
SPACE C
34
SPACE A
FLOW OF AIR
SPACE B
316
317
35
DISCHARGED INK

FIG. 6B

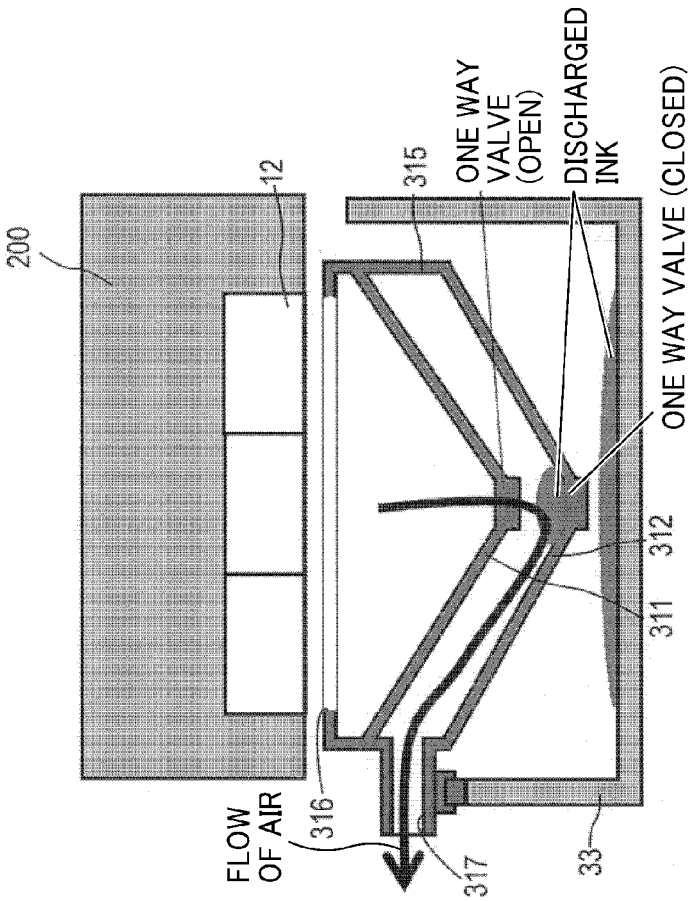

200
12
315
ONE WAY VALVE (OPEN)
DISCHARGED INK
ONE WAY VALVE (CLOSED)
312
311
FLOW OF AIR
316
317
33

FIG. 6A

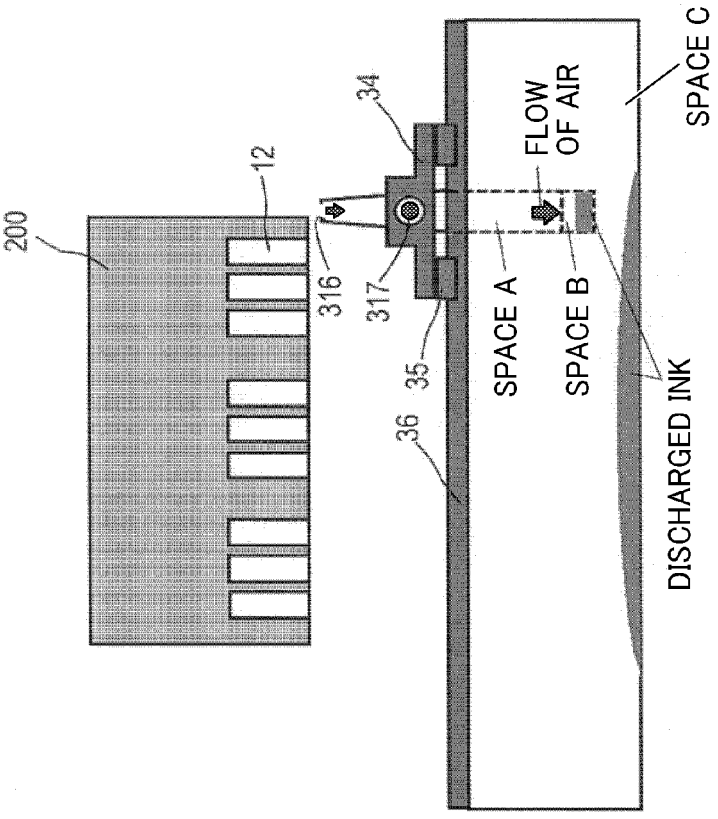

200
12
34
316
317
35
36
FLOW OF AIR
SPACE A
SPACE B
SPACE C
DISCHARGED INK

FIG. 7B

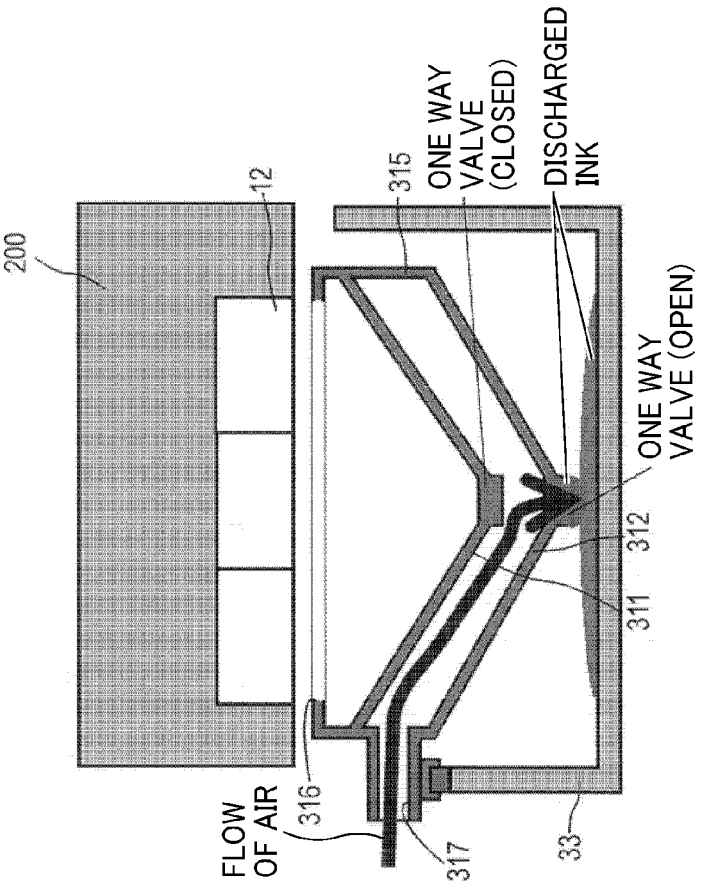
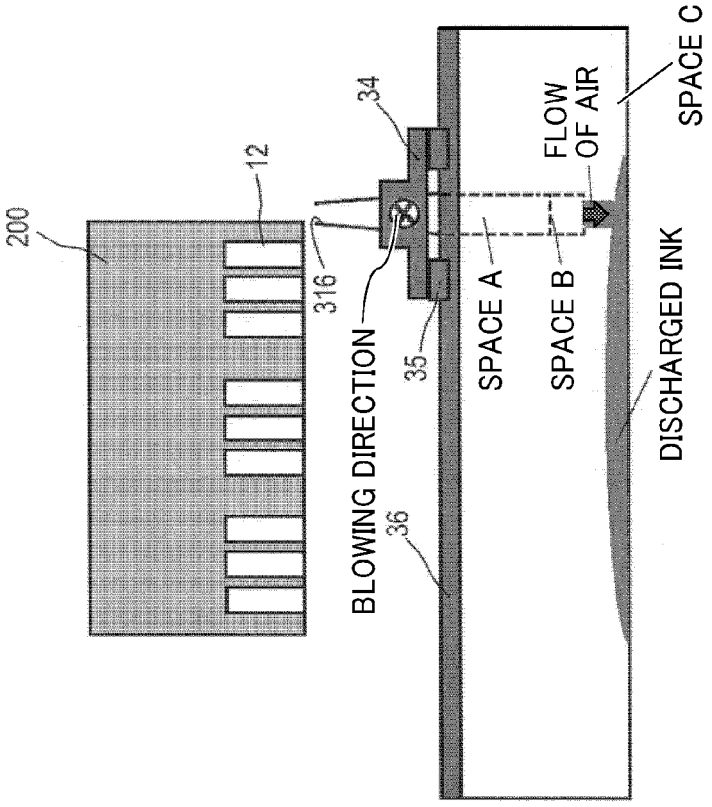

200
12
315
ONE WAY VALVE (CLOSED)
DISCHARGED INK
ONE WAY VALVE (OPEN)
312
311
FLOW OF AIR
316
317
33

FIG. 7A


200
12
34
316
BLOWING DIRECTION
35
SPACE A
SPACE B
FLOW OF AIR
SPACE C
DISCHARGED INK
36

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EUROPEAN SEARCH REPORT

Application Number
EP 20 16 1621

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	13 July 2020	João, César

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